

SPECIFICATION 501

PAVEMENTS

Copyright MAIN ROADS Western Australia

SPECIFICATION 501

PAVEMENTS

REVISION REGISTER

Date	Clause Number	Description of Revision	Authorised By
18 Oct 12	References	Added WA 143.2	PM
	Table 501.18	Added PSD for CRB used to manufacture HCTCRB	
	Table 501.20	Added 28 day UCS Amended minimum vertical modulus	
	Guidance Note 13	Deleted design traffic load requirements	
13 Aug 12	501.92	CRC under review	PM
01 Dec 11	Table 501A1	Deleted Crushed Recycled Concrete Basecourse	PM
	501.94	Deleted Crushed Recycled Concrete Basecourse Specification	
	Table 501.05	Added CRC, RAP and Unacceptable high density materials. Amended Low density and organic matter limits	
	Table 501.06	Amended grading limits	
	Table 501.07	Deleted LL and amended LAA and CBR limits	
	Guidance Notes	Added a note for Crushed Recycled Concrete Sub-Base	
	Table 501.20	Deleted 28 day UCS	
	501.11, 501.12	Amended SP43 Specification	
	501.09.07.2	Deleted 21 days testing	
	501.41.5	Added linear shrinkage	
	Guidance Notes	Surfacing requirements for HCTCRB basecourse	

CONTENTS

Clause No	Page
GENERAL	5
501.01 SCOPE	5
501.02 REFERENCES	5
501.03 DEFINITIONS.....	8
501.04 – 501.05 NOT USED.....	8
PRODUCTS AND MATERIALS	8
501.06 GRAVEL SUB-BASE	8
501.07 CRUSHED LIMESTONE SUB-BASE	9
501.08 GRAVEL BASECOURSE.....	10
501.09 CRUSHED ROCK BASE BASECOURSE.....	12
501.10 BITUMEN STABILISED LIMESTONE BASECOURSE.....	17
501.11 CEMENT FOR STABILISED PAVEMENTS.....	18
501.12 CEMENT FOR HCTCRB.....	19
501.13 – 501.25. NOT USED.....	20
CONSTRUCTION	20
501.26 GENERAL	20
501.27 DRYBACK REQUIREMENTS	21
501.28 SPREADING	21
501.29 COMPACTION.....	22
501.30 CEMENT STABILISATION	23
501.31 BLEND AREAS	27
501.32 DRAINAGE LAYER.....	27
501.33 – 501.40 NOT USED.....	28 29
ACCEPTANCE	29
501.41 GENERAL	29
501.42 COMPACTION AND DRYBACK	29
501.43 LAYER WIDTH.....	29
501.44 SURFACE SHAPE	29 30
501.45 SURFACE LEVELS.....	30
501.46 SURFACE FINISH.....	31
501.47 – 501.50 NOT USED.....	31
MAINTENANCE	31
501.51 SUBGRADE	31
501.52 SUB-BASE	31
501.53 BASECOURSE.....	31
501.54 – 501.80 NOT USED.....	31 32
AS BUILT AND HANDOVER REQUIREMENTS	32
501.81 – 501.90 NOT USED.....	32
CONTRACT SPECIFIC REQUIREMENTS	32
501.91 – 501.99 NOT USED.....	32
ANNEXURE 501 A	33

CONSTRUCTION REQUIREMENTS	33
ALTERNATIVE PAVEMENT MATERIALS	47
501.91 PAVEMENT MATERIALS – PRINCIPAL SUPPLY	47
501.92 CRUSHED RECYCLED CONCRETE SUB-BASE	48
501.93 FERRICRETE BASECOURSE.....	48
501.95 LIME STABILISED PAVEMENTS	51

SPECIFICATION 501

PAVEMENTS

GENERAL

501.01 SCOPE

1. The work under this specification consists of the supply of materials and construction of all types of unbound granular and modified granular pavement layers, including stabilisation of layers.

501.02 REFERENCES

1. Australian Standards, MAIN ROADS Western Australia Standards and MAIN ROADS Western Australia Test Methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are shown below:

Australian Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones for Building
AS 2008	Residual Bitumen for Pavements
AS 2350	Methods of Testing Portland and Blended Cements
AS 3705	Geotextiles - Identification, Marking and General Data
AS 3706	Geotextiles - Methods of Test
AS 3972	Portland and Blended Cement

Austrroads Test Methods

AG:PT/T053	Determination of Permanent Deformation and Resilient Modulus Characteristics of Unbound Granular Materials Under Drained Conditions
------------	---

MAIN ROADS Publications

Road Note No 5	Interim Guide to Prediction of Pavement Moisture for Strength Assessment of Granular Basecourse and Sub-Base Materials
Road Note No 8	Statistically Based Quality Control for Density in Road Construction
Road Note No 9 6706-02-133	Procedure for the Design of Flexible Pavements Water to be used in Pavement Construction

MAIN ROADS Test Methods

WA 0.1	Random Sample Site Location
--------	-----------------------------

WA 100.1	Sampling Procedures for Soil and Granular Pavement Materials
WA 105.1	Preparation of Disturbed Soil and Granular Pavement Material Samples
WA 110.1	Moisture Content: Convection Oven Method
WA 110.2	Moisture Content: Microwave Oven Method
WA 115.1	Particle Size Distribution: Sieving and Decantation Method
WA 115.2	Particle Size Distribution: Abbreviated Method for Coarse Materials
WA 120.2	Liquid Limit: Cone Penetrometer Method
WA 122.1	Plasticity Index
WA 123.1	Linear Shrinkage
WA 133.1	Dry Density/Moisture Content Relationship: Modified Compaction Fine and Medium Grained Soils
WA 133.2	Dry Density/Moisture Content Relationship: Modified Compaction Coarse Grained Soils
WA 134.1	Dry Density Ratio
WA 136.1	Moisture Ratio (Percent)
WA 140.1	Maximum Dry Compressive Strength
WA 141.1	California Bearing Ratio
WA 143.1	Determination of the Unconfined Compressive Strength of Laboratory Compacted Specimens
WA 143.2	Determination of the Unconfined Compressive Strength of Hydrated Cement Treated Crushed Rock Base
WA 216.1	Flakiness Index
WA 220.1	Los Angeles Abrasion Value
WA 220.2	Los Angeles Abrasion Value of Crushed Limestone
WA 313.2	Surface Profile: Three Metre Straight Edge
WA 324.2	Dry Density and Moisture Content: Nuclear Method
WA 330.1	Layer Thickness: Direct Measurement
WA 717.1	Dispersion of Bitumen in Soil
WA 730.1	Bitumen Content and Particle Size Distribution of Asphalt and Stabilised Soil: Centrifuge Method
WA 910.1	Chlorides and Total Soluble Salts in Soils and Water
WA 915.1	Calcium Carbonate Content

MAIN ROADS Specifications

Specification 100	GENERAL REQUIREMENTS
Specification 201	QUALITY SYSTEMS
Specification 302	EARTHWORKS
Specification 303	PITS AND QUARRIES
Specification 503	BITUMINOUS SURFACING

Specification 504 ASPHALT SURFACING
Specification 510 FULL DEPTH ASPHALT PAVEMENT
**AUSTRALIAN TECHNICAL INFRASTRUCTURE COMMITTEE (ATIC)
SPECIFICATION**

SP43 CEMENTITIOUS MATERIALS FOR CONCRETE

Other Test Methods

RC 131.01 Vic Roads test method - Lime Saturation Point of Soil
(pH Method)

501.03 DEFINITIONS

1. The following particular definitions shall apply:
 - a) "pavement" shall be any layer above subgrade and will include shoulders.
 - b) "retained pavement" shall be that portion of existing pavement remaining after removal of the existing seal.

2. Water used in any pavement construction or pavement material manufacture process shall comply with the requirements of Main Roads Western Australia publication 6706-02-133 "Water to be used in Pavement Construction" and shall be free from significant quantities of suspended material, organic matter, oil or acid.

Water

501.04 – 501.05 NOT USED

PRODUCTS AND MATERIALS

501.06 GRAVEL SUB-BASE SUPPLIED BY THE CONTRACTOR

501.06.01 GENERAL

1. Gravel sub-base material shall consist of durable pebble in soil mortar. The material shall be free from cobbles greater than 75.0mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.

General

501.06.02 PARTICLE SIZE DISTRIBUTION – WA 115.1

1. The sub-base material shall meet the grading requirements shown in Table 501.01 when tested in accordance with Test Method WA 115.1. The grading of material passing the 75.0mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size.

Particle Size Distribution

TABLE 501.01 PARTICLE SIZE DISTRIBUTION (GRAVEL SUB-BASE)

AS Sieve Size (mm)	% Passing by mass Minimum and Maximum Limits
75.0	100
37.5	80 - 100
19.0	50 - 100
9.5	36 - 81
4.75	25 - 66
2.36	18 - 53
1.18	13 - 43
0.425	8 - 32
0.075	3 - 19

501.06.03 OTHER ACCEPTANCE LIMITS

1. The material shall also comply with the limits shown in Table 501.02.

***Other
Acceptance
Limits***

TABLE 501.02 OTHER ACCEPTANCE LIMITS (GRAVEL SUB-BASE)

Test	Limits	Test Method
Liquid limit	30.0% Maximum	WA 120.2
Plasticity Index	10.0% Maximum	WA 122.1
Linear Shrinkage	4.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days) at 94% of MDD and 100% of OMC	30% Minimum	WA 141.1

501.07 CRUSHED LIMESTONE SUB-BASE SUPPLIED BY THE CONTRACTOR

501.07.01 GENERAL

1. The source material for the supply of crushed limestone shall be free of organic material, clay lumps, cap rock or any other foreign material deleterious to its performance in the pavement.

501.07.02 PARTICLE SIZE DISTRIBUTION – WA 115.1

1. The material shall comply with the grading limits shown in Table 501.03.

***Particle Size
Distribution***

**TABLE 501.03 PARTICLE SIZE DISTRIBUTION
(CRUSHED LIMESTONE SUB-BASE)**

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
75	100
19	55 – 85
2.36	35 – 65

501.07.03 OTHER ACCEPTANCE LIMITS

1. The material shall also comply with the limits shown in Table 501.04.

***Other
Acceptance
Limits***

TABLE 501.04 OTHER ACCEPTANCE LIMITS (CRUSHED LIMESTONE SUB-BASE)

Test	Limits	Test method
Los Angeles Abrasion Value of Crushed Limestone	20% Minimum, 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum	WA 915.1
California Bearing Ratio (Soaked 4 days) at 94% of MDD and 100% of OMC	50% Minimum	WA 141.1

501.08 GRAVEL BASECOURSE SUPPLIED BY THE CONTRACTOR

501.08.01 GENERAL

1. Gravel basecourse material shall consist of durable pebble in soil mortar. The material shall be free from particles having any dimension greater than 50mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials. When the stockpiled material contains oversized material, the Contractor shall screen the stockpiles to ensure that the pavement material does not contain more than 20% by mass of material retained on a 37.5mm sieve. The screen aperture shall be selected so that only the minimum quantity of material is removed from the existing stockpile to satisfy this requirement. Basecourse material having any dimension greater than 50mm shall be deemed oversized and shall not be delivered to the pavement construction area.

General

(NOTE: Check need for alternative paragraph 1, and then delete this note – refer Guidance Notes)

501.08.02 PARTICLE SIZE DISTRIBUTION – WA 115.1

1. The Particle Size Distribution shall be determined in accordance with Test Method WA 115.1. The particle size distribution of the portion passing a 37.5mm AS sieve shall conform to the grading limits shown in Table 501.08. The grading of material passing the 37.5mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size, and shall conform as closely as possible to the specified target grading.

Particle Size Distribution

TABLE 501.08 PARTICLE SIZE DISTRIBUTION GRAVEL BASECOURSE

(Gravel basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area)

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19.0	80	72 – 100
9.5	57	50 - 78
4.75	43	36 - 58
2.36	31	25 - 44
1.18	23	18 - 35
0.600	18	13 – 28
0.425	15	11 - 25
0.300	13	9 – 22
0.150	9	6 – 17
0.075	7	4 - 13
0.0135	4	2 - 9

501.08.03 OTHER ACCEPTANCE LIMITS

1. The material shall also comply with the limits shown in Table 501.09.

Other Acceptance Limits

TABLE 501.09 OTHER ACCEPTANCE LIMITS GRAVEL BASECOURSE

(Gravel basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area)

Test	Limits	Test Method
Liquid limit	25.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

- The Secondary Mineral Content in Basic Igneous Rock test in Table 501.09 is only applicable to basic igneous rock.
- The Accelerated Soundness Index test in Table 501.09 is only applicable to basic igneous rock.

501.09 CRUSHED ROCK BASE BASECOURSE SUPPLIED BY THE CONTRACTOR

501.09.01 GENERAL

- All crushed rock base shall consist of a uniformly blended mixture of coarse and fine aggregate.
- Coarse aggregate (retained 4.75mm sieve) shall consist of clean, hard, durable, angular fragments of rock produced by crushing sound unweathered rock and shall not include materials which break up when alternately wetted and dried. **Coarse Aggregate**
- Fine aggregate (passing 4.75mm sieve) shall consist of crushed rock fragments or a mixture of crushed rock fragments with natural sand or clayey sand. Crushed rock fine aggregate from each source shall, except as to size, comply with all the provisions specified for coarse aggregate. **Fine Aggregate**
- Refer to Hydrated Cement Treated Crushed Rock Base (HCTCRB) Basecourse Clauses 501.09.06, 501.09.07 and 501.12 below for details on the manufacture of HCTCRB. **HCTCRB**

501.09.02 LIMITS OF ACCEPTANCE

1. The mixture of fine and coarse aggregate forming the rock base shall be free from vegetable matter, lumps of clay, overburden, or any other deleterious matter.

501.09.03 PARTICLE SIZE DISTRIBUTION

1. The Particle Size Distribution of the material when tested in accordance with Test Method WA 115.1 shall comply with the requirements shown in Table 501.18. The grading of material passing the 37.5mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size, and shall conform as closely as possible to the specified target grading.

Particle Size Distribution

TABLE 501.18 PARTICLE SIZE DISTRIBUTION CRUSHED ROCK BASE BASECOURSE

AS 1152 Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits	
		General CRB	CRB for HCTCRB Manufacture
26.5		100	100
19.0	100	95 – 100	99 – 100
13.2	82	70 – 90	74 – 90
9.5	70	60 – 80	64 – 80
4.75	50	40 – 60	45 – 60
2.36	38	30 – 45	33 – 45
1.18	25	20 – 35	23 – 35
0.600	19	13 – 27	16 – 27
0.425	17	11 – 23	14 – 23
0.300	13	8 – 20	11 – 20
0.150	10	5 – 14	8 – 14
0.075	8	5 – 11	7 - 11

3. The Dust Ratio, defined as the ratio of the percentage passing by mass the 0.075mm sieve to the percentage passing by mass the 0.425mm sieve, shall be within the range 0.35 to 0.60.

Dust Ratio

501.09.04 OTHER ACCEPTANCE LIMITS

1. The crushed rock base shall also meet the other limits as shown in Table 501.19.

Other Acceptance Limits

TABLE 501.19 OTHER ACCEPTANCE LIMITS CRUSHED ROCK BASE BASECOURSE

Test	Limits	Test Method
Liquid Limit (Cone Penetrometer)	25.0% Maximum	WA120.2
Linear Shrinkage	2.0% Maximum 0.4% Minimum	WA123.1
Flakiness Index	30% Maximum	WA 216.1
Los Angeles Abrasion Value	35% Maximum	WA 220.1
Maximum Dry Compressive Strength	1.7MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days) at 99% of MDD and 100% of OMC	100% Minimum	WA141.1
Wet/Dry Strength Variation	35% Maximum	AS1141.22
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

2. The Secondary Mineral Content in Basic Igneous Rock test in Table 501.19 is only applicable to basic igneous rock.

3. The Accelerated Soundness Index test in Table 501.19 is only applicable to basic igneous rock.

501.09.05 MOISTURE CONTENT

1. Crushed rock base shall be thoroughly mixed with water using a pugmill to produce a homogeneous product suitable for placement into final position.

Mixing

2. Crushed rock base shall be pre-wet to greater than 95% of the Optimum Moisture Content as determined by Test Method WA 133.1.

Pre-wetting

501.09.06 HYDRATED CEMENT TREATED CRUSHED ROCK BASE (HCTCRB) BASECOURSE SUPPLIED BY THE CONTRACTOR

1. The hydrated cement treated crushed rock base (HCTCRB) shall be manufactured by blending $2.0 \pm 0.1\%$ by dry mass of cement with crushed rock base (CRB). The untreated CRB must comply with the requirements for CRB as specified in Clause 501.09.

General

The cement used in the manufacture of HCTCRB shall be General Purpose (Type GP).

Cement

3. The HCTCRB shall be manufactured by blending water and a target 2.0 % by dry mass of cement with the CRB. The mixing process shall produce a homogeneous mixture of crushed rock base, cement and water in which the water and cement are uniformly distributed. Mixing shall be carried out as either a batch or continuous process in an approved plant. This plant shall include measuring equipment, which will determine the mass of cement added to a known mass of crushed rock base at all stages of the mixing process. The Superintendent's approval of the Tenderer's plant will be conditional on this equipment being capable of determining the mass of cement added to the basecourse to within $\pm 0.1\%$ of the dry mass of the CRB.

Blending

4. **Prior to the use of the plant proposed to be used for the modification process, the Contractor shall certify to the Superintendent that the plant is capable of determining the mass of cement added to the basecourse to within $\pm 0.1\%$ of the dry mass of the CRB.**

HOLD POINT

5. During the initial hydration period the moisture content of the mixed and stockpiled HCTCRB shall be at least 90% of the optimum moisture content (OMC) of the crushed rock base used to produce the HCTCRB. The moisture content shall be determined in accordance with Test Method WA 110.1.

Moisture Content

6. The HCTCRB shall be stockpiled at the quarry for a period of not less than 21 days after the addition of cement and water to the CRB (i.e. minimum initial hydration period).

Initial Hydration Period

7. The HCTCRB must be compacted into the pavement in its final position not less than 30 days or greater than 60 days after the addition of cement and water to the CRB (i.e. minimum and maximum construction hydration periods).

Construction Hydration Period

8. The hydrated cement treated crushed rock base shall also meet the other limits as shown in Table 501.20.

Other Acceptance Limits

TABLE 501.20 OTHER ACCEPTANCE LIMITS (HYDRATED CEMENT TREATED CRUSHED ROCK BASE) SUPPLIED BY THE CONTRACTOR

Test	Limits	Test Method
Unconfined Compressive Strength at 7-days. At the in service density condition	1.0 MPa Maximum	WA 143.2
Unconfined Compressive Strength at 28-days. At the in service density condition	1.3 MPa Maximum	WA 143.2
Vertical Modulus of the top sub-layer At the in service conditions, including in-service stress, construction hydration period, moisture and density conditions	1000 MPa Minimum 1,500 MPa Maximum	Laboratory Repeated Load Triaxial Test AG:PT/T053 using internal displacement measuring device

501.09.07 HCTCRB TRIAL MIXES

1. The Contractor shall prepare trial mixes from each source of HCTCRB to be used in the Works. The trial mixes must cover the range of crushed rock base material and cement properties from each source that will be used to manufacture HCTCRB for the Works. The mixes must be made using the plant and degree of quality control proposed for the Works.

2. As a minimum the Contractor must undertake sufficient particle size distribution, LA abrasion, flakiness index, MDCS, linear shrinkage and soaked CBR tests on the crushed rock from each source to establish the range of its properties. Repeated load triaxial tests and unconfined compressive strength tests must be undertaken to establish that the HCTCRB from each source conforms to the specified acceptance limits (i.e. within the range of the source materials properties, construction hydration period, density and dryback moisture that will occur within the Works). As a minimum repeated load triaxial tests and unconfined compressive strength tests must be undertaken on samples compacted at hydration periods of 30 days and 60 days after the cement and water are added to the crushed rock base

3. Prior to the manufacture of any HCTCRB for use in the Works the Contractor must provide to the Superintendent for approval results of the trial mixes demonstrating that the HCTCRB and its constituents conform with all specified requirements. In seeking this approval the Contractor must specify the construction hydration period range that will be used in the Works. The construction hydration period must not be less than 30 days or greater than 60 days.

HOLD POINT

501.10 BITUMEN STABILISED LIMESTONE BASECOURSE SUPPLIED BY THE CONTRACTOR

501.10.01 GENERAL

1. Bitumen stabilised limestone (BSL) shall be produced by the addition of 2.0% residual bitumen by dry mass of crushed limestone material as specified in this Clause. The limestone shall be free from sand, roots and other foreign material.

General
2. The bitumen emulsion used to stabilise (modify) the crushed limestone shall comply with the requirements of AS 1160, "Bitumen Emulsion for Construction and Maintenance of Pavements" for Grade ASS/170-60 emulsion. The emulsifier used in the manufacture of the emulsion shall be Vinsol resin. The bitumen used in the manufacture of the emulsion shall be class 170 bitumen conforming to AS 2008, Residual Bitumen for Pavements. Tenderers shall nominate the source of supply of bitumen emulsion with their tender. The Contractor shall make arrangements for the Superintendent to sample the emulsion or any of its components at any time during normal working hours. These arrangements shall include a means of identifying lots of emulsion or the component material, which will be used in the Works.

Bitumen Emulsion
3. All water added during the mixing process and field moisture requirements during construction, shall contain a wetting agent such as "Teepol", "Comprox", or similar, which shall be added at a rate of 1 litre of wetting agent per 4000 litres of water used.

Wetting Agent
4. All stabilised limestone shall be stockpiled for at least three days before delivery to site. The mixture shall have a moisture content of at least 95% of the Optimum Moisture Content as determined by Test Method WA 133.1. The Moisture Content shall be determined in accordance with Test Method WA 110.1 from samples taken from trucks prior to delivery.

Moisture Content
5. The mixing process shall produce a homogeneous mixture of limestone, bitumen and water in which the bitumen is uniformly distributed in the form of a thin film covering the particles of the crushed limestone. Mixing shall be carried out as either a batch or continuous process in a suitable plant. This plant shall include measuring equipment which will determine the mass of bitumen emulsion added to a known mass of crushed limestone at all stages of the mixing process.

Mixing Process
- 6. Prior to the use of the plant proposed to be used for the modification process, the Contractor shall certify to the Superintendent that the plant is capable of determining the amount of bitumen emulsion added to the basecourse to within - 0.0% to + 0.2% of the dry mass of the limestone.**

HOLD POINT
- 7. Prior to modification of the basecourse, the Contractor shall give the Superintendent at least three (3) working days' notice of such modification.**

HOLD POINT

501.10.02 PARTICLE SIZE DISTRIBUTION

1. The Particle Size Distribution of the BSL after mixing and delivery shall be determined in accordance with Test Method WA 730.1 and shall comply with the details shown in Table 501.21. **Particle Size Distribution**

TABLE 501.21 PARTICLE SIZE DISTRIBUTION (BSL)

As Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.50	100
19.00	90 – 100
4.75	60 – 90
1.18	35 - 75

501.10.03 OTHER ACCEPTANCE LIMITS

1. The Bitumen Stabilised Limestone shall also meet the other acceptance limits as shown in Table 501.22. **Other Acceptance Limits**

TABLE 501.22 OTHER ACCEPTANCE LIMITS (BSL)

Test	Limits	Test Method
Los Angeles Abrasion Value of Crushed Limestone	20.0% Minimum 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum	WA 915.1
Dispersion of Bitumen in Soil #	Class 1	WA 717.1
Bitumen Content – Centrifuge Method	2.0% Minimum 2.2% Maximum	WA 730.1

Compliance for bitumen dispersion of any lot shall be based on the results of the assessment of 3 samples randomly selected from the lot being judged and tested in accordance with Test Method WA 717.1. All results must have a dispersion of Class 1; however the Superintendent may accept the material if one of the three samples has a dispersion of Class 2.

501.11 CEMENT FOR STABILISED PAVEMENTS

1. Cement for stabilisation of any pavement layer shall comply with the requirements of AS 3972, Type LH. Any sampling and testing of cement shall be in accordance with AS 2350. The cement shall be sufficiently dry to flow freely during application. **Cement**

2. Cement for stabilisation of any pavement layer shall comply with the requirements of Australian Technical Infrastructure Committee (ATIC) Specification SP43. The Cementitious Material Registration Scheme (CMRS) shall be used to confirm that the cement complies to ATIC - SP43. The standard application form for CMRS registration is shown in Annexure 501B.

3. **Prior to commencing cement stabilisation the Contractor shall confirm that the cement complies with ATIC – SP43 and shall provide the CMRS registration number for the cement to the Superintendent for approval of the cement.**

**HOLD
POINT**

4. The Contractor shall arrange cement delivery and have on site bulk storage facilities. The Contractor shall be responsible for all arrangements in regard to the transfer of cement between delivery vehicles, on site bulk storage facilities and cement spreaders.

Delivery

5. The Contractor shall use cement in approximately the chronological order in which it is delivered from the manufacturer. Transportation units and storage bins for bulk cement shall be weatherproof and shall be constructed so that there is no dead storage. The Contractor shall demonstrate that the storage bins for bulk cement do not have any dead storage. If dead storage exists the bins shall be emptied completely at least once every three months. Cement delivered in bags shall be stored in weatherproof structures having floors raised above the ground. Cement that is more than three months old shall not be used.

6. **Prior to commencing cement stabilisation, the Contractor shall certify to the Superintendent that the cement is no more than 3 months old**

HOLDPOINT

501.12 CEMENT FOR HCTCRB

1. Cement for use in HCTCRB shall comply with the requirements of AS 3972, Type GP. Any sampling and testing of cement shall be in accordance with AS 2350. The cement shall be sufficiently dry to flow freely during mixing with the CRB.

Cement

2. Cement used for the manufacture of HCTCRB shall comply with the requirements of Australian Technical Infrastructure Committee (ATIC) Specification SP43 (ATIC – SP43). The Cementitious Material Registration Scheme (CMRS) shall be used to confirm that the cement complies to ATIC - SP43. The standard application form for CMRS registration is shown in Annexure 501B.

3. **Prior to commencing the manufacture of the HCTCRB the Contractor shall confirm that the cement complies with ATIC – SP43 and shall provide the CMRS registration number for the cement to the Superintendent for approval of the cement.**

**HOLD
POINT**

4. The Contractor shall use cement in approximately the chronological order in which it is delivered from the manufacturer. Transportation units and storage bins for bulk cement shall be weatherproof and shall be constructed so that there is no dead storage. The Contractor shall demonstrate that the storage bins for bulk cement do not have any dead storage. If dead storage exists the bins shall be emptied completely at least once every three months. Cement delivered in bags shall be stored in weatherproof structures having floors raised above the ground. Cement that is more than three months old shall not be used.

Delivery

5. Prior to commencing the manufacture of the HCTCRB, the Contractor shall certify to the Superintendent that the cement is no more than 3 months old

HOLDPOINT

501.13 – 501.25 NOT USED

CONSTRUCTION

501.26 GENERAL

1. Pavement construction includes the supply, placing, compacting and finishing of pavement material in accordance with the Specifications and Drawings to the prepared sub-grade surface.

2. Pavement construction shall include construction of stabilised pavements.

3. Where a drainage layer has been constructed on the prepared subgrade surface, the drainage layer shall be the foundation for the subsequent pavement layer(s).

**Drainage
Layers**

4. Prior to the construction of any pavement layer, the Contractor shall certify to the Superintendent that the underlying layer has been constructed as specified.

**HOLD
POINT**

5. Natural gravels and ferricrete, including cement stabilised natural gravels and ferricrete, shall not be used as basecourse material for freeway pavements, future freeway pavements, and Controlled Access Highways in the metropolitan area.

**Gravel &
Ferricrete
Restrictions**

6. Pavers that utilise transverse augers shall not be used for pavement construction.

Pavers

501.27 DRYBACK REQUIREMENTS

501.27.01 SUBGRADE

1. Pavement construction shall not commence until the layer 150mm below the subgrade surface has dried back such that the Dryback Characteristic Moisture Content (DMc) is equal to or less than the proportion of the Optimum Moisture Content as shown in Annexure 501A as determined by Test Method WA 133.1 or Test Method WA 133.2 as appropriate. The Dryback Characteristic Moisture Content shall be determined in accordance with Specification 201 QUALITY SYSTEMS. Where the material in the layer 150mm below the subgrade surface contains more than 20% by mass of material retained on a 37.5mm sieve the Optimum Moisture Content and the Dryback Characteristic Moisture Content shall be determined on that portion of the material that passes a 37.5mm sieve.

***Subgrade
Dryback***

501.27.02 SUB-BASE

1. Basecourse construction shall not commence until the sub-base has dried back such that the Dryback Characteristic Moisture Content (DMc) is equal to or less than the proportion of Optimum Moisture Content as shown in Annexure 501A as determined by WA 133.1 or 133.2. The Dryback Characteristic Moisture Content shall be determined in accordance with Specification 201 QUALITY SYSTEMS.

***Sub-Base
Dryback***

2. Where the sub-base material contains more than 20% by mass of material retained on a 37.5mm sieve the Optimum Moisture Content and the Dryback Characteristic Moisture Content shall be determined on that portion of the material that passes a 37.5mm sieve.

***Oversize
Material***

501.27.03 BASECOURSE

1. No binder shall be applied to a basecourse lot until it has dried back such that the Dryback Characteristic Moisture Content of both the upper half and lower half of the basecourse layer is less than or equal to the proportion of the Optimum Moisture Content (OMC) as shown in Annexure 501A as determined by WA 133.1 or 133.2. Where no such proportion of OMC is shown in Annexure 501A, the Dryback Characteristic Moisture Content of the basecourse shall be dried back to 85% of OMC or less. The Dryback Characteristic Moisture Content shall be determined in accordance with Specification 201 QUALITY SYSTEMS.

***Basecourse
Dryback***

501.28 SPREADING

501.28.01 GENERAL

1. Each pavement layer worked shall be generally parallel to the finished pavement surface and shall extend the full width of the layer.

501.28.02 SUB-BASE

1. Sub-base shall be worked in compacted layers not greater than 250mm nor less than 100mm. Where less than 100mm is required to be worked the underlying sub-base shall be scarified to such a depth that the resulting compacted thickness of the layer to be worked is not less than 100mm.

501.28.03 BASECOURSE

1. Basecourse, shall be worked in compacted layers not more than 230mm nor less than 100mm compacted thickness. Except that HCTCRB basecourse shall be worked in compacted layers not less than 150 mm compacted, thickness.

2. For insitu rehabilitation works the Superintendent may give approval for the basecourse to be worked in a compacted layer of up to 300 mm compacted, thickness. This approval shall not be unreasonably withheld, but can be withdrawn at any time if the Superintendent is not satisfied that all the requirements of the contract are being met.

501.29 COMPACTION

501.29.01 GENERAL

1. Pavement material shall be spread, mixed and compacted to achieve uniformity free from any evidence of segregation.

2. Compaction shall be carried out at a Construction Characteristic Moisture Content (CM_C) that is greater than 95% of the Optimum Moisture Content and with a uniform compactive effort applied longitudinally and transversely to the road alignment to achieve the density as shown in Annexure 501A as well as the width, shape, level and surface finish as specified.

501.29.02 HYDRATED CEMENT TREATED CRUSHED ROCK BASE (HCTCRB)

1. Compaction and trimming of HCTCRB to shape and level shall be completed within twelve (12) hours of the incorporation of the HCTCRB into the pavement layer. HCTCRB basecourse shall be compacted to a Characteristic Dry Density Ratio shown in Annexure 501A, or greater.

Density

2. The maximum dry density used in the calculations shall be determined on pre-treated material sampled from the basecourse lots prior to compaction and shall be determined in accordance with Test Method WA 133.1. Pre-treatment shall comprise mixing HCTCRB material at a moisture content dry of OMC in a cement mixer with a bowl of approximately 0.06 cubic metres for 560 ± 20 revolutions, at the construction hydration period that corresponds to that of the lot being tested.

Sample Pre-treatment

3. Basecourse dryback prior to bituminous surfacing shall be in accordance with Annexure 501A and shall be based on the OMC determined at Clause 501.29.02.2.

Basecourse Dryback

4. Bituminous surfacing of the HCTCRB shall not commence until the basecourse stiffness has achieved a Characteristic Clegg Impact Value of 55 or greater when tested in accordance with AS 1289.6.9.1. The Clegg Impact Values shall be determined at 9 locations per lot. The locations shall be selected in accordance with WA 0.1.

**Basecourse
Stiffness**

5. The Characteristic Clegg Impact Value (CIVc) is defined by the expression:

**Clegg
Impact
Value**

$$\text{CIVc} = \text{CIV} - 0.59s$$

Where CIV = the mean of the results of Clegg Impact Value on the lot being assessed reported to the nearest 1.0.

s = is the standard deviation of the results of the Clegg Impact Value on the lot being assessed, calculated in accordance with Specification 201 QUALITY SYSTEMS and reported to the nearest 0.1.

6. HCTCRB trimmed from a lot shall not be incorporated into another basecourse lot. If a completed layer of HCTCRB basecourse does not satisfy all of the requirements of the Specification and has to be reworked, the Contractor shall repeat all the requirements for HCTCRB at no cost to the Principal. Rework shall include any disturbance to the surface of the HCTCRB basecourse during trimming to meet shape or level requirements that occurs more than twelve (12) hours after the incorporation of the HCTCRB into the pavement layer. The rework depth shall not be less than the full depth of the affected layer.

Rework

501.29.03 BITUMEN STABILISED LIMESTONE (BSL)

1 During the construction process the bitumen stabilised limestone (BSL) shall not be ripped up and reworked more than once. If the BSL has dried back to less than 80% of OMC it shall not be reworked. BSL trimmed from one lot shall not be incorporated into another basecourse lot.

Rework

501.30 CEMENT STABILISATION

501.30.01 GENERAL

1. The Contractor shall cement stabilise the specified pavement layer with the proportion of cement and to the depth of the pavement layer as shown in Annexure 501A.

2. The cement stabilised pavement layer shall be constructed at the locations shown in Annexure 501A and to the tolerances and requirements specified for this type of pavement.

501.30.02 TRIAL SECTION

1. The Contractor shall carry out a preliminary trial of the proposed stabilising operations. The trial shall determine:

a) the effectiveness of the plant;

- b) the number of passes of the stabilising machine necessary to achieve the specified mixing;
 - c) the desirable moisture content for compaction operations; and
 - d) the compacted depth of layer being worked, including the allowance for trimming to spoil and level tolerances.
2. The trial section shall be located within the Works area.

3. Prior to conducting such a trial the Contractor shall agree with the Superintendent the location, length and width of trial section(s) within the Works.

***HOLD
POINT***

4. The Contractor shall not change the method developed during the trial without approval from the Superintendent.

501.30.03 PLANT AND EQUIPMENT

a) Cement Spreader

1. The spreading equipment shall be a stabilising agent spreader, which has been specifically designed for such work. The spreader shall be capable of uniformly distributing cement and accurately controlling the spread rate such that when mixing is complete, the cement content shall be in accordance with the requirements of the Spreading of Cement Clause below.

***Cement
Spreader***

2. The spreader shall be equipped with gates to vary the width of spread and with electronic weigh scales to give daily totals of product used.

b) Stabilising Machine

***Stabilising
Machine***

1. Cutting, pulverising, mixing, adding water and spreading of mixed material shall be accomplished using a stabilising machine specifically designed for stabilisation.

2. The stabilising rotor action shall be such that the rotor revolves in an upwards and forwards cutting direction. The rotor shall be of the recycler type and fitted with bullet teeth cutting tips.

3. The stabilising machine shall also satisfy the following requirements:

- a) It shall be capable of producing a uniformly mixed material throughout the specified depth of the work.
- b) It shall be equipped with a variable depth of cut control, and an accurate gauge to measure depth of cut which is readily visible to the operator.
- c) It shall have provision for adding water automatically through a system comprising a pump, flow meter, variable control valve and full width spray bar. Each nozzle on the spray bar shall be fully and independently adjustable, and the water pump shall have the capacity to supply up to 1500 litres per minute.

501.30.04 PRELIMINARY TREATMENT

1. It shall be the Contractor's responsibility to determine whether pre-ripping the in-situ pavement material is necessary. Under no circumstances shall ripping to a depth exceeding the depth to be stabilised be permitted.

Pre-Ripping

501.30.05 SPREADING OF CEMENT

1. The cement stabilised pavement layer shall contain the proportion of cement as a percentage of the dry mass of pavement material as shown in Annexure 501A. Cement shall be spread uniformly at a controlled rate over the area to be stabilised using a suitable cement spreader.

**Cement
Content**

2. The Contractor shall provide to the Superintendent daily records of the amounts of cement used and actual spread rates obtained per section treated.

**Calculation
Methods**

3. The percentage cement shall be determined by either
- placing three (3) trays each of one third one square metre in area in front of the cement spreader and measuring the mass of cement deposited on the trays for each lot, or
 - by use of an on-board calibrated electronic weight scale system.

The percentage cement (P%) shall be calculated thus:

$$\% = \frac{M \times 100}{A \times T \times MDD}$$

Where M = total mass of cement (kg) as determined by one of the following methods:
a) on each tray
b) on-board calibrated electronic weight scale system.

A = method a): total area of the trays (m²)
method (b): total measured area spread (m²)

T = Thickness to be stabilised (mm) (including allowances for tolerances and trimming)

MDD = Maximum Dry Density of the pavement material without the addition of cement (kg/m³)

4. The percentage cement determined for each tray in accordance with this Clause shall be maintained within ± 10% by mass of the cement content specified in this Clause throughout the stabilisation works.

5. The use of method (b) in determining the values 'M' and 'A' is subject to satisfactory calibration of the measuring device and the production of associated certification in accordance with the Contractor's Quality System. Audits on this method shall be carried out using the measuring tray method.

**Calibration
Requirement**

6. Once the cement has been spread, no other plant other than that needed for spreading, or for mixing and spreading the mixed material, shall be permitted to travel over the area to be stabilised.

501.30.06 INCORPORATION OF CEMENT

1. The spreading of cement shall not proceed when rain is imminent. The spread cement shall be incorporated into the pavement layer immediately following the spreading operation. All spread cement shall be incorporated into the pavement layer within the same working day. Cement shall not be spread when the prevailing wind velocity is sufficient to make the cement particles airborne.

2. Cutting, stabilising, mixing, adding water and spreading of mixed material shall take place as a single operation within the stabilizing machine.

3. Cutting, stabilising, mixing, adding water and spreading of mixed material shall continue until the maximum size of all material (other than rock) is not greater than 25mm, and the cement and water are uniformly incorporated into the mixed material without streaks or pockets of cement.

501.30.07 COMPACTION

1. Compaction and trimming of the mixed material to shape and level shall be completed within six (6) hours of the completion of incorporation of cement into the pavement layer and shall be compacted to the Characteristic Dry Density Ratio as shown in Annexure 501A or greater.

***Time for
Compaction***

2. The required moisture content shall be based on the results of the trials and density testing carried out. The Contractor shall achieve and maintain the required moisture content of the mixed material by controlling the amount of water added during the mixing process within the stabilising machine.

***Moisture
Content***

3. Once established the moisture content shall be maintained within the CMc range in accordance with Specification 201 QUALITY SYSTEMS.

501.30.08 REWORK

1. If a completed layer of cement stabilisation does not satisfy all of the requirements of the Specification and has to be reworked, the Contractor shall repeat all the requirements for Cement Stabilisation including the addition of 50% of the original cement content at no cost to the Principal.

Rework

2. Rework shall include any disturbance to the surface of the cement stabilized layer during trimming to meet shape or level requirements that occurs more than six (6) hours after the completion of incorporation of cement into the pavement layer. The rework depth shall not be less than the full depth of the affected layer.

501.30.09 CONSTRUCTION JOINTS

1. If the stabilized work is such that it cannot be completed in one continuous operation, the Contractor shall provide construction joints at each discontinuity in the operation.

2. All construction joints shall be made transverse to and/or parallel to the direction of the stabilised run, and shall be made just prior to the commencement of the next stabilised run.
3. The joints shall be formed by cutting back into the compacted stabilised material to form a vertical face. The loose trimmed material shall be removed from the joint before the next section is mixed and compacted.

501.31 BLEND AREAS

1. In areas denoted as “blend areas” or “match existing pavement” on the drawings, the cut edge of the existing bituminous surfacing and the wall of the excavation shall be in accordance with the requirements stated in Specification 302 EARTHWORKS.
2. The work shall comprise removal of the existing pavement to a sufficient depth to place the new pavement to the required levels, shaping and compaction.
3. Pavement shall be supplied, placed and compacted in accordance with this Specification.
4. Within the blend areas the level of the subgrade or pavement layer shall be in accordance with the detail shown on the Drawings.
5. The appropriate bituminous surfacing treatment shall then be applied in accordance with Specification 503 BITUMINOUS SURFACING and, where applicable, with Specification 504 ASPHALT SURFACING or Specification 510 FULL DEPTH ASPHALT PAVEMENT, to provide a flush joint and smooth transition between new and old construction, including any required matching of concrete kerbing to line and level.

501.32 DRAINAGE LAYER

501.32.01 GENERAL

1. The drainage layer shall consist of a Geotextile lining and a sand material of the material type and thickness as shown in Annexure 501A. The drainage layer shall be constructed immediately above the subgrade to the details shown in the drawings.

501.32.02 GEOTEXTILE

1. The Geotextile shall be a non-woven fabric consisting of long chain synthetic polymer fibres composed of at least 85% by mass of polyesters, polyolefins or polyamides. The fibres shall be formed into a fabric by needle punching, heat or chemical bonding processes such that they are capable of retaining their relative position in the Geotextile.
2. In addition, the fibres shall be stabilised against ultra-violet (UV) radiation and shall have low water absorbency.
3. The Geotextile shall be free of any flaws or defects that may adversely affect the mechanical or physical properties of the fabric.
4. Each roll of Geotextile shall be provided with a suitable covering to protect the fabric against moisture and ultra-violet radiation. Each roll shall be marked in conformance with AS 3705.

5. Rolls shall be stored on site under a waterproof cover and shall be supported off the ground. The Contractor shall take appropriate measures to protect the Geotextile from damage.

Storage

6. The Geotextile shall comply with the requirements shown in Table 501A5 and Table 501A6 of Annexure 501A.

Properties

7. All properties represent minimum roll values, that is, the test result from any sampled roll shall exceed the minimum value in Table 501A5.

501.32.03 CONSTRUCTION

a) Geotextile

Geotextile

1. The Contractor's process of installation of the Geotextile shall ensure that fabric is not damaged.

2. The initial lift thickness of fill materials placed directly over the Geotextile shall be a minimum uncompacted thickness of 300mm. The use of vibratory compaction equipment over the Geotextile should be minimized for the initial lift.

Initial Lift

3. Unless otherwise shown on the Drawings, the minimum overlap requirement shall be 300mm. Successive sheets of Geotextile shall be overlapped a minimum of 300mm with the upslope section overlying the down slope.

Overlap

4. The period of time between laying out and cover of the Geotextile shall not exceed 14 days.

5. Damaged areas of Geotextile may be repaired by overlaying the damaged section with a patch. The patch shall extend a minimum of 1 metre beyond the area of damage.

Repairs

6. The Contractor shall certify that the Geotextiles delivered to site meet the Specification requirements. Sampling, conditioning and statistical analysis of results shall be carried out in accordance with AS 3706.1. Sampling frequency shall be in accordance with Appendix A of the standard. If directed otherwise, duplicate samples shall be provided to the Superintendent.

Sampling and Testing

b) Drainage Layer Sand

Drainage Layer Sand

1. The drainage layer sand shall comply with the following requirements:

- i) Particle Size Distribution (WA 115.1) as shown in Table 501A7 of Annexure 501A.
- ii) Linear Shrinkage (WA 123.1) – The portion of the sample which passes the 0.425mm sieve (soil mortar) shall have a linear shrinkage not exceeding 1.0%.
- iii) Construction – Construction of the drainage layer shall be as specified for sub-base.

501.33 – 501.40 NOT USED

ACCEPTANCE

501.41 GENERAL

1. Each pavement layer shall be constructed in accordance with this Specification to satisfy the criteria shown in Annexure 501A.
2. Where a pavement material has been supplied by the Contractor, the Contractor must undertake sufficient testing of that material sampled from the stockpiles, in accordance with Specification 201 QUALITY SYSTEMS, to demonstrate that the material complies in all respects with the specified requirements.
3. **Prior to the construction of any pavement layer, the Contractor shall certify to the Superintendent that the pavement material supplied by the Contractor complies in all respects with the specified requirements.** **HOLD POINT**
4. Where a pavement material has been supplied by the Contractor, the Contractor must undertake sufficient testing of that material sampled from the pavement, after compaction is completed, to demonstrate that the pavement material particle size distribution and linear shrinkage complies with the specified requirements.
5. **Prior to the Date of Practical Completion, the Contractor shall certify to the Superintendent that the pavement material supplied by the Contractor complies with the specified linear shrinkage and particle size distribution after compaction into the pavement.** **HOLD POINT**

501.42 COMPACTION AND DRYBACK

1. Each pavement layer shall be constructed to the dimensions and details shown on the Drawings and to the requirements of the Specification and shall be compacted to the Characteristic Dry Density Ratio shown in Annexure 501A or greater. Each pavement layer shall be dried back to the Dryback Characteristic Moisture Content shown in Annexure 501A or lower. Where the sub-base material contains more than 20% by mass of material retained on a 37.5mm sieve, the Optimum Moisture Content and the Maximum Dry Density shall be determined on that portion of the material that passes a 37.5mm sieve.

501.43 LAYER WIDTH

1. The outer top edge of any layer of the pavement shall be no closer to the road centreline and no more than 100mm further from the road centreline than the positions shown in the drawings.

501.44 SURFACE SHAPE

501.44.01 SUB-BASE

1. The shape of the sub-base shall be judged to be acceptable when the maximum deviation from a 3 metre straight edge placed in any position on the surface does not exceed 10mm. **Max Deviation 10mm**

2. Additionally, for pavement widening work, the crossfall at any position on the new surface measured at right angles to the centreline shall be within 0.5% of the existing crossfall on the outer 2 metres of the adjacent traffic lane at that location.

Widening

501.44.02 BASECOURSE

1. The shape of the basecourse shall be judged to be acceptable when the maximum deviation from a 3 metre straight edge placed in any position on the surface does not exceed 6mm.

**Max
Deviation
6mm**

2. Additionally, for widening work, the crossfall measured at any position on the new surface at right angles to the centreline shall be within 0.5% of the existing crossfall or of the crossfall on the outer 2 metres of the adjacent traffic lane at that location.

Widening

501.45 SURFACE LEVELS

501.45.01 SUB-BASE

a) Construction or Reconstruction Sections

1. The level of the completed sub-base surface shall be deemed to be conforming when the level measured at any point on the surface is within +5mm, -25mm of the sub-base level at that point as determined from the drawings.

**Construction
Sections**

b) Pavement Widening Sections

1. The level of the completed sub-base surface shall be deemed to be conforming when the levels of the sub-base at its junction with the existing pavement are within +5mm, -25mm of the levels as determined from the basecourse depth making due allowances for the effect of the existing crossfall of the pavement.

**Widening
Sections**

501.45.02 BASECOURSE

a) Construction or Reconstruction Sections

1. The level of the completed basecourse surface shall be judged to be acceptable when the level measured at any point on the surface is within the following tolerances for the basecourse level for that point as determined from the drawings:

**Construction
Sections**

- i) where final surface is asphalt - 5mm, + 10mm
- ii) elsewhere - 5mm, + 20mm

2. Where the basecourse is stabilised, the depth of stabilisation shall be deemed to be acceptable when the actual depth of the stabilised material after compaction shall nowhere depart from the specified depth by more than - 0mm, + 25mm.

**Stabilised
Basecourse**

b) Pavement Widening Sections

1. The level of the completed basecourse surface shall be judged to be acceptable when the levels of the basecourse at its junction with the existing seal are within -0mm, +5mm of the top cut edge level of the existing seal.

**Widening
Sections**

501.46 SURFACE FINISH

1. Completed pavement layers shall be in a homogeneous, uniformly bonded condition with no evidence of layering, cracking, disintegration or surface tearing. The finished surface should appear as a stone mosaic interlocked with fine material and shall be dense, even textured and tightly bonded. The basecourse must retain those characteristics after rotary brooming and be suitable to receive bituminous surfacing. Prior to the application of a bituminous surfacing the surface of the basecourse shall be uniformly dry.

501.47 – 501.50 NOT USED

MAINTENANCE

501.51 SUBGRADE

1. Completed subgrade construction shall be maintained to the specified standards of surface shape, level, dryback and compaction up to the time of construction of the sub-base.
2. Watering shall be continued as necessary to prevent, dusting or loosening of the surface.
3. Completed subgrade construction shall also be maintained to the specified standard of dryback up to the time of application of the bituminous surfacing.

501.52 SUB-BASE

1. Completed sub-base construction shall be maintained to the specified standards of surface shape, level, dryback and compaction up to the time of construction of the basecourse.
2. Watering shall be continued as necessary to prevent shrinkage cracking, dusting or loosening of the surface.
3. Completed sub-base construction shall also be maintained to the specified standard of dryback up to the time of application of the bituminous surfacing.

501.53 BASECOURSE

1. Completed basecourse construction shall be maintained to the specified standards of surface shape, level, compaction, dryback and finish up to the time of application of the bituminous surfacing.
2. Watering shall be continued as necessary to prevent shrinkage cracking, dusting or loosening of the surface.

501.54 – 501.80 NOT USED

AS BUILT AND HANDOVER REQUIREMENTS

501.81 – 501.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

501.91 – 501.99 NOT USED

ANNEXURE 501 A

CONSTRUCTION REQUIREMENTS

1. COMPACTION OF PAVEMENT LAYERS

1.1 Pavement layers shall be compacted to the densities shown in Table 501A1.

TABLE 501A1 COMPACTION VALUES

Pavement Layer	Minimum Characteristic Dry Density Ratio % (R _c)
Drainage Layer	94%
Sub-Base	94%
Cement Stabilised Sub-Base	94%
Lime Stabilised Sub-Base	94%
Crushed Recycled Concrete Sub-Base	94%
Basecourse (final surfacing – sprayed seal)	96% or 98% (Select appropriate value then delete this note. Refer to Guidance Notes)
Basecourse (final surfacing – asphalt)	98% or 99% (Select appropriate value then delete this note. Refer to Guidance Notes)
Cement Stabilised Basecourse	96%
Lime Stabilised Basecourse	96%
Bitumen Stabilised Limestone Basecourse	98%
Crushed Rock Base Basecourse	99%
Hydrated Cement Treated Crushed Rock Base Basecourse	99%

2. DRYBACK OF PAVEMENT LAYERS

2.1 Basecourse or other pavement layers shall be dried back to the requirements shown in Table 501A2.1 or Table 501A2.2 prior to the application of bituminous binder or the construction of the overlying layer.

TABLE 501A2.1 DRYBACK ON SUBGRADE OR SUBBASE LAYERS

Subgrade or Pavement Layers	Maximum Dryback Characteristic Moisture Content (DMc) as a proportion of Optimum Moisture Content
Layer 150mm below Subgrade surface (except for Perth sand)	85%
Drainage Layer	
Sub-Base	85%
Basecourse	Refer Table 501A2.2

TABLE 501A2.2 BASECOURSE DRYBACK

Basecourse Material Type	Maximum Dryback Characteristic Moisture Content (DMc) as a proportion of Optimum Moisture Content
Basecourse (final surfacing – sprayed seal)	85%
Basecourse (final surfacing – asphalt)	70%
Crushed Rock Base (all surfacing types)	60%
Hydrated Cement Treated Crushed Rock Base (all surfacing types)	70%

3. CEMENT STABILISED PAVEMENTS

3.1 Cement stabilised pavement layers shall be constructed at the locations and with the parameters as shown in Table 501A3:

TABLE 501A3 CEMENT STABILISED PAVEMENTS

Section		Depth of Stabilisation (mm)	Width of Stabilisation (m)	Cement Content (% by dry mass of Pavement Layer)
From	To			
Sub-Base Layers				
Basecourse Layers				

4. LIME STABILISED PAVEMENTS

4.1 Lime stabilised pavement layers shall be constructed with the parameters as shown in Table 501A4:

TABLE 501A4 LIME STABILISED PAVEMENTS

Section		Depth of Stabilisation (mm)	Width of Stabilisation (m)	Equivalent Pure Hydrated Lime Content (% by dry mass of Pavement Layer)
From	To			
Sub-Base Layers				
Basecourse Layers				

5. DRAINAGE LAYER

5.1 GEOTEXTILE

TABLE 501A5 MECHANICAL PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Minimum G Rating as defined in AUSTRROADS Guide to Geotextiles #			AS 3706.4 & AS 3706.5

NOTE:

1. # Burst Strength (CBR Plunger Method) shall be the 5th percentile value determined in accordance with A S3706.1 & AS 3706.4 and Puncture Resistance (Drop Cone Method) shall be the 5th percentile value determined in accordance with AS 3706.1 & AS 3706.5.

TABLE 501A6 HYDRAULIC PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Maximum Equivalent Opening Size (EOS) (µm)			AS 3706.7 [#]
Minimum Q ₁₀₀ (L/m ² /sec)			AS 3706.9 [#]

NOTES:

1. # Maximum Equivalent Opening Size (EOS) and Minimum Q₁₀₀ are mean values.
2. Q₁₀₀ = Flow rate under 100mm constant head determined using the Perpendicular Flow Test.

5.2 DRAINAGE LAYER SAND

1. Drainage Layer sand shall comply with the requirements shown in Table 501A7:
 - a) Particle Size Distribution - WA 115.1

TABLE 501A7 PARTICLE SIZE DISTRIBUTION - WA 115.1

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
37.5	90 - 100
2.36	30 - 100
0.075	0 - 3

ANNEXURE 501 B

CEMENTITIOUS MATERIALS FOR CONCRETE REQUEST FOR REGISTRATION BY MANUFACTURER

Cement or Blend Details	
Product Name	
Type	
Proportions	
Manufacturer	
Place of Manufacture	
Source of Constituent Materials	
Cement Clinker	
Fly Ash	
Slag	
Limestone	
Gypsum	
Grinding Aids	
Supply Details	
Dispatching Supplier	
Contact Name	
Contact Phone No.	
Contact Address	
Suppliers ABN	

Send this form with the sample to:

RTA Chemical and Materials Laboratory Att: Laboratory Officer Unit H, 75 St. Hilliers Rd, Auburn NSW 2144	For RTA Laboratory Use Only: Date of Registration: Registration No:
---	--

SPECIFICATION 501 GUIDANCE NOTES

DELETE THESE GUIDANCE NOTES FROM FINAL DOCUMENT AFTER USING FOR REFERENCE

All edits to downloaded TDP documents shall be tracked (most word processing software allows this to be done automatically). Deletions shall be struck through e.g. ~~example~~. Insertions shall be in italics e.g. *example*. If **all** information relating to a clause is deleted then the clause number should be retained and the words "**NOT USED**" should be inserted.

The proposed documents with tracked changes shall be submitted to the Project Manager for review, prior to printing the final batch of documents. When this final printing is carried out, the tracked changes option is to be **turned off**.

The Custodian of this specification is the Pavements and Surfacing Manager.

1. PAVEMENT MATERIAL SPECIFICATIONS

1.1 BASECOURSE

1. Not Used.
2. For roads with a design traffic loading of less than 5×10^6 ESA, the applicable Natural Gravel Basecourse Particle Size Distribution Table 501.10 and Consistency Limits Table 501.11 may be selected. Delete the Tables not required.
3. For roads with a design traffic loading of less than 5×10^6 ESA, the MDCS criteria in Table 501.11 Other Acceptance Limits (Gravel Basecourse) may be reduced from 2.3 MPa to 1.7 MPa. Delete note from the Specification.
4. For roads with a design traffic loading of less than 5×10^6 ESA, the applicable Ferricrete basecourse Particle Size Distribution Table 501.15 and Consistency Limits Table 501.16 may be selected. Delete the Tables not required.
5. For roads with a design traffic loading of less than 5×10^6 ESA, the MDCS criteria in Table 501.16 Other Limits Ferricrete may be reduced from 2.3 MPa to 1.7 MPa. Delete note from the Specification.

TABLE 501.10 PARTICLE SIZE DISTRIBUTION (GRAVEL BASECOURSE)(Suitable for design traffic < 5 x 10⁶ ESA)

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing By Mass Minimum and Maximum Limits
37.5	100	100
19.0	74	71 – 100
9.5	54	50 – 81
4.75	40	36 – 66
2.36	29	25 – 53
1.18	21	18 – 43
0.425	13	11 – 32
0.075	6	4 – 19
0.0135	3	2 – 9

TABLE 501.11 OTHER ACCEPTANCE LIMITS (GRAVEL BASECOURSE)(Suitable for design traffic < 5 x 10⁶ ESA)

Test	LIMITS	Test Method
Liquid limit	25.0% Maximum	WA 120.2
Linear Shrinkage	3.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1

1.2 SUB BASE

Modification of the sub-base specification may also be considered in accordance with 1.1 Basecourse above.

2. LATERITIC GRAVEL BASE & SUB-BASE SUPPLIED BY CONTRACTOR

Typical sub-base grading and Consistency Limits (as used in South-West Region) may be as follows:

2.1 PARTICLE SIZE DISTRIBUTION

TABLE 501B1 - PARTICLE SIZE DISTRIBUTION (LATERITIC GRAVEL SUB-BASE)

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
75.0	100	100
37.5	100	80 – 100
19.0	75	50 – 100
9.5	59	36 – 81
4.75	46	25 – 66
2.36	36	18 – 53
1.18	28	13 - 43
0.425	20	8 - 32
0.075	11	3 - 19

2.2 CONSISTENCY LIMITS

The portion of the sample passing the 0.425mm sieve shall conform to the following:

- (a) Liquid Limit WA 120.2 - not greater than 25.0%
- (b) Linear Shrinkage WA 123.1 - not greater than 3.0%

Typical basecourse grading and Consistency Limits (as used in South-West Region) may be as follows:

2.3 PARTICLE SIZE DISTRIBUTION

TABLE 501B2 - PARTICLE SIZE DISTRIBUTION (LATERITIC GRAVEL BASECOURSE)

As Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
37.5	100
19.0	71 - 100
9.5	50 - 81
4.75	36 - 66
2.36	25 - 53
1.18	18 - 43
0.425	11 - 32
0.075	4 - 19

2.4 CONSISTENCY LIMITS

The portion of the sample passing the 0.425mm sieve shall conform to the following:

- a) Liquid Limit MRWA 120.2 - not greater than 25.0%
- b) Linear Shrinkage MRWA 123.1 - not greater than 3.0%

2.5 REWORK (refer Clause 501.26)

The paragraph 6 below may be required for inclusion in Clause 501.26 for basecourse material with gravel particles prone to excessive wear during mixing and compaction. A high Los Angeles Abrasion value or past experience of excessive breakdown during construction with similar material would justify use of this clause to limit rework of gravel basecourse.

6. This basecourse material will breakdown under the action of construction plant. The Contractor shall compact any lot using this material for basecourse only twice. Any basecourse that requires rework after having been already compacted twice shall be removed and replaced at no cost to the Principal.	Rework
---	---------------

(Insert paragraph as required, and remove grid lines)

3. GRAVEL BASECOURSE – OVERSIZE MATERIAL (refer Clause 501.08)

3.1 An alternative paragraph 1 in Clause 501.08 is provided where it is considered necessary to ensure the removal or treatment of oversize material in excess of 300mm in size.

3.2 If applicable, insert the alternative paragraph 1 in Clause 501.08 provided below (and remove grid lines):

<p>1 Gravel basecourse material shall consist of durable pebble in soil mortar. The material shall be free from particles having any dimension greater than 37.5mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.</p> <p>2 The Contractor shall remove all oversize material with any dimension greater than 300mm and this material shall not be delivered to the pavement construction area. This material and all other oversize material are to be included in the measurement of the stockpile for determining the volume of material used.</p> <p>3 All other oversize material shall be crushed by rolling with a minimum of six (6) passes of a grid roller as specified in the "Compaction: Principal's Method Specification" Clause of Specification 302 EARTHWORKS</p> <p>4 After the initial crushing, any material having any dimension greater than 50mm shall be deemed to be oversize and shall not be used in pavement construction. Additional crushing shall then be undertaken until the pavement material does not contain more than 20% by mass of material retained on a 37.5mm sieve</p>
--

4. PRINCIPAL SUPPLIED MATERIALS (refer Clause 501.91)

4.1 Materials are normally required to be supplied by the Contractor. Where supply is by the Principal (for example, gravel in stockpiles), Clause 501.91 in the section CONTRACT SPECIFIC REQUIREMENTS (or a suitably edited version of this clause) is applicable.

4.2 Amend this clause as shown to indicate whether the material is supplied at a cost to the Contractor, or is supplied free of charge. Applying a charge may conserve material where there is a limited supply, but appropriate supervision and a suitable means of measurement must be established.

4.3 Insert details of any other Principal supplied materials as required.

5. OPTIONAL PAVEMENT MATERIALS (refer Clauses 501.92 to 501.94)

5.1 The section PRODUCTS AND MATERIALS includes commonly used pavement materials. Other pavement materials should be included under CONTRACT SPECIFIC REQUIREMENTS and selected as required.

5.2 Pavement materials not listed should be researched and approved as required before inclusion.

6. DRAINAGE LAYER

6.1 GEOTEXTILE

1. Where a drainage layer is required, it is usually constructed between the subgrade and the lower pavement layer.

2. A Geotextile may or may not be required as part of the drainage layer. Typical details of Geotextile are as follows:

TABLE 501B3 MECHANICAL PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Minimum G Rating as defined in AUSTRROADS Guide to Geotextiles #	1700	1000	AS 3706.4 & AS 3706.5

(NOTE: Typical G Rating values only are shown - insert appropriate values to suit specific conditions)

TABLE 501B4 HYDRAULIC PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Maximum Equivalent Opening Size (EOS) (µm)	200	200	AS3706.7#
Minimum Q ₁₀₀ (L/m ² /sec)	50	50	AS3706.9#

(NOTE: Typical EOS and Q₁₀₀ values only are shown - insert appropriate values to suit specific conditions)

6.2 SAND FOR DRAINAGE LAYER

1. Bassendean Sand is commonly used as a drainage layer in the Metro area, with the following grading limits.

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
37.5	90 - 100
2.36	30 - 100
0.075	0 - 3

PARTICLE SIZE DISTRIBUTION - WA 115.1

2. Insert appropriate details of the specified drainage layer material.

7. PAVEMENT COMPACTION

7.1 Where a range is given for the minimum characteristic dry density ratio in Table 510 A1, the higher value in the range should be selected unless there is evidence that the basecourse properties will be damaged by so doing (e.g. if a higher compactive effort causes breakdown of the stone and adversely affects the grading or the linear shrinkage of the basecourse).

A higher compactive effort will reduce the risk of post construction wheel path rutting under traffic loading.

A more uniform pavement layer can be expected when a higher minimum characteristic dry density ratio is specified. To achieve the higher density, the Contractor will need to exercise greater control over the uniformity of the mixing and compaction processes (e.g. especially over the amount and uniformity of moisture in the pavement layer during compaction).

7.2 Cement stabilised or Lime Stabilised Basecourse must not be used under asphalt wearing courses unless approved by the Manager Materials Engineering

7.3 Refer to Engineering Road Note No. 8 for guidance, to augment engineering judgement and knowledge of local materials.

7.4 Plastic pavement materials should be moist cured overnight before compaction takes place if the insitu or imported basecourse is in a dry condition. Insert Clause 501.96 in CONTRACT SPECIFIC REQUIREMENTS if plastic pavement material is present.

8. DRYBACK OF PAVEMENT AND SUBGRADE LAYERS

8.1 Always applied to the basecourse layer.

8.2 Normally a requirement for sub-base and cohesive subgrade material. Dryback of Perth sand subgrade is not required.

9. DIEBACK CONTROL

9.1 Insert as a CONTRACT SPECIFIC REQUIREMENT if dieback controls should be included in pavement construction.

9.2 Refer to any general requirements shown in Specification 204 ENVIRONMENT.

10. CEMENT STABILISED PAVEMENTS

10.1 Cement stabilisation can be applied to any pavement layer, but typically only to the basecourse layer.

10.2 If cement stabilisation of the basecourse is specified (e.g. at floodways), determine the following and insert into Annexure 501A (in addition to required Compaction):

- a) Depth of stabilisation - typically 150mm to 200mm.
- b) Cement content - typical values are 1.0%, 1.5% or 2% by dry mass of the basecourse material.
- c) The cement content required, will be determined by the unconfined compressive strength (UCS) of the material when tested in accordance with WA 143.1. The UCS specimens shall be compacted using General Purpose (Type GP) cement, cured for seven (7) days in a controlled environment and immersed in water for four (4) hours prior to compression testing. The specimens are to be compacted at the specified density and 100% of OMC. The 7-day UCS must be in the range of 0.6 – 1.0MPa.

10.3 The cement content required for reworked sections is specified as 50% of the original cement content at Clause 501.30.08 (1). This is a default percentage and it is preferable if UCS testing is undertaken in the laboratory prior to construction commencing to determine the percentage of cement that should be added if rework is required. The rework cement content may vary with the length of time elapsed before rework is undertaken. The minimum practical spread rate that can be achieved by most cement spreaders is 3kg/m², which equates to approximately 1% cement for a laterite gravel stabilised to a depth of 150mm.

10.4 The mandatory use of padfoot rollers for initial compaction should be considered in the following circumstances:

- a) When the section length is 100m or more.
- b) The depth of material to be stabilised is 175mm or more.
- c) The percentage of material retained on a 37.5mm sieve is less than 10%.

Padfoot rollers are more efficient in achieving density but trimming out the padfoot marks is difficult in short sections and those with coarse material that could tear the surface. Insert Clause 501.97 in the CONTRACT SPECIFIC REQUIREMENTS if mandatory use of padfoot rollers is required.

11. LIME STABILISATION (refer Clause 501.95)

11.1 Lime modification is not commonly used, but can be applied to any pavement layer, typically only to the basecourse layer.

11.2 If lime modification of the basecourse is specified, determine the following and insert into Annexure 501A (in addition to required compaction):

- a) Depth of stabilisation - typically 150mm to 200mm.
- b) Lime content is determined by laboratory testing. Because lime varies in purity (depending on manufacture) and strength (depending on whether it is quicklime, hydrated lime or lime slurry), the optimum lime content must be expressed as a percentage of equivalent pure hydrated lime (calcium hydroxide) by dry mass of the basecourse material

11.3 The process for determining whether Lime modification is appropriate and the required % of pure hydrated Lime for pavement modification is;

- a) Refer to section 4.9 Preliminary Binder Selection of the Austroads Guide to Pavement Technology- Part - 4D: Stabilised Materials to determine if Lime is a suitable additive for the selected pavement material.
- b) Undertake laboratory testing to determine the minimum % of lime (i.e. the Lime Demand) that must be added to achieve long term soil modification. Determine the "Lime Demand" of the soil in accordance with VicRoads Manual of Testing method RC 131.01 "Lime Saturation Point of Soil (pH Method)". This method uses hydrated lime for the laboratory testing and includes reference to a methodology for determining the percentage of lime that must be added if another type of lime (e.g. quick lime) is used in the field.
- c) Determine the UCS of the modified material in accordance with Main Roads Test Method WA 143.1. The test specimens are to be compacted at the specified density and 100% of OMC and must be 28 day cured.
- d) The optimum Lime content of the soil for modification must satisfy both the Minimum Lime Content to achieve long term modification at Step (b) and the % of lime that must be added to the soil to produce a 28-day UCS at Step (c) falling in the range 0.7MPa to 1.5MPa.
- e) Should the Lime Demand test require a % of lime that results in a 28-day UCS that exceeds 1.5MPa then lime modification must not be used.

11.4 The lime content required for reworked sections is specified as 50% of the original lime content at Clause 501.95.09 (1). This is a default percentage and it is preferable that testing is undertaken in the laboratory in accord with Clause 11.3 above prior to construction commencing to determine the percentage of lime that should be added if rework is required. The rework lime content may vary with length of time elapsed before rework is undertaken. The minimum practical spread rate that can be achieved by most lime spreaders is 3kg/m², which equates to approximately 1% lime for a laterite gravel stabilised to a depth of 150mm.

11.5 The safety aspects of using lime stabilisation are referred to in Clause 501.95.02.

12 DURABILITY OF BASIC IGNEOUS ROCKS

Additional tests have been included in Table 501.9 for the purpose of excluding material that has the potential to degrade in service from being used as Crushed Rock Base or Gravel basecourse. The colour of the rocks may be green, grey or black, but the basaltic rocks that most commonly present a risk of degradation are often dark green. The existing classification and strength tests in clauses 501.08 and 501.09 are not suitable to identify the presence of material prone to degradation. Vic Roads Technical Bulletin 39 provides additional guidance on this topic.

13. HYDRATED CEMENT TREATED CRUSHED ROCK BASE (HCTCRB)

13.1 A Geotextile Reinforced Seal must be specified whenever HCTCRB basecourse is used. The GRS must comprise a double/double seal (14mm/7mm with Class 170 binder and heavy grade fabric) in accordance with the requirements of Specification 503.

The purpose of the GRS is to maintain a waterproof seal on the HCTCRB basecourse.

HCTCRB should not be specified for pavements with a sprayed seal wearing course.

14. CRUSHED RECYCLED CONCRETE SUB-BASE

Crushed Recycled Concrete Sub-Base in accord with Clause 501.92 is recommended to be used as the Sub-Base layer for Full Depth Asphalt pavements.

CONTRACT SPECIFIC REQUIREMENTS TO ADD OR DELETE

The following clauses are to be placed under the CONTRACT SPECIFIC REQUIREMENTS section as required. Note that the Clause numbers may be varied within the range allocated to this section to suit the requirements of the project and the remaining "Not Used" numbers adjusted accordingly.

ALTERNATIVE PAVEMENT MATERIALS

501.91 PAVEMENT MATERIALS – PRINCIPAL SUPPLY

1. Where pavement materials are supplied by the Principal, details of such materials are provided in Specification 100 GENERAL REQUIREMENTS Annexure 101E.

2. Pavement material will be made available to the Contractor free of charge / at a specified cubic metre rate * (measured in the stockpile) from stockpiles located as described in Specification 100 GENERAL REQUIREMENTS Annexure 101E. The material shall be extracted from the stockpiles without contamination from the underlying strata and shall be free from boulders, clods, stumps, roots, stocks, vegetable matter or other deleterious material prior to loading and carting.

Availability

(* Authors – select as applicable)

3. If the pavement material is made available from borrow pits, any removed vegetation or material that is discarded may be stockpiled separately and used later in pit reinstatement in accordance with Specification 303 PITS AND QUARRIES.

Vegetation

4. When the stockpiled material contains oversized material, the Contractor shall screen the stockpiles to ensure that the pavement material does not contain more than 20% by mass of material retained on a 37.5mm sieve. The screen aperture shall be selected so that only the minimum quantity of material is removed from the existing stockpile to satisfy this requirement. Basecourse material having any dimension greater than 50mm shall be deemed oversized and shall not be used in pavement construction.

**Oversize
Material**

5. Any oversized material discarded in the stockpile area or any oversized material discarded from the pavement shall be removed to be stockpiled in borrow pits and respread evenly over the pit excavation area prior to the rehabilitation of the Pit.

6. Access tracks to pavement material stockpiles and pits shall be constructed and maintained in accordance with Specification 303 PITS AND QUARRIES.

**Access
Tracks**

501.92 [CRUSHED RECYCLED CONCRETE SUB-BASE SUPPLIED BY THE CONTRACTOR] – UNDER REVIEW

501.93 FERRICRETE BASECOURSE SUPPLIED BY THE CONTRACTOR

501.93.01 SOURCE ROCK

1. Ferricrete basecourse shall predominantly consist of crushed indurated ferricrete and may include natural fragmented ferricrete and lateritic gravel. For blended materials the proportion of crushed material shall not be less than 50%. The material shall be generally free from organic matter and other deleterious materials. **General**

2. The source rock shall also conform to the following limits shown in Table 501.12. **Source Rock Acceptance Limits**

TABLE 501.12 SOURCE ROCK ACCEPTANCE LIMITS (FERRICRETE BASECOURSE)

Test	Limits	Test Method
Los Angeles Abrasion Value	60% Maximum	WA 220.1

501.93.02 PARTICLE SIZE DISTRIBUTION

1. The Particle Size Distribution of the material when tested in accordance with Test Method WA 115.1 shall comply with the requirements shown in Table 501.13 or Table 501.15. The grading of material passing the 37.5mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size, and shall conform as closely as possible to the specified target grading. **Particle Size Distribution**

TABLE 501.13 PARTICLE SIZE DISTRIBUTION (FERRICRETE BASECOURSE)

(Ferricrete basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area)

AS Sieve Size (mm)	Target Grading % Passing by Mass	% Passing by Mass Minimum and Maximum Limits
37.5	100	100

19	80	72 – 100
9.5	57	50 – 78
4.75	43	36 – 58
2.36	31	25 – 44
1.18	23	18 – 35
0.600	18	13 – 28
0.425	15	11 – 25
0.300	13	9 – 22
0.150	9	6 – 17
0.075	7	4 – 13
0.0135	4	2 – 9

2. The Dust Ratio, defined as the ratio of the percentage passing by mass the 0.075mm sieve to the percentage passing by mass the 0.425mm sieve, shall fall within the range 0.3 to 0.7.

501.93.03 OTHER ACCEPTANCE LIMITS

**Other
Acceptance
Limits**

1. The material shall also conform to the following limits shown in Table 501.14 and Table 501.16.

TABLE 501.14 OTHER ACCEPTANCE LIMITS (FERRICRETE BASECOURSE)

(Ferricrete basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area)

Test	Limits	Test Method
Liquid limit	25.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3MPa Minimum	WA 140.1
Maximum Dry Density	2.0 t/m ³ Minimum	WA 133.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1

TABLE 501.15 PARTICLE SIZE DISTRIBUTION (FERRICRETE BASECOURSE)

(Suitable for design traffic < 5 x 10⁶ ESA)

AS Sieve Size	% Passing by Mass	% Passing by mass
---------------	-------------------	-------------------

(mm)	Target Grading	Minimum and Maximum Limits
37.5	100	100
19	74	71 – 100
9.5	54	50 – 81
4.75	40	36 – 66
2.36	29	25 – 53
1.18	21	18 – 43
0.425	13	11 – 32
0.075	6	4 – 19
0.0135	3	2 – 9

2. The Dust Ratio, defined as the ratio of the percentage passing by mass the 0.075mm sieve to the percentage passing by mass the 0.425mm sieve, shall fall within the range 0.3 to 0.7.

**TABLE 501.16 OTHER ACCEPTANCE LIMITS
(FERRICRETE BASECOURSE)**

(Suitable for design traffic < 5 x 10⁶ ESA)

Test	Limits	Test Method
Liquid limit	25.0% Maximum	WA 120.2
Linear Shrinkage	3.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3MPa Minimum	WA 140.1
Maximum Dry Density	2.0 t/m ³ Minimum	WA 133.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1

TABLE 501.17 NOT USED.

501.95 LIME STABILISED PAVEMENTS

501.95.01 MATERIALS

1. Lime for stabilisation of any pavement layer shall comply with the requirements of AS 1672. The lime shall be sufficiently dry to flow freely during application. **Lime**
2. The Contractor shall arrange lime delivery and have on site bulk storage facilities. The Contractor shall be responsible for all arrangements in regard to the transfer of lime between delivery vehicles, on site bulk storage facilities and lime spreaders. **Delivery**

501.95.02 GENERAL

1. The pavement material shall be stabilised with lime for the sections and to the compacted depths shown either in Annexure 501A or as shown on the Drawings.
2. Stabilisation shall include preliminary loosening of the pavement layer, mixing and compacting the pavement material as necessary, spreading lime over the area to be treated, and the thorough blending of in-situ pavement material, lime and water as required to produce a homogeneous stabilised layer over the specified lengths and widths.
3. The Contractor's shall handle and use the quicklime/slaked lime in a safe manner, and shall provide adequate protection to the workforce, the public, stock and property. **Safety Requirements**

501.95.03 PLANT AND EQUIPMENT

- a) Lime Spreader **Lime Spreader**
 1. The spreading equipment shall be a mechanical stabilising agent spreader that has been specifically designed for such work. The spreader shall be capable of uniformly distributing lime and accurately controlling the spread rate such that when mixing is complete the lime content shall be in accordance with the requirements of Clause 501.95.05.
 2. The spreader shall be equipped with gates to vary the width of spread and with electronic weigh scales to give daily totals of product use.
- b) Stabilising Machine
 1. Cutting, pulverising, mixing, adding water and spreading of blended material shall be accomplished using a machine specifically designed for pavement recycling. The stabilising machine's rotor action shall be such that the rotor revolves in an upwards and forwards cutting direction. The rotor shall be of the recycler type and fitted with bullet teeth cutting tips.

2. Rotary hoes and other implements normally used for agricultural work shall not be used. The stabilising machine shall also satisfy the following requirements:

- a) Be capable of producing a uniformly mixed material throughout the specified depth of the work.
- b) Be equipped with a variable depth of cut control, and an accurate gauge to measure depth of cut which is readily visible to the operator.
- c) Have provision for adding water automatically through a system comprising a pump, flow meter, variable control valve and full width spray bar. Each nozzle on the spray bar shall be fully and independently adjustable and the water pump shall have the capacity to supply a minimum of 900 litres per minute.

501.95.04 PRELIMINARY TREATMENT

1. It shall be the Contractor's responsibility to determine whether pre loosening and mixing of the in situ material is necessary.

2. Under no circumstances shall the first loosening and mixing operation of the pavement layer exceed the final stabilised depth.

501.95.05 SPREADING OF LIME

1. Lime shall be spread uniformly at a controlled rate over the area to be stabilised using a suitable lime spreader.

2. The lime stabilised pavement layer shall contain an average of not less than the equivalent percentage of hydrated lime (calcium hydroxide) as stated in Annexure 501A. The percentage stated is a percentage of the dry mass of the pavement layer material. The Contractor shall keep daily records of the amounts of lime used and actual spread rates achieved per section treated and shall make such records available to the Superintendent upon request.

Composition

3. The actual spread rate of lime achieved shall be determined by either:

- a) placing three trays each of approximately one third of a square metre in area in front of the lime spreader and measuring the mass of lime deposited on the trays for each lot, or
- b) by the use of an on-board electronic weigh scale system.

4. The percentage lime (P%) shall be calculated thus:

$$P\% = \frac{M}{A \times T \times MDD} \times 100$$

- Where
- M = total mass of lime (kg) as determined by one of the following methods:
(a) on each tray
(b) on-board electronic weight scale system.
- A = method (a) total area of the trays (m²)
method (b) total measured area spread (m²)
- T = Thickness to be stabilised (mm) (including allowances for tolerances and trimming)
- MDD = Maximum Dry Density of the pavement material without the addition of lime (kg/m³)

5. The percentage lime determined for each tray in accordance with this clause shall be maintained within $\pm 10\%$ by mass of the specified lime content throughout the stabilisation works.

6. The use of method (b) in determining the values 'M' and 'A' is subject to satisfactory calibration of the measuring device and the production of associated certification in accordance with the Contractor's Quality System. Audits on this method shall be carried out using the measuring tray method.

7. Once the lime has been spread, no other plant other than that needed for spreading, or for mixing and spreading the mixed material, shall be permitted to travel over the area to be stabilised.

501.95.06 INCORPORATION OF LIME

1. The spreading of lime shall not proceed when rain is imminent. The spread lime shall be incorporated into the pavement layer immediately following the spreading operation. All spread lime shall be incorporated into the pavement layer within the same working day. Lime shall not be spread when the prevailing wind velocity is sufficient to make the lime particles airborne.

2. Cutting, pulverising, mixing, adding water and spreading of mixed material shall take place as a single operation within the stabilising machine.

3. Cutting, pulverising, mixing, adding water and spreading of mixed material shall continue until the maximum size of all material (other than rock) is not greater than 25mm, and the lime and water are uniformly incorporated into the mixed material without streaks or pockets of lime.

501.95.07 MOISTURE CONTENT

1. The required moisture content shall be based on the results of any trials and/or density testing carried out.
2. The Contractor shall be responsible for achieving and maintaining the required moisture content by controlling the amount of water added during the mixing process within the stabilising machine.
3. The moisture content shall be maintained within the CMC range of the dry mass of pavement material.

501.95.08 COMPACTION

1. Compaction and trimming of the mixed material to shape and level shall be completed within the same working day that the lime is incorporated into the pavement layer. The mixed material shall be compacted to the Characteristic Dry Density Ratio as shown in Annexure 501A, or greater.
2. The Contractor shall be responsible for any additional stabilising, including the supply and incorporation of additional lime, required as a result of non-compliance with this clause as directed by the Superintendent.

501.95.09 REWORK

1. If a completed layer of lime stabilisation does not satisfy all of the requirements of the Specification and has to be reworked, the Contractor shall repeat all the requirements for Lime Stabilisation including the addition of 50% of the original lime content at no cost to the Principal.
2. Rework shall include any disturbance to the surface of the lime stabilized layer during trimming to meet shape or level requirements that is undertaken after the working day that the lime is incorporated into the pavement layer. The rework depth shall not be less than the full depth of the affected layer.

Rework

501.95.10 CONSTRUCTION JOINTS

1. When the stabilising work cannot be completed in one continuous operation, the Contractor shall provide construction joints at each discontinuity in the operation.
2. Construction joints shall be made transverse to and/or parallel to the direction of the stabilising run, and shall be made just prior to the commencement of the next stabilising run.
3. The joints shall be formed by cutting back into the compacted stabilised material to form a vertical face. The loose trimmed material shall be removed from the joint before the next section is mixed and compacted and shall be disposed of to the Contractor's spoil area.

501.95.11 PRELIMINARY TRIAL

1. The Contractor shall carry out a preliminary trial of the proposed stabilising operations. The trial shall determine:
 - a) The effectiveness of the plant.
 - b) The number of passes of the stabilising machine necessary to achieve the specified mixing.
 - c) The desirable moisture content for compaction operations.
2. The trial section shall be located within the Works area.
3. **Prior to conducting such a trial the Contractor shall agree with the Superintendent the location, length and width of trial section(s) within the Works.** ***HOLD POINT***

501.96 PLASTIC MATERIALS

1. All basecourse and sub base gravel pavements shall be premixed by grader and windrowed to a uniform moisture content greater than 95% of the Optimum Moisture Content and left to "cure" for at least 24 hours prior to compaction commencing. Compaction shall be carried out within 72 hours of the time of gravel curing commencing.

501.97 COMPACTION – CEMENT STABILISED PAVEMENTS

1. Initial compaction must be carried out using a vibratory padfoot roller meeting the requirements of Specification 302 EARTHWORKS, Clause 302.44.4.

Note: check the above clause 302.44.4 cross reference number is still current as any revision to Specification 302 could affect the clause numbering of that Specification and is not automatically picked up here.

SPECIFICATION AMENDMENT CHECKLIST

Specification Name: No: **501** Revision No: _____ Title: **PAVEMENTS**

Project Manager: Name: _____ Signature: _____ Date: _____

Checked By: Name: _____ Signature: _____ Date: _____

Contract No: _____ Contract Description: _____

ITEM	DESCRIPTION	SIGN OFF
<i>Note: All changes/amendments <u>must</u> be shown in Tracked Change mode until approved.</i>		
1.	Project Manager has reviewed Specification and identified Additions and Amendments.	
2.	CONTRACT SPECIFIC REQUIREMENTS addressed? – Contract specific materials/products/clauses added? (Refer Specification Guidance Notes for guidance).	
3.	Any unlisted Materials/Products proposed and approved by the Project Manager? – if “Yes” provide details at 15.	
4.	Standard Clauses amended? – MUST SEEK approval from MCP.	
5.	Clause deletions shown as ‘NOT USED’.	
6.	Appropriate INSPECTION & TESTING parameters included in Spec 201 (Test Methods, Minimum Testing Frequencies verified).	
7.	ANNEXURES completed (Refer Specification Guidance Notes).	
8.	HANDOVER and AS BUILT requirements addressed.	
9.	Main Roads QS has approved changes to SMM.	
10.	Project Manager certifies completed Specification reflects intent of the design.	
11.	Completed Specification – independent verification arranged by Project Manager	
12.	Project Manager’s review completed.	
13.	SPECIFICATION GUIDANCE NOTES deleted.	
14.	TABLE OF CONTENTS updated.	
15.	Supporting information prepared and submitted to Project Manager.	
Further action necessary:		

Signed: _____ (*Project Manager*) Date: _____