



# **DEVELOPMENT ENGINEERING SPECIFICATIONS - CONSTRUCTION SPECIFICATION**

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# DEVELOPMENT CONSTRUCTION SPECIFICATION

CQC  
Revision 3



# QUALITY CONTROL REQUIREMENTS

**SPECIFICATION CQC  
QUALITY CONTROL REQUIREMENTS**

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## SPECIFICATION CQC QUALITY CONTROL REQUIREMENTS

### GENERAL

#### CQC1 SCOPE

1. This Specification covers the contractual requirements for the quality control testing and survey by the Contractor; including the minimum test frequencies to be employed to demonstrate conformance to the requirements of the technical specifications.

**Testing and Survey**

#### CQC2 LOTS

(Note – This does not mean a subdivisional 'lot')

1. All items of work shall be subdivided into lots. Each lot shall be given a unique lot number.

2. Lots shall be chosen by the Contractor but shall be within the limits given in Annexure CQC-B. In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.

**Lot Size**

3. The lot numbers shall be used as identifiers on all surveys and test results.

**Lot Numbers**

4. The Contractor shall determine the bounds of each lot before sampling and shall identify each lot clearly.

**Lot Identification**

5. The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous.

**Lot Boundaries**

6. The lot identification system and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

**Test Results**

#### CQC3 SAMPLING AND TESTING

1. All compliance inspections and tests shall be based on lots.

**Lots**

2. The maximum lot sizes and minimum testing frequencies are listed in the Annexures to the relevant Specifications and/or in Annexure CQC-B to this Specification. Where no minimum frequency of testing, or maximum lot size is stated in the Specification, the Contractor shall nominate appropriate frequencies for the Superintendent's approval.

**Lot Sizes  
Frequency of Testing**

3. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the Works in the Drawings or Specification, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the Works to demonstrate its compliance with the Specification.

**Sampling Locations**

4. Where Test Methods are nominated in the Technical Specifications, sampling and testing shall be carried out by a NATA registered laboratory accredited for those test methods and sampling procedures. Sampling shall be conducted by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and shall be supervised by the approved signatory from that laboratory. Test results shall be reported on NATA endorsed test documentation which shall include a statement by the approved signatory certifying that the correct sampling procedures have been followed.

**Sampling and Testing**

- |  |   |
|--|---|
| <p>5. In special circumstances the Principal may accredit a laboratory that is not NATA registered for specific tests or inspection procedures.</p>  | <p><b>Special Accreditation</b></p>               |
| <p>6. The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity. The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work.</p>          | <p><b>Reinstatement</b></p>                       |
| <p>7. Random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. Annexure CQC-A defines the method to be used for determining test locations of random sampling in each lot.</p> | <p><b>Random Sampling</b></p>                     |
| <p>8. For quality control of processes other than compaction of layers of earthworks, flexible pavement and asphalt, the sampling locations will be proposed by the Contractor and will require the approval of the Superintendent.</p>  | <p><b>Sampling Locations</b></p>                  |
| <p>9. In all cases the samples shall be each considered to be representative of the lot and all test results will be required to meet the appropriate tolerances for the lot.</p>  | <p><b>All Test Results to Meet Tolerances</b></p> |

#### CQC4 SURVEYING

- |   |                                       |
|---|---------------------------------------|
| <p>1. Surveying Control shall include all measurement, calculation and record procedures necessary to:</p> <ul style="list-style-type: none"> <li>(a) set out the Works</li> <li>(b) verify conformance to the Drawings and Specification in relation to dimensions, tolerances and three dimensional position</li> <li>(c) determine lengths, areas or volumes of materials or products, where required for measurement of work.</li> </ul>      | <p><b>Requirements</b></p>            |
| <p>2. The Contractor shall appoint qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all Surveying Control.</p>   | <p><b>Surveyor Qualifications</b></p> |
| <p>3. The procedures and equipment used must be capable of attaining the tolerances nominated in the Specification.</p>   | <p><b>Equipment</b></p>               |
| <p>4. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.</p>  | <p><b>Sampling Locations</b></p>      |
| <p>5. The Contractor shall submit a Survey Conformance Report to the Superintendent for each lot or component where design levels, position and/or tolerances have been specified. The Survey Conformance Report shall show 'specified vs actual' for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.</p> | <p><b>Conformance Report</b></p>      |

#### CQC5 RECORDS

- |  |                       |
|--|-----------------------|
| <p>1. Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.</p> | <p><b>Storage</b></p> |
|--|-----------------------|

## **QUALITY CONTROL REQUIREMENTS**

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2. The Contractor shall submit all conformance records to the Superintendent for inspection and approval. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the Principal.

***Copies of  
Records  
Contractor's  
Cost***

**CQC6      WITHDRAWN**

## ANNEXURES

### ANNEXURE CQC-A RANDOM SAMPLING

#### CQC-A1 GENERAL

1. Random sampling of test locations shall be used to control all elements of construction as detailed in Annexure CQCB.
2. By arrangement with the Superintendent, areas which are not (generally) rectangular may be notionally rearranged to suit the method of determining sample locations as described in hereunder.

#### CQC-A2 SAMPLING RATES EARTHWORKS & PAVEMENTS

1. The number of samples (n) per lot shall not be less than shown in Table CQC-A1.

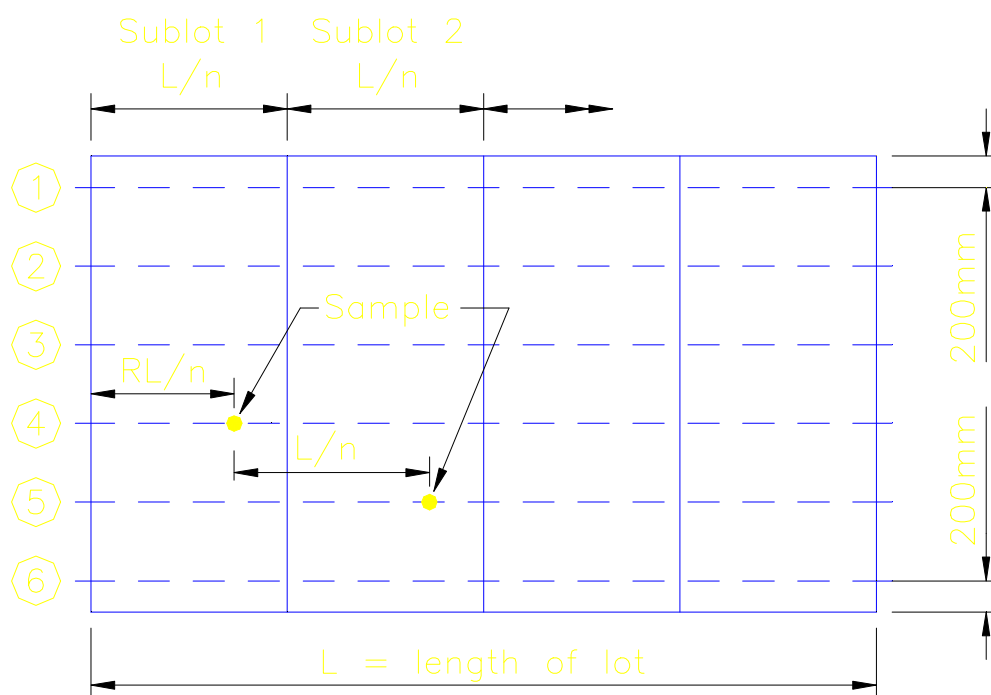
LOT SIZE	MINIMUM NUMBER OF SAMPLES PER LOT	
	Each continuous layer of earthworks	Each continuous layer of selected material zone or pavement layers
$> 5000\text{m}^2$	The greater of: 6 samples or 1 sample per $2000\text{m}^2$	The greater of: 10 samples or 1 sample per $1000\text{m}^2$
$1000\text{m}^2$ to $5000\text{m}^2$	5	The greater of: 5 samples or 1 sample per $500\text{m}^2$
$200\text{m}^2$ to $1000\text{m}^2$	3	3
$< 200\text{m}^2$	1	1

**Table CQC-A1 - Sampling Rates Earthworks and Pavements**



**CQC-A3      RANDOM SAMPLING LOCATIONS**

1. Sampling locations within a lot for the control of relative compaction shall be determined as follows:
  - (i) Representing the lot as a rectangle, sub-divide the lot lengthwise into equi-area sub-lots in accordance with the number of samples selected (n) in accordance with Table CQC-A1.
  - (ii) Establish six grid lines within the lot, as illustrated in Figure CQC-A2;
  - (iii) Throw a die to select a number between 1 and 6. This determines which grid line to use for the sample location in sub-lot 1;
  - (iv) Throw die to select a group (1-6) in Table CQC-A2;
  - (v) Throw die twice to select two random numbers (between 1 and 6) for row and column in Table CQC-A2 and obtain random fraction R;
  - (vi) Length co-ordinate for sample location in Sub-lot 1 =  $RL/n$ ;
  - (vii) For sample location in next sub-lot:-  
Add  $L/n$  to previous length co-ordinate.  
Add 1 (on a cycle of 6) to previous grid line.



**Figure CQC-A2 — Sampling Locations for Rectangular Lot**

GROUP	ROW	COLUMN					
		(1)	(2)	(3)	(4)	(5)	(6)
(1)	(1)	0.78178	0.45467	0.00347	0.27296	0.00020	0.36517
	(2)	0.59678	0.67931	0.25434	0.59054	0.32444	0.41504
	(3)	0.14464	0.17269	0.61154	0.18291	0.83242	0.50776
	(4)	0.89010	0.44764	0.07451	0.20428	0.49513	0.91440
	(5)	0.91941	0.47726	0.33160	0.30670	0.65114	0.36852
	(6)	0.51085	0.38148	0.22169	0.66578	0.67050	0.69559
(2)	(1)	0.81891	0.48626	0.88892	0.82994	0.16941	0.81528
	(2)	0.37410	0.60232	0.12070	0.79017	0.32981	0.34908
	(3)	0.45921	0.15648	0.58052	0.37413	0.08124	0.97145
	(4)	0.86614	0.94719	0.78872	0.91972	0.45149	0.15107
	(5)	0.26590	0.41140	0.95477	0.81267	0.24018	0.07324
	(6)	0.95205	0.39438	0.73697	0.59427	0.71146	0.00575
(3)	(1)	0.18694	0.36502	0.17828	0.84312	0.57003	0.58583
	(2)	0.91211	0.86936	0.43030	0.27672	0.47393	0.10342
	(3)	0.80714	0.34295	0.00775	0.90855	0.33368	0.21842
	(4)	0.67579	0.92686	0.18005	0.00645	0.11256	0.05278
	(5)	0.03184	0.69876	0.16676	0.43346	0.86992	0.03275
	(6)	0.15623	0.02905	0.72763	0.19095	0.80847	0.39729
(4)	(1)	0.72109	0.17970	0.22505	0.35561	0.98935	0.27818
	(2)	0.37348	0.19381	0.43331	0.75033	0.99963	0.42232
	(3)	0.12129	0.32386	0.56705	0.87165	0.84460	0.92955
	(4)	0.54948	0.08844	0.47061	0.78419	0.18731	0.93485
	(5)	0.15097	0.44967	0.48759	0.84161	0.19212	0.05146
	(6)	0.32360	0.66850	0.99382	0.94050	0.96449	0.96217
(5)	(1)	0.68091	0.54191	0.10910	0.94237	0.23161	0.15167
	(2)	0.97121	0.83626	0.70896	0.45296	0.69475	0.11264
	(3)	0.19723	0.98260	0.57429	0.94789	0.64457	0.20809
	(4)	0.84036	0.14095	0.29451	0.40256	0.34521	0.64924
	(5)	0.97500	0.98056	0.82276	0.97130	0.77329	0.89855
	(6)	0.83244	0.30828	0.06882	0.68471	0.71081	0.91649
(6)	(1)	0.75892	0.29685	0.70044	0.91238	0.53356	0.45239
	(2)	0.13229	0.19701	0.36074	0.32254	0.62045	0.26691
	(3)	0.34789	0.22179	0.91891	0.87651	0.91011	0.97469
	(4)	0.97211	0.68943	0.12831	0.50006	0.20793	0.61151
	(5)	0.24954	0.17809	0.56093	0.51524	0.69135	0.68967
	(6)	0.10062	0.11852	0.47089	0.64765	0.44644	0.35548

Table CQC-A2 - Table of Random Fractions

**ANNEXURE CQC-B**  
**MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**

**GENERAL**

1. The maximum lot sizes and minimum test frequencies are separately specified for all major activities covered by the Technical Specifications as listed hereunder.
2. The requirements applicable to this Contract are identified with an asterisk indicating that only these details are attached in this Annexure.
3. Where material/product quality certification can be obtained from the supplier, tests listed per contract/separable part need not be repeated.

**Contents of Annexure CQC-B**

Item	Sub-Annexure	Required (*) for this Contract	Reference Specification	Sub-Annexure Heading
1	B1		C213	Earthworks
2	B2		C220 C221 C222 C223 C224	Stormwater Drainage - Pipe Culverts, Box Culverts, Open Drains, Kerb & Gutter, Drainage Structures
3	B3		C230 C231 C232 C233	Subsurface Drainage
4	B4		C241	Stabilisation
5	B5		C242	Flexible Pavements
6	B6		C244	Sprayed Bituminous Surfacing
7	B7		C245	Asphaltic Concrete
8	B8		C247 C248	Ready Mixed Concrete Production and Supply
9	B9		C247	Mass Concrete Subbase
10	B10		C248	Plain or Reinforced Concrete Base
11	B11		C255	Bituminous Microsurfacing
12	B12		C254	Segmental Paving
13	B13		C271	Minor Concrete Works
14	B14		C261	Pavement Markings
15	B15		C262	Signposting
16	B16		C273	Landscaping
17	B17		C401	Water Reticulation
18	B18		C402	Sewerage System

**Sub-Annexure B1  
EARTHWORKS (Specification C213)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Stripping Topsoil	Surface Levels	20,000m <sup>2</sup>	1 Cross Section at each design	Survey
Excavation	Geometry	20,000m <sup>2</sup>	1 Cross Section at each design	Survey
Floor of Cuttings	Material Quality - CBR Compaction	10,000m <sup>2</sup> 10,000m <sup>2</sup>	1 per 2,000m <sup>2</sup> * Table A1- Annexure CQC-A	T117A T166 AS1289.F1.1
Foundation for Embankments	Compaction	20,000m <sup>2</sup>	Table A1- Annexure CQC-A	T166
Embankments - General	Geometry  Material Quality - CBR  Compaction/Moisture Content	One layer 20,000m <sup>2</sup>  One layer 20,000m <sup>2</sup>  One layer 20,000m <sup>2</sup>	1 Cross Section at each design  1 per 1,000m <sup>3</sup>  Table A1- Annexure CQC-A	Survey  T117A AS1289.F1.1  T166 AS1289.5.1.1 AS1289.5.7.1
Road Carriageway Embankments - Select Zone	Geometry  Material Quality - Maximum Particle Size - CBR  Compaction/Moisture Content	One layer 20,000m <sup>2</sup>  10,000m <sup>2</sup> 10,000m <sup>2</sup>  One layer 10,000m <sup>2</sup>	1 Cross Section at each design  1 per 1,000m <sup>3</sup> * 1 per 500m <sup>3</sup> *  Table A1- Annexure CQC-A	Survey  T106 AS1289.F1.1 T117A  AS1289.5.1.1, T119, T120, T166
Fill Adjacent to Structures: Bridges, Retaining Walls and Cast-in-Situ Culverts	Material Quality - Maximum Particle Size - Plasticity Index  Compaction/Moisture Content	1 per Contract 1 per Contract  1 per Structure	1 per 200m <sup>3</sup> * 1 per 200m <sup>3</sup> *  2 per Structure	T106 AS1289.3.3.1  AS1289.5.1.1, T119, T120, T166

\* Note: or part thereof, per lot.

**Sub-Annexure B2**
**STORMWATER DRAINAGE - PIPE CULVERTS, BOX CULVERTS, OPEN DRAINS  
INCLUDING KERB & GUTTER, DRAINAGE STRUCTURES  
(Specifications C220, C221, C222, C223, C224)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Supply of Precast Units	Precast Quality - Suppliers documentary evidence and certification	1 delivery	1 per type/size/ class per delivery	
Siting and Excavation	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Foundation	Compaction	1 drainage line/structure	1 per 20 lin m *	T166
Material surrounding Steel Structures	Material Quality - pH/Electrical Resistivity	1 drainage line/structure	1 per material	AS1289D3.1 AS1289.D4.1
Bedding	Material Quality - Particle Size Distribution Compaction/Moisture Content	1 per contract 1 per drainage line/structure	1 per 200m <sup>3</sup> * 1 per layer, max 100m <sup>2</sup>	AS1141.11 AS1289.5.7.1, T166
Concrete Bedding or Lining	Refer 'Minor Concrete Works'			
Installation of Precast Units	Geometry	1 per drainage line/structure	1 per drainage line/structure	Survey
Selected Backfill	Material Quality - Maximum Particle Size - Plasticity Index Compaction/Moisture Content	1 per contract 1 per contract 1 per drainage line/structure	1 per 200m <sup>3</sup> * 1 per 200m <sup>3</sup> * 1 per 2 layers max 100m <sup>2</sup>	T106 AS1289.3.3.1 AS1289.5.7.1, T166
Rock Fill for Gabions/ Wire Mattresses	Material Quality: - Particle Size Distribution - Wet Strength - Wet/Dry Strength Variation	1 per contract 1 per contract 1 per contract	1 per 200m <sup>3</sup> 1 per contract 1 per contract	AS1141.11 AS1141.22 AS1141.22
Kerb and Gutter	Geometry		1 Cross Section per 10m	Survey and 3m Straight Edge

\* Note: or part thereof, per lot.

**Sub-Annexure B3**

**SUBSURFACE DRAINAGE (Specifications C230, C231, C232, C233)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Material Supply	Material Quality - Supplier's documentary evidence and certification of:  Pipe  Filter Material - Grading (Type A, B, C, D) - Coefficient of Permeability (Type B) - Grading Variation after Treatment (Type B) - Wet Strength (Type C, D) - 10% Fines Wet/Dry (Type C, D) Geotextile	1 per contract/size   1 per contract/size 1 per contract/size 1 per contract/size 1 per contract/size 1 per contract/size 1 per contract	1 per type/size   1 per type 1 per type 1 per type 1 per type 1 per type	AS1141.11   AS1289.E5.1 ASTM-D2434-68 T102, T103, AS1141.11 AS1141.22 AS1141.22
Excavation - Trench Base	Line and Grade  Compaction	1 per drainage line  1 per drainage line	1 per drainage line  1 per 200 lin m*	Survey  AS1289
Bedding and Backfill				
- Filter Material	Compaction	1 per drainage line	1 per 100 lin m*	AS1289
- Selected Backfill	Compaction	1 per drainage line	1 per 100 lin m*	AS1289
- Earth Backfill	Compaction	1 per drainage line	1 per 100 lin m*	AS1289
Drainage Mat	Geometry	2000m <sup>2</sup>	1 Design Cross Section	Survey

\* Note: or part thereof, per lot

## Sub-Annexure B4

### STABILISATION (Specification C241)

\* Note: or part thereof, per lot.

**Sub-Annexure B5**  
**FLEXIBLE PAVEMENTS (Specification C242)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Base and Subbase Supply	<p>Material Quality - Supplier's documentary evidence and certification</p> <ul style="list-style-type: none"> <li>- Particle Size Distribution</li> <li>- Fine Particle Size Distribution Ratio</li> <li>- Liquid Limit</li> <li>- Plastic Limit</li> <li>- Plasticity Index</li> <li>- CBR</li> <li>- Maximum Dry Compressive Strength</li> <li>- Particle Shape</li> <li>- Aggregate Wet Strength</li> <li>- Wet/Dry Strength Variation</li> <li>- Modified Texas Triaxial Classification</li> <li>- Unconfined Compressive Strength (Modified)</li> <li>- Unconfined Compressive Strength (Bound)</li> </ul>	1 contract/ material type	<p>1 per 1,000t*</p> <p>1 per 1,000t*</p> <p>1 per 1,000t*</p> <p>1 per 1,000t*</p> <p>1 per 1,000t*</p> <p>1 per 1,000t*</p> <p>1 per 5,000t*</p> <p>1 per 5,000t*</p> <p>1 per 5,000t*</p> <p>1 per 5,000t*</p> <p>1 per contract</p> <p>1 per 5,000t*</p> <p>1 per 1,000t*</p>	<p>T106</p> <p>T107</p> <p>T108</p> <p>AS1289.3.3.1</p> <p>AS1289.3.3.1</p> <p>AS1289.F1.1</p> <p>T114</p> <p>AS1141.14</p> <p>AS1141.22</p> <p>AS1141.22</p> <p>T171</p> <p>T116</p> <p>T131</p>
Placement	<p>Geometry</p> <p>Deflection Control - Benkelman Beam</p> <p>Compaction/Moisture Content</p>	<p>One layer 5,000m<sup>2</sup> max 1 day's placement</p> <p>One layer 5,000m<sup>2</sup> max 1 day's placement</p> <p>One layer 5,000m<sup>2</sup> max 1 day's placement</p>	<p>1 Design Cross Section</p> <p>10 per 100 lin m* per lane</p> <p>1 per 30 lin m per lane minimum 6 per lot</p> <p>Table A1- Annexure CQC-A</p>	<p>Survey</p> <p>3m Straight Edge</p> <p>T160</p> <p>AS1289.5.2.1, T119, T120, T130, AS1289.5.8.1</p>

\* Note: or part thereof, per lot.



**Sub-Annexure B6**  
**SPRAYED BITUMINOUS SURFACING (Specification C244)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	<p>Material Quality - Suppliers documentary evidence and certification of:</p> <ul style="list-style-type: none"> <li>- Class 170 Bitumen</li> <li>- Class 320 Bitumen</li> <li>- Refinery Cutback Bitumen</li> <li>- Polymer Modified Binder</li> <li>- Bitumen Adhesion Agent</li> <li>- Cutback Oils</li> <li>- Aggregate Precoating Agent</li> <li>- Aggregate <ul style="list-style-type: none"> <li>· Grading</li> <li>· ALD</li> <li>· Wet Strength</li> <li>· 10% Fines Wet/Dry</li> <li>· Particle Shape</li> <li>· Fractured Faces</li> <li>· Stripping</li> <li>· Initial Adhesion</li> <li>· Polished Agg Friction V.</li> </ul> </li> </ul>	<p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per delivery</p> <p>1 per delivery/ tanker</p> <p>1 per delivery/ tanker</p> <p>1 stockpile</p> <p>1 stockpile</p> <p>1 per contract</p> <p>1 per contract</p> <p>1 per contract</p> <p>1 per contract</p> <p>1 per contract</p> <p>1 per contract</p> <p>1 per contract</p>	<p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per tanker load</p> <p>1 per delivery</p> <p>1 per delivery/ tanker</p> <p>1 per delivery/ tanker</p> <p>1 per 400m<sup>3</sup> *</p> <p>1 per 200m<sup>3</sup> *</p> <p>†</p> <p>†</p> <p>†</p> <p>†</p> <p>†</p> <p>†</p> <p>†</p> <p>†</p>	<p>AS1141.11</p> <p>T235</p> <p>AS1141.22</p> <p>AS1141.22</p> <p>AS1141.14</p> <p>T239</p> <p>T230</p> <p>T238</p> <p>AS1141.41</p>
Application Rates	<p>Binder</p> <p>Aggregate</p>	<p>1 day's operation</p> <p>1 day's operation</p>	<p>Calculate per spray run</p> <p>Calculate per spray run</p>	

† One per Contract or change in material

\* Note: or part thereof, per lot

**Sub-Annexure B7**  
**ASPHALTIC CONCRETE (Specification C245)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	<p>Material Quality - Supplier's documentary evidence and certification of:</p> <ul style="list-style-type: none"> <li>- Coarse &amp; Fine Aggregates <ul style="list-style-type: none"> <li>· Grading</li> <li>· Moisture Content</li> <li>· Wet Strength</li> <li>· 10% Fines Wet/Dry</li> <li>· Particle Shape</li> <li>· Fractured Faces</li> <li>· Resistance to Stripping</li> <li>· Polishing Agg Friction Value</li> </ul> </li> <li>- Mineral Filler</li> <li>- Class 170/320 Bitumen <ul style="list-style-type: none"> <li>· Viscosity at 60°C</li> <li>· Penetration at 15°C</li> <li>· Viscosity at 135°C</li> <li>· Flash point (°C)</li> <li>· Insoluble matter</li> <li>· Rolling thin film oven test <ul style="list-style-type: none"> <li>(a) Ductility, residue, 15°C</li> <li>(b) Viscosity, residue, 60°C or</li> <li>(c) App. viscosity, residue, 25°C</li> </ul> </li> <li>· Thin film oven test (1.6mm) <ul style="list-style-type: none"> <li>(a) Ductility, residue, 25°C</li> </ul> </li> <li>· Density at 15°C</li> <li>· Water Content and Foaming at 175°C</li> </ul> </li> <li>- Scrap Rubber/C170 Bitumen Mixture <ul style="list-style-type: none"> <li>· Minimum Recovery</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>1 wk's prod'n</li> <li>1 wk's prod'n</li> <li>1 per contract</li> <li>1 per contract</li> <li>1 per contract</li> <li>1 per contract</li> <li>1 per contract</li> <li>1 per contract</li> <li>1 mth's prod'n</li> <li>1 wk's production</li> <li>1 per contract</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>1 day's operation</li> </ul>	<ul style="list-style-type: none"> <li>1 per day</li> <li>1 per day</li> <li>)</li> <li>) 1 per</li> <li>) contract</li> <li>) or change in</li> <li>) material</li> <li>)</li> <li>1 per month</li> <li>1 per tanker load</li> <li>1 per contract or change in supplier</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>1 per tanker load</li> </ul>	<ul style="list-style-type: none"> <li>AS1141.11</li> <li>T120</li> <li>AS1141.22</li> <li>AS1141.22</li> <li>AS1141.14</li> <li>T239</li> <li>T230</li> <li>AS1141.41</li> <li></li> <li>AS2341.2</li> <li>AS2341.12</li> <li>AS2008</li> <li>AS2341.14</li> <li>AS2341.8</li> <li>AS2008</li> <li>AS2341.11</li> <li>AS2341.2</li> <li></li> <li>AS2008,</li> <li>AS2341.5</li> <li>AS2008</li> <li>AS2341.11</li> <li>AS2341.7</li> <li>T501</li> <li></li> <li>T1180</li> </ul>

**QUALITY CONTROL REQUIREMENTS**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply (Cont'd)	<ul style="list-style-type: none"> <li>- Polymer Modified Bitumen                             <ul style="list-style-type: none"> <li>(i) SBS Modified Bitumens                                     <ul style="list-style-type: none"> <li>· Elasticity Recovery at 60°C</li> <li>· Viscosity on ER at 60°C</li> <li>· Torsional Recovery at 25°C</li> <li>· Viscosity at 135°C</li> <li>· Segregation</li> <li>· Flash Point (°C)</li> <li>· Softening Point (°C)</li> <li>· Ductility 4°C after RTFO</li> <li>· Penetration at 25°C</li> </ul> </li> <li>(ii) EVA Modified Bitumens                                     <ul style="list-style-type: none"> <li>· Elasticity Recovery at 45°C</li> <li>· Viscosity by Elastomer at 45°C</li> <li>· Torsional Recovery at 25°C</li> <li>· Softening Point (°C)</li> <li>· Viscosity at 135°C</li> <li>· Ductility 4°C after RTFO</li> <li>· Penetration at 25°C</li> </ul> </li> </ul> </li> <li>- Bitumen Adhesion Agent                             <ul style="list-style-type: none"> <li>· Resistance to Stripping</li> </ul> </li> <li>- Scrap Rubber                             <ul style="list-style-type: none"> <li>· Grading</li> <li>· Shape/Length</li> <li>· Foaming (%)</li> <li>· Moisture Content (%)</li> <li>· Iron Content (%)</li> <li>· Bulk Density (%)</li> </ul> </li> <li>- Bitumen Emulsion</li> </ul>	<ul style="list-style-type: none"> <li>1 week's operation</li> <li>"</li> <li>1 contract</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>1 week's operation</li> <li>"</li> <li>1 contract</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>1 contract</li> <li>1 week's production</li> <li>"</li> <li>1 contract</li> <li>"</li> <li>"</li> <li>"</li> <li>1 contract</li> </ul>	<ul style="list-style-type: none"> <li>1 per tanker load</li> <li>"</li> <li>1 per grade per contract or change in supplier</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>"</li> <li>1 per tanker load</li> <li>"</li> <li>1 per grade per contract or change in supplier</li> <li>"</li> <li>"</li> <li>"</li> <li>1 per contract or change in material</li> <li>1 per contract or change in supplier</li> <li>"</li> <li>"</li> <li>"</li> <li>1 per tanker load/bulk delivery</li> </ul>	<ul style="list-style-type: none"> <li>T741</li> <li>T741</li> <li>T739</li> <li>AS2341.3</li> <li>T740</li> <li>AS2341.14</li> <li>AS2341.18</li> <li>AS2341.10,</li> <li>AS2341.11</li> <li>ASTM, D5</li> <li>T741</li> <li>T741</li> <li>T739</li> <li>AS2341.18</li> <li>AS2341.3</li> <li>AS2341.10,</li> <li>AS2341.11</li> <li>ASTM, D5</li> <li>T230</li> <li>T734</li> <li>T731</li> <li>T732</li> <li>T733</li> <li>RTA Spec 3254</li> </ul>
Mix Design	Approval of mix and NATA certification. Supplier's documentary evidence and certification	1 mix	1 per mix	

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Production Mix	Temperature Sampling Moisture Content Grading Binder Content Voids in Compacted Mix Maximum Theoretical Density	) ) 1 day's ) production ) per site, ) max 500t ) )	1 per truck load 1 per 50t 1 per 50t* 1 per 50t* 1 per 50t* 1 per 50t* 1 per 50t*	Measure  AS2150 T607 T607 T601,AS1507, T606 AS1507
Laying	Temperature  Levels  Surface Quality  Relative Compaction/Layer Thickness	1 day's laying per site, max 500t  1 layer, max 500t  1 layer, max 500t  1 layer, max 500t	1 per truck load  1 cross section per 15m  10 per 100m* lane length  Table A1 Annexure CQC-A	Measure  Survey  3m Straight Edge  T601, T606

\* Note: or part thereof, per lot

**Sub-Annexure B8  
READY-MIXED CONCRETE PRODUCTION & SUPPLY  
(Specifications C247, C248)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Raw Materials Supply	Material Quality - Supplier's documentary evidence and certification of:-			
	Cement	1 mth's prod'n	1 per week	AS 3972
	Flyash	1 mth's prod'n	1 per month	AS 3582.1
	Water	1 contract	1 per contract	T1004, AS1289.D2.1
	Admixtures	1 mth's prod'n	1 per month	AS 1478
	Fine Aggregates			
	- Grading	1 wk's prod'n	1 per 200m <sup>3</sup> concrete*	AS1141.11
	- Moisture Content	1 wk's prod'n	1 per day	
	- Sulphate Soundness	1 contract	1 per contract	AS1141.24
	- Bulk Density	1 contract	1 per contract	AS 2758.1
	- Unit Mass	1 contract	1 per contract	AS 2758.1
	- Water Absorption	1 contract	1 per contract	AS 2758.1
	- Material Finer 2µm	1 contract	1 per contract	AS 2758.1
	- Deleterious Material (Impurities/Reactive)	1 contract	1 per contract	AS 2758.1
	Coarse Aggregates			
	- Grading	1 wk's prod'n	1 per 200m <sup>3</sup> concrete*	AS1141.11
	- Moisture Content	1 wk's prod'n	1 per day	
	- Wet Strength	1 contract	1 per contract	AS1141.22
	- 10% Fines Wet/Dry	1 contract	1 per contract	AS1141.22
	- Abrasion (Los Angeles)	1 contract	1 per contract	AS1141.23
	- Sulphate Soundness	1 contract	1 per contract	AS1141.24
	- Particle Shape	1 contract	1 per contract	AS1141.14
	- Fractured Faces	1 contract	1 per contract	T239
	- Bulk Density	1 contract	1 per contract	AS 2758.1
	- Unit Mass	1 contract	1 per contract	AS 2758.1
	- Water Absorption	1 contract	1 per contract	AS 2758.1
	- Material Finer 75µm	1 contract	1 per contract	AS 2758.1

**QUALITY CONTROL REQUIREMENTS**

<b>ACTIVITY</b>	<b>KEY QUALITY VERIFICATION REQUIREMENTS</b>	<b>MAXIMUM LOT SIZE</b>	<b>MINIMUM TEST FREQUENCY</b>	<b>TEST METHOD</b>
Raw Materials Supply (Cont'd)	- Weak Particles	1 contract	1 per contract	AS 2758.1
	- Light Particles	1 contract	1 per contract	AS 2758.1
	- Deleterious Materials (Impurities/Reactive)	1 contract	1 per contract	AS 2758.1
	- Iron Unsoundness	1 contract	1 per contract	AS 2758.1
	- Falling/Dusting Unsoundness	1 contract	1 per contract	AS 2758.1
Mix Design	Compressive Strength	1 contract mix	1 per mix per contract	AS1012.14
	Aggregate Moisture Content	1 contract mix	1 per mix per contract	
	Consistency - Slump	1 contract mix	1 per mix per contract	AS1012.3
	Air Content	1 contract mix	1 per mix per contract	T320
	Shrinkage	1 contract mix	1 per mix per contract	T321

\* Note: or part thereof, per lot

**Sub-Annexure B9  
MASS CONCRETE SUBBASE (Specification C247)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Concrete Supply	Refer Sub-Annexure C8: Concrete Production and Supply			
	Concrete/Air Temperature	50m <sup>3</sup>	1 per 50m <sup>3*</sup>	Measure
	Air Content	50m <sup>3</sup>	1 per 50m <sup>3*</sup>	AS1012.4 Method 2
	Consistency - Slump	50m <sup>3</sup>	1 per load	AS1012.3 Method 1
	Compressive Strength (7 day)	50m <sup>3</sup>	1 pair per 50m <sup>3*</sup>	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m <sup>3</sup>	1 pair per 50m <sup>3*</sup>	AS1012.1 AS1012.8 AS1012.9
Placement	Thickness	50m <sup>3</sup>	5m grid on plan area	Survey and
	Geometry	50m <sup>3</sup>	1 cross section per 15m	Survey and 3m Straight Edge
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	T864
	Application Rate	1 day's work	1 per 500m <sup>2*</sup>	
Joints	Geometry	50m <sup>3</sup>	All joints	Survey

\* Note: or part thereof, per lot

**Sub-Annexure B10**

**PLAIN OR REINFORCED CONCRETE BASE (Specification C248)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Concrete Supply	Refer Sub-Annexure C8: Concrete Production and Supply			
	Concrete/Air Temperature	50m <sup>3</sup>	1 per 50m <sup>3</sup> *	Measure
	Air Content	50m <sup>3</sup>	1 per 50m <sup>3</sup> *	AS1012.4 Method 2
	Consistency - Slump	50m <sup>3</sup>	1 per load	AS1012.3 Method 1
	Compressive Strength (7 day)	50m <sup>3</sup>	1 pair per 50m <sup>3</sup> *	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m <sup>3</sup>	1 pair per 50m <sup>3</sup> *	AS1012.1 AS1012.8 AS1012.9
Placement	Relative Compaction			
	- Machine Placed	50m <sup>3</sup>	1 per 50m <sup>3</sup> *	AS1012.14
	- Hand Placed	50m <sup>3</sup>	2 per lot	AS1012.14
	Thickness	50m <sup>3</sup>	5m grid on plan area	Survey
	Geometry	50m <sup>3</sup>	1 cross section per 15m	Survey and 3m Straight Edge
Ride Quality	Profile Factor	50m <sup>3</sup>	All lanes	T179
Surface Texture	Texture Depth	50m <sup>3</sup>	2 per 50m <sup>3</sup>	T240
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	T864
	Application Rate	1 day's work	1 per 500m <sup>2</sup> *	
Joints	Sealant Material Quality Supplier's documentary evidence and certification	1 contract	1 per prod'n batch	
	Geometry	50m <sup>3</sup>	All joints	Survey

\* Note: or part thereof, per lot



**Sub-Annexure B11  
BITUMINOUS MICROSURFACING (Specification C255)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	<p>Material Quality - Supplier's documentary evidence and certification of:</p> <ul style="list-style-type: none"> <li>- Bitumen (prior to emulsification)</li> <li>- Bitumen Emulsion <ul style="list-style-type: none"> <li>· Residual Binder Content (Residue from Evaporation)</li> </ul> </li> <li>- Mineral Aggregates <ul style="list-style-type: none"> <li>· Degradation Factor</li> <li>· Los Angeles Value</li> <li>· Aggregate Wet Strength</li> <li>· Wet/Dry Strength Variation</li> <li>· Polished Aggregate Friction Value</li> <li>· Sand Equivalent</li> </ul> </li> <li>- Mineral Filler</li> <li>- Combined Aggregate Grading</li> </ul>	<p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 month's prod'n</p> <p>1 contract</p>	<p>1 per contract or change in material</p> <p>1 per delivery</p> <p>1 per source</p> <p>1 per source</p> <p>1 per source</p> <p>1 per source</p> <p>1 per source</p> <p>1 per source</p> <p>1 per month</p> <p>1 per 200m<sup>3</sup>*</p>	<p>AS1160, App.D</p> <p>AS1141.25</p> <p>AS1141.23</p> <p>AS1141.22</p> <p>AS1141.22</p> <p>AS1141.42</p> <p>AS1289.C7.1</p> <p>AS1141.11, AS1141.12</p>
Mix Design	Approval of mix and NATA certification - Supplier's documentary evidence and certification	1 mix	1 per mix	
Production Mix	<p>Grading</p> <p>Residual Binder Content</p>	<p>1 day's prod'n</p> <p>max 50m<sup>3</sup></p>	<p>1 per 50m<sup>3</sup>*</p> <p>1 per 50m<sup>3</sup>*</p>	<p>AS2891.3.1</p> <p>AS2891.3.1</p>
Laying	<p>Levels</p> <p>Surface Quality</p>	<p>1 layer, max 200m<sup>3</sup></p> <p>1 layer, max 200m<sup>3</sup></p>	<p>1 cross section per 15m</p> <p>10 per 100m* lane length</p>	<p>Survey</p> <p>3m Straight Edge</p>

\* Note: or part thereof, per lot

**Sub-Annexure B12**  
**SEGMENTAL PAVING (Specification C254)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	<p>Material Quality - Supplier's documentary evidence and certification of:</p> <ul style="list-style-type: none"> <li>- Concrete Segmental Paving Units</li> <li>- Clay Segmental Paving Units</li> <li>- Bedding Sand <ul style="list-style-type: none"> <li>· Grading</li> </ul> </li> <li>- Joint Filling Sand <ul style="list-style-type: none"> <li>· Grading</li> </ul> </li> <li>- Joint Filler</li> </ul>	<p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p> <p>1 contract</p>	<p>1 per contract</p> <p>1 per contract</p> <p>1 per contract or change in material</p> <p>1 per contract or change in material</p> <p>1 per contract</p>	<p>AS1141.11</p> <p>AS1141.11</p>
Base	<p>Geometry</p> <p>Surface Quality</p>	<p>One layer 5000m<sup>2</sup>, max 1 day's placement</p> <p>"</p>	<p>One cross section per 15m</p> <p>10 per 50m per lane/paving length*</p>	<p>Survey</p> <p>3m Straight Edge</p>
Edge Restraints	Refer 'Minor Concrete Works'			
Laying Paver Units	<p>Joint Width</p> <p>Geometry</p> <p>Surface Quality</p>	<p>1 day's placement</p> <p>1 day's placement</p> <p>1 day's placement</p>	<p>All joints</p> <p>One cross section per 15m</p> <p>10 per 50m per lane/paving length*</p>	<p>Measure</p> <p>Survey</p> <p>3m Straight Edge</p>

\* Note: or part thereof, per lot

**Sub-Annexure B13  
MINOR CONCRETE WORKS (Specification C271)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Subgrade	Compaction	1000 lin m or 1000m <sup>2</sup>	1 per 200 lin m or 200m <sup>2</sup>	AS1289.5.7.1
Gravel Subbase Construction	Compaction	1 day's placement	1 per 100 lin m or 100m <sup>2</sup>	AS1289.5.7.1
	Subbase Geometry	1 day's placement	1 per 15 lin m	3m Straight Edge
Steel Supply	Material Quality - Suppliers documentary evidence and certification	1 delivery	1 per production batch	
Ready-Mixed Concrete Supply	Material Quality - Suppliers documentary evidence and certification	1 contract	1 per mix type	
	Consistency - Slump	15m <sup>3</sup>	1 per load	AS1012.3 Method 1
	Compressive Strength (7 and 28 day)	15m <sup>3</sup>	2 pairs per 15m <sup>3</sup>	AS1012.1, AS1012.8, AS1012.9
Concrete Placement	Finished Levels	15m <sup>3</sup>	1 cross section per 15m	Survey and 3m Straight Edge
Backfilling	Material Quality			
	- Maximum particle size	1 contract/ material type	1 per 200m <sup>3</sup> *	T106
	- Plasticity Index	1 contract/ material type	1 per 200m <sup>3</sup> *	AS1289.3.3.1
	Compaction	1 structure, max 200m <sup>3</sup>	1 per layer, max 200m <sup>2</sup> *	AS1289.5.7.1
Sprayed Concrete	Test Panels and Cores	1 contract	3 test panels and 4 cores per mix design	AS1012.4, AS1012.9 AS1012.14
	Compressive Strength Cores	15m <sup>3</sup>	2 per 15m <sup>3</sup>	AS1012.4, AS1012.9 AS1012.14
	Curing Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	

\* Note: or part thereof, per lot

**Sub-Annexure B14**  
**PAVEMENT MARKINGS (Specification C261)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	- Paint	1 contract	1 per contract or change in material	
	- Glass Beads	1 contract	"	
	- Thermoplastic Material	1 contract	"	
	- Raised Pavement Markers	1 contract	"	
Paint Application	Wet Film Thickness	1 contract	1 per site visit or change in pressure settings	Annexure C261A
	Application Rate of Glass Beads	1 contract	1 per site visit or change in pressure settings	Annexure C261B
Thermoplastic Application	Cold Film Thickness	1 contract	1 per site visit or change in pressure settings	Measure by micrometer
	Application Rate of Glass Beads	1 contract	1 per site visit or change in pressure settings	Annexure C261B

**Sub-Annexure B15  
SIGNPOSTING (Specification C262)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	- Sign Blanks	1 contract	1 per contract, or change in material	
	- Aluminium Extrusion Backing	1 contract	"	
	- Retro-reflective Material	1 contract	"	
	- Non-reflective Paint	1 contract	"	
	- Non-reflective Sheet Material	1 contract	"	
	- Steel Sign Support Structures	1 contract	"	
Concrete Foundations	Refer 'Minor Concrete Works'			

**Sub-Annexure B16**  
**LANDSCAPING (Specification C273)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Imported Topsoil	Material Quality			AS4419
	- pH	10,000m <sup>2</sup>	1 per 500m <sup>3</sup>	
	- Organic Content	10,000m <sup>2</sup>	1 per 500m <sup>3</sup>	
	- Soluble Salt Content	10,000m <sup>2</sup>	1 per 500m <sup>3</sup>	

**Sub-Annexure B17  
WATER RETICULATION (Specification C401)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:  - uPVC Pipes - Ductile Iron Pipes  - Copper Pipe - Polyethylene Pipe - Stop Valves Material - Non Return Valves - Spring Hydrants	1 contract 1 contract  1 contract 1 contract 1 contract 1 contract 1 contract	1 per contract " " " " " 1 per contract	AS2977 AS2280 and AS2129 AS1432 AS1159 AS2638 and AS2129 AS3578 AS2544 or AS3952
Siting and Excavation	Geometry	1 line	1 per line	Survey
Bedding	Material Quality - Grading	1 contract	1 per contract per source	AS2032
Thrust and Anchor Blocks	Refer Annexure C13			
Concrete Encasement	Refer Annexure C13			
Chamber Covers and Frames	Geometry	1 cover/frame	1 per cover/frame	survey
Testing of Pipelines	Pressure testing	1 line	1 per line	As specified C401.28
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m <sup>2</sup>	AS1289.5.7.1
Switchgear and Controlgear Assembly	Electrical function	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

**Sub-Annexure B18**  
**SEWERAGE SYSTEM (Specification C402)**

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:  - uPVC Pipes - Ductile Iron Pipes  - Vitrified Clay Pipes - Precast Access Chambers	1 contract 1 contract  1 contract 1 contract	1 per contract " " "	AS1477 AS2280 and AS2129 AS1741 AS4198
Siting and Excavation	Geometry	1 line/structure	1 per line/structure	Survey
Bedding	Material Quality - Grading	1 contract	1 per contract per source	T106
Concrete Bedding	Refer Annexure C13			
Laying and Jointing of Pipes, Access Chambers, Structures	Geometry	1 line	1 per line	Survey
Thrust and Anchor Blocks	Refer Annexure C13			
Concrete Encasement	Refer Annexure C13			
Cast-in-situ Access Chambers	Material Quality - Tri-Calcium Aluminate Content  - Fineness Index - Minimum Cement Content	1 contract 1 contract 1 contract	1 per contract per source " "	AS3972 AS3972 AS3972
Acceptance Test of Gravitation Mains and Access Chambers	- Compressed Air Testing  - Hydrostatic Testing	1 line  1 per test length Test length = 1370m pipeline dia.(mm)	1 per line  1 per line	As specified C402.36 C402.37 As specified C402.38
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m <sup>2</sup>	AS1289.5.7.1
Switchgear and Controlgear Assembly	Electrical Compliance	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	



# DEVELOPMENT CONSTRUCTION SPECIFICATION

**C101**  
Revision 3

**GENERAL**



## SPECIFICATION C101 - GENERAL

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## SPECIFICATION C101 : DEVELOPMENT CONSTRUCTION - GENERAL

### PROJECT SPECIFIC INFORMATION

#### C101.01 LOCATION AND DESCRIPTION OF PROJECT

1. *Location:*

2. *Description:*

3. *Access:*

#### C101.02 EXTENT OF WORK

1. Works under this Contract comprise the supply of labour, materials and plant to construct the Works. It includes but is not limited to the following items of construction which shall be carried out in their entirety in strict accordance with and to the true intent and purpose of, the Conditions of Contract, these Technical Specifications, the Drawings listed herein, and under the supervision of the Superintendent.

#### C101.03 WITHDRAWN

### GENERAL REQUIREMENTS

#### C101.04 DRAWINGS

1. The Drawings which form part of the Contract Documents are bound in a separate volume.

#### C101.05 STANDARDS AND TEST METHODS

1. Unless otherwise specified in the Contract, and where applicable, materials and workmanship shall be in accordance with the relevant standard of the Standards Association of Australia.

***Australian  
Standards***

2. A standard applicable to the Works shall be the edition last published 14 days prior to the closing date for tenders unless otherwise specified.

- |   |   |
|---|---|
| 3. Overseas standards and other standard documents named in the Specification shall be applicable in the same manner as Australian Standards to relevant materials and workmanship. | <b><i>Overseas Standards</i></b>        |
| 4. Copies of any standards quoted or referred to in the Specification shall be kept on the site if so specified.  | <b><i>Copies to be kept on Site</i></b> |
| 5. Where no suitable AS test methods are available, those of the relevant State Road Authority shall be used. These are designated T123 etc.  | <b><i>Other Test Methods</i></b>        |

#### **C101.06 TESTING AND SURVEY**

- |   |                                 |
|---|---------------------------------|
| 1. All testing and survey as required by the Technical Specifications shall be arranged and carried out by the Contractor and all test results and survey records made available to the Superintendent and Council. The cost of all such testing and survey shall be borne by the Contractor. | <b><i>Contractor's Cost</i></b> |
| 2. The minimum frequency of testing and survey shall be in accordance with the Specification for QUALITY CONTROL REQUIREMENTS.  | <b><i>Minimum Frequency</i></b> |

#### **C101.07 WORKING AREAS**

- |  |                                 |
|--|---------------------------------|
| 1. The Principal will not be responsible for the safe-keeping of any of the Contractor's plant, equipment, tools, materials or other property. The Contractor may provide, and pay for, any security fencing considered necessary around any office, workshop or storage area, subject to the Superintendent's approval.       | <b><i>Security</i></b>          |
| 2. If existing fencing is cut or altered by the Contractor, the Contractor shall provide and maintain temporary fencing to the satisfaction of the Superintendent during the Contract to prevent unauthorised entry into the property, and shall reinstate the fencing and remove temporary fencing on completion of the work. | <b><i>Temporary Fencing</i></b> |

#### **C101.08 SMOOTH JUNCTIONS**

- |   |  |
|---|--|
| 1. Construction work carried out under this Contract adjacent to or adjoining existing works, shall make smooth junctions with the existing work. |  |
|---|--|

#### **C101.09 SETTING OUT THE WORKS**

- |   |  |
|---|--|
| 1. The Superintendent will provide Permanent Marks as shown on the Drawings. The Superintendent will also establish bench marks related to the level datum.   | <b><i>Provision of Marks</i></b>   |
| 2. Before any of the given survey marks on the base lines or the various control lines are affected by the works, the Contractor shall transfer such survey marks to side positions clear of operations and shall note, and inform the Superintendent in writing, of the extent of such movement.   | <b><i>Transfer of Marks</i></b>  |
| 3. The Contractor shall give the Superintendent not less than two full working days' notice of the intention to perform any portion of the relocation of survey control, establishment of recovery pegs, or setting out or levelling, so that suitable arrangements can be made for checking of the work by the Superintendent. If no such notification is given and a control mark is disturbed or destroyed, then the cost of re-establishing the control shall be borne by the Contractor. | <b><i>Notice for Relocation</i></b><br><br><b><i>Contractor's Cost</i></b> |
| 4. The Contractor shall provide and fix adequate recovery pegs in suitable locations adjacent to the elements of work to enable location and construction to be checked.  | <b><i>Recovery Pegs</i></b>  |

5. All pegs and profiles placed by the Contractor shall be removed on completion of work unless otherwise directed by the Superintendent.

***Removal***

6. The Contractor shall always establish the level datum from the benchmark provided. Design levels are not to be interpolated from the natural surface.

***Datum  
Establishment***

#### **C101.10 SITE MEETINGS**

1. Regular site meetings will be held for the purpose of discussion of the progress and co-ordination of the work under the Contract and any matters of doubt regarding the intent or interpretation of the Drawings or the Specification. The Contractor shall arrange for relevant sub-contractors or their responsible representatives to be present at these meetings. The meetings will be held at a time nominated by the Superintendent.

***Represent-  
ation***

2. The Superintendent shall also give Council 48 hours notice of the date, time and location of the meetings. A Council representative may attend these meetings.

***Advice to  
Council***

3. The Superintendent or Superintendent's Representative shall chair site meetings, keep minutes of the proceedings and shall provide copies of the minutes for the Contractor, all present at the meeting and others concerned with the matters discussed.

***Responsibility  
for Minutes***

#### **C101.11 WORK-AS-EXECUTED DRAWINGS**

1. The Contractor shall supply the Superintendent with fully marked-up and certified Work-as-Executed Drawings for the whole of the Contract prior to issue of the Final Certificate. Prints or reproduces of the Contract Drawings will be supplied by the Principal free of charge for this purpose.

***Submission***

2. Work-as-Executed Drawings for Roadworks shall show in red ink all changes to the Contract Drawings and actual values of all levels shown on the Drawings. The Drawings shall be signed by a Surveyor and certified by the Contractor.

***Roadworks***

3. Work-as-Executed Drawings for Bridgeworks shall show in red ink all changes to the Contract Drawings, including variations to levels, dimensions, concrete, reinforcement, prestressing and other materials, all non-conformances accepted without rectification, suppliers and model numbers of bearings and proprietary joints and type of barrier railings installed where both steel and aluminium alternatives are detailed. The Drawings shall be certified by the Contractor.

***Bridgeworks***

#### **C101.12 ITEMS TO BE SUPPLIED BY THE PRINCIPAL**

1. Items listed in the Schedule of Items to be supplied by the Principal (TBS Items) will be supplied and delivered free on truck by the Principal free of cost to the Contractor at points to be nominated. The Contractor shall give the Superintendent notice of the time he requires delivery of TBS Items in accordance with the Requirements of the Technical Specification or as specified below.

***Delivery***

2. If any TBS Item is found to be damaged or defective the Contractor shall so inform the Superintendent within 2 days of taking delivery of such item. If the Contractor does not report damage or defect, it shall be deemed that the TBS Item was free from damage or defect when received. The Contractor shall then be responsible for any replacement or making good as may be directed by the Superintendent.

***Damage or  
Defect***

3. The Contractor shall be responsible for the storage, protection and insurance of all TBS Items received.

***Contractor's  
Responsibility***

**C101.13 SCHEDULE RATES**

1. Requirements in respect of all matters specified in this General Specification shall be considered as incidental to the Works and no separate Rates shall be provided in the Schedule in respect thereof.

***No Separate Rates***

**C101.14 PROTECTION OF THE ENVIRONMENT**

1. All work shall be carried out in such a manner as to avoid nuisance and/or damage to the environment. The Contractor shall comply with the requirements of the conditions of approval imposed by Council and shall conform with all Acts including but not exclusively, the Environment Protection Authority Act, Protection of the Environment Operations Act 1997 and the Bushfire Act. No variation in costs or extensions of time will be considered due to these requirements.

***Conformance to Acts***

2. The Contractor shall prepare an Environment Management Plan in accordance with CPSC guidelines and carry out the Works to avoid erosion, contamination and sedimentation of the site and its surroundings.

***Erosion Control***

3. Herbicides and other toxic chemicals shall not be used on the site without the prior written approval of the Superintendent.

***Herbicides and Toxic Chemicals***

4. No noise or smoke or other nuisance, which in the opinion of the Superintendent is unnecessary or excessive shall be permitted by the Contractor in the performance of the Works under this Contract. Should work outside customary working hours be approved, the Contractor shall not use, during such period, any plant, machinery or equipment which in the opinion of the Superintendent is causing or is likely to cause a nuisance to the public. No noisy works and/or works likely to disturb nearby residents shall be undertaken during the hours precluding such activity as specified by Council in accordance with the requirements for development consent and the Protection of the Environment Operations Act 1997.

***Noise, Smoke or Other Nuisances***

5. The Contractor shall ensure that fugitive dust from disturbed areas is minimised by a method approved by the Superintendent.

***Dust Control***

**C101.15 DRAINAGE OF WORKS**

1. The Contractor shall provide for the effectual diversion of surface water from the Works and provide and ensure proper flushing for storm and subsoil water across and beyond the Works at all times.

***Stormwater Diversion***

2. Temporary erosion and sedimentation control shall be completed prior to commencement of earthworks.

**C101.16 BLASTING**

1. Blasting will not be permitted without the specific approval of the Council. If such approval is given then blasting shall be carried out strictly in accordance with the Specification - EARTHWORKS.

**C101.17 LIMITS ON NOISE**

1. The Contractor shall only use plant that have effective residential class silencers fitted to all engine exhaust, have engine covers fitted, are maintained in good order, and in addition meet the following requirements.

***Plant with Silencers***

- (a) On purchase have met the NAASRA Specification for Noise levels of plant and equipment, or
- (b) Have a Maximum Noise level ( $L_{MAX}$ ) less than 80 dB(A) when measured at a distance of 7 metres.

2. Notwithstanding noise emission limits on plant, noise emanating from the construction site when measured at any noise sensitive location (such as a residential premise), as determined by the Environment Protection Authority shall not exceed an L10 sound pressure level (noise level exceeded for 10% of the sample time) the greater of:

**Maximum  
Noise Levels**

- (a) Short term (period of up to 1 month) 65dBA or 20dBA above ambient
- (b) Medium term (period of 1 month up to 6 months) 55dBA or 10dBA above ambient
- (c) Long term (any period of more than 6 months) 50dBA or 5dBA above ambient

3. The monitoring positions and time period for monitoring purposes shall be set by the EPA with the time period generally based on a series of 10 to 15 minute measurements which shall be averaged over the entire daily working period for the activity concerned.

**Monitoring**

4. The Contractor will be responsible for any damage and compensation payments as a result of non observance of the above requirements. No claim by the Contractor arising out of these requirements will be considered by the Principal.

**Contractor's  
Responsibility**

#### **C101.18 LIMITS ON GROUND VIBRATION**

1. It is the intent of this Specification that ground vibration levels, transmitted from operating items of plant in the vicinity of residential premises shall not exceed levels that are close to the lower level of human perception inside the premise nor will cause structural damage to the building.

**Levels**

2. Vibration (RMS Z-Axis) generated by construction works shall not exceed

**Limits**

Curve 4 - for the period of 1 month or less

Curve 2 - for the period of more than 1 month

as defined in British Standard BS6472 "Evaluation of Human Exposure to Vibration in Buildings (1 HZ to 80 HZ)" when measured inside nearby residential premises.

3. Ground vibrations generated by construction works shall not exceed a peak particle velocity ( $V_R$  max) limit of 5 mm/sec when measured within one metre of any residential premise.

**Peak Particle  
Velocity**

4. The Contractor shall be responsible for any damage and compensation payments as a result of non-observance of the above requirements. No claim by the Contractor will be considered by the Principal.

**Contractor's  
Responsibility**

#### **C101.19 MISCELLANEOUS**

1. Any Survey Marks are to be preserved. The developer is responsible for the relocation by a Registered Surveyor of any State or Council Survey Marks prior to the commencement of any construction works. In the case of State Survey Marks, a plan of survey showing the relocated marks shall be provided by the surveyor and lodged with the Surveyor General's Office. In the case of Council Survey Marks, a plan of survey showing

**Survey Marks**



the relocated marks shall be provided by the surveyor and lodged with Council's Assets and Contracts Department.

2. The developer is responsible for adequate safety precautions during progress of the works, including the erection of any signs, lights and barricades necessary for pedestrian and traffic safety.

***Public Safety***

3. Any existing services such as electricity, telephone and water shall be maintained in their existing location together with any conditions set by Council. The developer will be responsible for repairs to any damage caused to any services provided by Council or Service Authorities.

***Services***

It is the responsibility of the contractor to give adequate prior notice and information, and make arrangements with the respective authorities for any alterations of existing services and installations.

4. Storage of pipes, gravel and other materials in public roads or reserves will not be permitted.

***Storage of materials***

5. Council's verge (road reserve) shall be left in a safe and tidy condition, free from all hazards to public safety.

***Completion of Works***

## **SPECIAL REQUIREMENTS**

### **C101.20 OH&SR MANAGEMENT PLAN**

The Contractor shall produce an Occupational Health & Safety Regulation Management Plan approved by the Superintendent for the specific contract works prior to commencement of the Contract. The Contractor shall comply with all "Workcover" Regulations, Codes of Practice and Australian Standards.

### **C101.21 RESERVED**

### **C101.22 RESERVED**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C201  
Revision 3

## CONTROL OF TRAFFIC



## SPECIFICATION C201 - CONTROL OF TRAFFIC

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## CONTROL OF TRAFFIC

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**SPECIFICATION C201 : CONTROL OF TRAFFIC****GENERAL****C201.01 SCOPE**

1. The work to be executed under this Specification consists of all work necessary to provide for the safe movement of traffic and the protection of persons and property through and/or around the work site.

2. The extent of work includes the design, construction, maintenance and removal of temporary roadways and detours, the provision of traffic controllers, signposting, roadmarkings, raised pavement markers, lights, barriers and any other items required. All temporary traffic arrangements required by works under this Contract are included under this Specification except where specified otherwise.

***Works  
Included***

3. Control of traffic shall be in accordance with RTA Manual "Traffic Control at Worksites"

***Standards***

**C201.02 REFERENCES**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

(a) **RTA Manual "Traffic Control at Worksites"**

(b) **AUSTROADS Publications**

AUSTROADS - Guide to Traffic Engineering Practice - Intersections at Grade  
AUSTROADS - Guide to the Geometric Design of Rural Roads

(c) **Australian Standards**

AS/NZS 1906.1 Retroreflective materials and devices for road traffic control purposes  
AS2445.1 Manual of uniform traffic control devices  
AS 1742.3 Retroreflective materials and devices for road traffic control purposes  
AS 1743 Road Sign Specifications  
AS 1744 Form of letters and numerals for road sign traffic control purposes.

**C201.03 TRAFFIC CONTROL PLAN (TCP)**

1. The Contractor shall construct the work with the least possible obstruction to traffic.

***Minimise  
Obstruction***

2. The Contractor shall obtain all necessary approvals from Councils and other Authorities for temporary traffic arrangements.

***Contractor's  
Responsibility***

3. Two weeks before undertaking work which would involve any obstruction whatsoever to traffic the Contractor shall submit, for the Superintendent's and Council's approval, a Traffic Control Plan (TCP) in accordance with RTA Manual "Traffic Control at Worksites".

***Control Plan***

4. The Plan shall include:-

**Control  
PlanContents**

- (a) design drawings for any temporary roadways and detours in accordance with Clause C201.11 showing pavement, wearing surface and drainage details,
- (b) details of arrangements for construction under traffic in accordance with RTA Manual "Traffic Control at Worksites"
- (c) Traffic Control Plan (TCP):
  - (i) location, size and legend of all temporary signs
  - (ii) temporary regulatory signs and temporary speed zones, and
  - (iii) all traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guardfence and barrier boards.

5. Where the TCP involves Regulatory Traffic Control Signs or Devices the period of notice shall be increased to five weeks in accordance with Clause C201.24.

**Notice**

6. The Traffic Control Plan (TCP) shall be in accordance with the requirements of this specification and the Drawings.

7. Special consideration to the safety of pedestrians and workers shall be given in the preparation of the Traffic Control Plan. Particular care shall be taken when requiring reversal of traffic flows or the separation of unidirectional flow by medians or other physical separation.

**Safety**

### **C201.04 SIDE ROADS AND PROPERTY ACCESSES**

1. At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and stock to and from side roads and property accesses connecting to the roadway. Work which affects the use of side roads and existing accesses shall not be undertaken without providing adequate alternative provisions to the prior satisfaction of the Superintendent.

**Access**

### **C201.05 TRAFFIC CONTROLLERS**

1. The Contractor shall advise the Superintendent of the names of proposed traffic controllers with a signed declaration that they are appropriately trained in the duties of traffic controllers in accordance with AS 1742.3.

**Trained Traffic  
Controllers**

### **C201.06 APPROVED CLOTHING FOR WORK PERSONNEL**

1. All personnel working in close proximity to traffic shall wear high visibility clothing to the requirements of AS 1742.3.

**Safety Clothing**

### **C201.07 TEMPORARY SPEED ZONING**

1. All temporary speed zonings are to be approved in writing by Roads & Traffic Authority.

2. Where a temporary speed limit has been approved, the Contractor shall arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection. Where and when directed by the Superintendent, the Contractor shall erect these

**Speed Zone  
Signs**

signs, cover the signs when the speed zone is not in use and remove the signs when the speed zone is no longer required as part of the provision for traffic. A diary recording operation times of the speed zone shall be kept by the Contractor.

- |   |                          |
|---|--------------------------|
| 3. All costs associated with temporary speed zoning signposting shall be borne by the Contractor. | <b>Contractor's Cost</b> |
|---|--------------------------|

**201.08 WITHDRAWN**

**TEMPORARY ROADWAYS AND DETOURS**

**C201.09 APPROVAL**

- |   |                        |
|---|------------------------|
| 1. The Contractor shall submit for the Superintendent's approval the design of all proposed temporary roadways and detours. | <b>Temporary Roads</b> |
|---|------------------------|

**C201.10 DESIGN STANDARDS**

Refer to Council's Road Design Specification D1.

**C201.11 DESIGN DRAWINGS**

Refer to Council's Road Design Specification D1.

**C201.12 DRAINAGE**

Refer to Council's Stormwater Drainage Design Specification D5

**C201.13 CONSTRUCTION OF EARTHWORKS AND PAVEMENT**

Refer to Council's Pavement Design Specification D2

**C201.14 SURFACING**

Refer to Council's Pavement Design Specification D2

**C201.15 GUARDFENCE**

Refer to Council's Guardfence Construction Specification C264

**C201.16 OPENING TO TRAFFIC**

- |  |                                  |
|--|----------------------------------|
| 1. Temporary roadways and detours (including portable or temporary traffic signals sites) shall not be open to traffic until they have been inspected, approved and authorised in writing by the Superintendent.       | <b>Approval to use</b>           |
| 2. All signposting, pavement marking, guardfence and portable or temporary traffic signals shall be completed before the opening of temporary roadways to traffic.   | <b>Signposting</b>               |
| 3. Unless otherwise approved by the Superintendent, the opening of temporary roadways shall be arranged so that sections of existing roadway being replaced are not disturbed for a minimum of forty eight (48) hours. | <b>Existing Roadway Retained</b> |

In the event of temporary roadway failure and there is a warrant to redirect traffic back onto



## CONTROL OF TRAFFIC

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the existing roadway, the Superintendent shall determine the redirection.

4. The costs associated with the redirection of traffic back onto the existing roadway shall be borne by the Contractor.

**Contractor's  
Cost**

5. Unless otherwise approved by the Superintendent, traffic shall be switched to a temporary roadway or detour only where the Contractor's usual workforce will be on site for a minimum of two days thereafter.

**Traffic Switch**

### C201.17 MAINTENANCE

1. The Contractor shall be responsible for the maintenance of temporary roadways and detours and shall ensure the road surface is kept safe for traffic. Any potholes or other failures shall be repaired without delay.

**Contractor's  
Responsibility**

### C201.18 REMOVAL

1. Upon completion of the Work the temporary roadways and/or detour arrangements shall be removed and the area restored to a condition equivalent to that which existed prior to the commencement of the work.

**Restoration**

## ARRANGEMENTS FOR TRAFFIC

### C201.19 CONSTRUCTION UNDER TRAFFIC

1. Where a temporary roadway or a detour is not provided or available then, subject to the approval of the Superintendent, construction under traffic may be permitted provided a minimum of 3.5 m lane width is available for through traffic on a two lane roadway and where 3.5 m lanes are available in both directions for through traffic when working on multilane roads.

**Lane Width**

2. The carriageway/s shall be restored to a safe and trafficable state for through traffic prior to cessation of work each day.

**Carriageway  
Restoration**

3. Full details of temporary signposting, traffic control devices and traffic control methods, in accordance with the appropriate arrangement diagrams in SAA HB81, are to be submitted for the Superintendent's approval at least five working days before undertaking any work which would involve construction under traffic.

**Signs and  
Markings**

### C201.20 OPENING COMPLETED WORK

1. The Contractor shall give the Superintendent at least five working days written notice confirming the date of opening completed work to traffic. The procedure for opening shall be determined through consultation between the Superintendent, the Contractor and the Council.

**Written Notice**

2. The Contractor shall be responsible for the removal of all temporary traffic control devices no longer required for the safety of traffic, when the Works or part thereof are opened to traffic.

**Contractor's  
Responsibility**

## TRAFFIC CONTROL DEVICES

### C201.21 ARRANGEMENT OF TRAFFIC CONTROL DEVICES

1. The arrangement and placement of traffic control devices shall be carried out in

**Arrangement**

accordance with SAA HB81. The arrangement diagrams illustrate the more common examples of the arrangement of traffic control devices and set out the minimum requirements.

***Diagrams***

2. All temporary traffic control devices when no longer required shall be covered and/or removed without delay in order to maintain unambiguous safe guidance to traffic.

***Unnecessary Signs***

## **C201.22 MAINTENANCE OF TRAFFIC CONTROL DEVICES**

1. All traffic control devices shall be maintained in accordance with AS 1742.3 so that they are in good order and in the correct positions day and night. They shall be neat and clean, and signs shall be clear and legible at all times.

***Contractor's Responsibility***

2. The Contractor may need to be contacted outside normal working hours to arrange for adjustments or maintenance of traffic control devices. The Contractor shall notify the Superintendent, the Council and the local Police, in writing, the names, addresses, and means of communicating with personnel nominated for this purpose.

***Out of Hours Contact***

3. The Contractor shall erect a sign, minimum 1.8m x 0.9m in size. The sign shall display the name, address and contact telephone numbers of the Principal and Contractor.

***Sign***

## **C201.23 ADEQUATE TRAFFIC CONTROL DEVICES**

1. Where the Contractor fails to provide and maintain adequate traffic control devices specified in this Specification, the Superintendent shall arrange to have such items provided and maintained.

***Default by Contractor***

2. The cost of providing and maintaining adequate traffic control devices arranged by the Superintendent shall be borne by the Contractor.

***Contractor's Cost***

## **C201.24 REGULATORY TRAFFIC CONTROL SIGNS AND DEVICES**

1. A Regulatory Traffic Control Sign or Device shall be in accordance with AS 1742.3, and shall require approval by the appropriate Authority before its erection. This approval should be obtained through the Superintendent. Five weeks written notice by the Contractor shall be required to ensure that approval is obtained before erection of these signs.

***Prior Approval***

## **C201.25 SIGNS**

1. Signs shall be designed and manufactured in accordance with AS 1743. Details of each letter shall be as shown in AS 1744.

***Specifications***

2. The reflective material used on signs shall be Class 2 material complying with AS 1906.1 except where otherwise specified. The fluorescent material used on signs shall be fluorescent red.

***Reflective Material***

## **C201.26 WITHDRAWN**

## **C201.27 FLASHING ARROW SIGNS**

1. Flashing arrow signs shall comply with AS 1742.3.

## **C201.28 BARRIER BOARDS**

1. Barrier boards shall comply with AS 1742.3.

***Standard***

2. Trestles supporting the barrier boards may be manufactured of timber, metal or other suitable material and shall be yellow. The trestles shall provide firm supports for the barrier board and be kept in place by sandbags or other devices. The bases of the trestles shall not protrude beyond the ends of the boards.

***Trestle Support***

### **C201.29 HIGH VISIBILITY MESH FENCING**

1. High visibility mesh fencing shall be constructed where shown on the Drawings, Traffic Control Plan (TCP) or as directed by the Superintendent.
2. High visibility mesh fencing shall be constructed in accordance with AS 1742.3, containment fences.
3. The mesh fencing shall be paraweb or equivalent as approved by the Superintendent.

### **C201.30 TEMPORARY POST-MOUNTED DELINEATORS**

1. In addition to the requirements of AS 1742.3, temporary post mounted delineators shall be provided in conjunction with high visibility mesh fencing which is erected parallel to and in close proximity to traffic.

### **C201.31 CONES AND BOLLARDS**

1. Traffic cones and bollards shall comply with AS 1742.3 and be placed in accordance with the arrangement diagrams in SAA HB81.
2. Unless cones are firmly fixed in position they shall be used only while work is in progress, or in locations where there is an employee in attendance who shall reinstate any of the cones which have been dislodged by traffic. Otherwise they shall be removed and bollards or barriers substituted.
3. Cones and bollards used under night conditions shall be reflectorised in accordance with AS 1742.3.

***Standard and Placement***

***Conditions of Use***

***Reflectorised for Night Work***

### **C201.32 TRAFFIC WARNING LAMPS**

1. Traffic warning lamps shall comply with AS 1165 and shall be installed in accordance with AS 1742.3. The Contractor shall ensure that warning lamps are in good working order, correctly aligned and positioned with respect to the direction of traffic flow each night, before the site is left unattended.

***Standards and Positioning***

### **C201.33 TEMPORARY PAVEMENT MARKINGS**

1. All pavement markings shall be reflectorised and consist of painted lines, roadmarking tape and/or raised pavement markers in accordance with the relevant Australian Standards or as otherwise approved by the Superintendent and shall be provided in accordance with AS 1742.3.
2. Where the adjoining roadway is edgelined, temporary roadways shall be similarly edgelined.

***Reflectorised Markings***

***Adjoining Work***

### **C201.34 TEMPORARY LINEMARKING**

1. Where temporary linemarking is required on the final wearing surface, only

***On Final***

pavement marking tape shall be used.

**Surface**

2. Where the pavement linemarking has become ineffective in the opinion of the Superintendent, remarking shall be undertaken within forty-eight hours of direction by the Superintendent. The cost of remarking the pavement lines shall be borne by the Contractor.

**Contractor's  
Cost**

3. Where a single carriageway is opened adjacent to or used in lieu of an existing dual carriageway length, pavement arrows indicating the direction of flow of traffic shall be placed at not more than 500 m or at a spacing nominated by the Superintendent. The arrows shall be removed if the section is then reincorporated as dual carriageway.

**Pavement  
Arrows**

4. Immediately before or after placement of new markings all superseded pavement markings shall be obliterated or removed to the satisfaction of the Superintendent.

**Old Markings  
Removed**

5. On a final surface, obliteration by painting shall not be permitted.

#### **C201.35 RAISED PAVEMENT MARKERS**

1. Where raised pavement markers have become ineffective in the opinion of the Superintendent, they shall be replaced within twenty four hours of direction by the Superintendent.

**Ineffective  
Markers**

2. The cost of replacing ineffective pavement markers shall be borne by the Contractor.

**Contractor's  
Cost**

3. All superseded raised pavement markers shall be immediately removed from the pavement by the Contractor.

**Removal of  
Superseded  
Markers**

### **SPECIAL REQUIREMENTS**

**C201.36 RESERVED**

**C201.37 RESERVED**

**C201.38 RESERVED**

**C201.39 RESERVED**

**C201.40 RESERVED**

**C201.41 WITHDRAWN**

DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C211

Revision 3

**CONTROL OF EROSION AND  
SEDIMENTATION**



**SPECIFICATION C211 - CONTROL OF EROSION AND SEDIMENTATION**

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**SPECIFICATION C211  
CONTROL OF EROSION AND SEDIMENTATION**

**GENERAL**

**C211.01 SCOPE**

1. The work to be executed under this Specification consists of the construction of structures and the implementation of measures to control erosion and sedimentation. These may be temporary or permanent.
2. The Contractor shall plan and carry out the whole of the Works to avoid erosion and sedimentation of the site, surrounding country, watercourses, waterbodies and wetlands.

**C211.02 REFERENCE DOCUMENTS**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

**(a) Council Specifications**

- D7 Singleton Shire Council Design Specification
- C212 - Clearing and Grubbing
- C213 - Earthworks
- C273 - Landscaping
- Singleton Shire Council Erosion and Sediment Control Development Control Plan  
(all land where Council is the consent authority)

**(b) Australian Standard Test Methods**

- AS.1289.5.1.1 - Determination of dry density/moisture content relation of a soil using standard compactive effort.

**(c) State Legislation**

- NSW Clean Waters Act, 1970
- Soil Conservation Act, 1938
- Water Act, 1912
- The Protection of the Environment Operations Act 1997 (NSW)

**(d) Other**

- NSW Department of Land and Water Conservation (DLWC) Urban Erosion and Sediment Control

**C211.03 EROSION AND SEDIMENTATION CONTROL PLAN**

1. For consideration of erosion and sedimentation control measures, the site shall be subdivided into sections based on the catchment area draining to each permanent drainage structure in the works. In addition to the area bounded by the road reserve, the sections shall include:

***Site Sections***



- (a) access and haulage tracks,
- (b) borrow pits and
- (c) compound areas, such as Contractor's facilities and concrete batching areas.

2. Before the natural surface is disturbed on each of these sections, the Contractor shall submit to Council an Erosion and Sedimentation Control Plan for that section. This Plan shall be superimposed on half-sized drainage drawings (the drawings) of the works and shall be detailed for each catchment area of the works.

***The Drawings***

3. The Plan shall consist of scale diagrams indicating:

***Plan Inclusions***

- (a) features of the site including contours and drainage paths,
- (b) relevant construction details of all erosion and sedimentation control structures,
- (c) all permanent and temporary erosion and sedimentation control measures, including the control measures to be implemented in advance of, or in conjunction with, clearing and grubbing operations as required under the Specification for CLEARING AND GRUBBING,
- (d) an order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage, and
- (e) proposed time schedules for construction of structures and implementation of measures to control erosion and sedimentation.

4. Singleton Shire Council Design Specification D7 and the DLWC publication Urban Erosion and Sediment Control provides guidance on typical permanent and temporary erosion and sedimentation control measures which may be required and guidance in the preparation of an Erosion and Sedimentation Control Plan.

***Guidance***

5. No work shall commence until Council has approved the Erosion and Sedimentation Control Plan. Such approval shall not relieve the Contractor of the full responsibility to provide whatever measures are required for effective erosion and sedimentation control at all times.

***Contractor's Responsibility***

6. The Contractor shall adhere to the approved Erosion and Sedimentation Control Plan. Any variation from the approved plan will require prior approval of Council.

***Adherence to Plan***

#### **C211.04 EROSION AND SEDIMENTATION CONTROL MEASURES**

1. Erosion and sedimentation control measures shall include, but shall not be limited to, the following:

***Scope***

- (a) The installation of permanent drainage structures before the removal of topsoil and commencement of earthworks for formation within the catchment area of each structure.
- (b) The prompt completion of all permanent and temporary drainage works, once commenced, to minimise the period of exposure of disturbed areas.
- (c) The stabilisation of diversion and catch drains to divert uncontaminated runoff from outside the site, clear of the site. Catch drains shall be installed and lined, as specified or as directed by the Superintendent, before the adjacent ground is disturbed and the excavation is commenced.
- (d) The passage of uncontaminated water through the site without mixing with contaminated runoff from the site.

## CONTROL OF EROSION AND SEDIMENTATION

---

- (e) The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.
- (f) The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.
- (g) The restoration of the above drainage and sedimentation control works on a day to day basis to ensure that no disturbed area is left without adequate means of containment and treatment of contaminated water.
- (h) The limitation of areas of erodible material exposed at any time to those areas being actively worked.
- (i) The minimisation of sediment loss during construction of embankments by means such as temporary or reverse superelevations during fill placement, constructing berms along the edge of the formation leading to temporary batter flumes and short term sediment traps.
- (j) The progressive vegetation of the site, in accordance with the Specification for LANDSCAPING, as work proceeds.

## PERMANENT EROSION AND SEDIMENTATION CONTROL

### C211.05 EARTHWORKS FOR PERMANENT EROSION AND SEDIMENTATION CONTROL BASINS

- |  |  |
|--|--|
| 1. Earthworks for permanent erosion and sedimentation control basins shall be to the planned levels and dimensions shown on the Drawings or such levels and dimensions as determined by the Superintendent.  | <b><i>Planned Levels</i></b>                           |
| 2. The entire storage and embankment foundation area of permanent erosion and sedimentation control basins shall be cleared in accordance with the Specification for CLEARING AND GRUBBING and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with the Specification for EARTHWORKS. | <b><i>Site Preparation</i></b>                         |
| 3. The embankments shall be constructed in layers not exceeding 200 mm in depth and compacted so that the relative compaction, determined by AS 1289, shall not be less than 95 per cent for standard compactive effort.   | <b><i>95% Compaction Requirements</i></b>              |
| 4. If payment for embankment construction is on a Schedule of Rates basis, at least three days before construction of the embankment the Contractor shall provide the Superintendent with survey information which will be sufficient to subsequently measure the volume of the constructed embankment.                                | <b><i>Contractor to Provide Survey Information</i></b> |

### C211.06 INLETS, SPILLWAYS AND LOW FLOW OUTLETS FOR SEDIMENTATION CONTROL BASINS AND SEDIMENT TRAPS

- |   |                               |
|---|-------------------------------|
| 1. Inlets and spillways shall be constructed using rock filled woven galvanised steel mattresses laid on a needle punched, mechanically bonded, non-woven geotextile filter fabric, as shown on the Drawings or as directed by the Superintendent. The rock filled mattresses shall be laid in accordance with the manufacturer's instructions and Specification. | <b><i>Rock Mattresses</i></b> |
|---|-------------------------------|

### C211.07 DROP INLET SEDIMENT CONTROL

- |  |                                    |
|--|------------------------------------|
| 1. Drop inlet sediment traps and inlet control banks shall be constructed on completion of each gully pit unless otherwise directed by the Superintendent. These drop inlet sediment traps and inlet control banks are additional to the temporary sedimentation control measures that may be required under Clause C211.10 during construction of the gully pits. | <b><i>Time of Construction</i></b> |
|--|------------------------------------|

2. The drop inlet sediment traps are intended to remove sediment from the surface flow before it enters the drainage system. The inlet control banks shall be constructed as required to prevent the surface flows bypassing the gully pits.

***Purpose***

3. The drop inlet sediment traps shall be constructed as shown on the Drawings. The associated inlet control banks shall consist of at least two courses of sandbags containing a 10:1 sand/cement mix. The bags shall be keyed at least 25 mm into the surface, dampened sufficiently to ensure hydration of the cement and tamped lightly to provide mechanical interlock between adjacent bags.

***Control Banks***

#### **C211.08 CLEANING SEDIMENTATION CONTROL STRUCTURES**

1. The Contractor shall clean out permanent sedimentation control structures, cleaning out whenever the accumulated sediment has reduced the capacity of the structure by 50 per cent or more, or whenever the sediment has built up to a point where it is less than 300 mm below the spillway crest. All permanent sedimentation control structures shall be cleaned out by the Contractor prior to Practical Completion of the Works.

***Contractor's Responsibility***

2. Accumulated sediment shall be removed from permanent sedimentation control structures in such a manner as not to damage the structures. The sediment removed shall be disposed of in such locations that the sediment will not be conveyed back into the construction areas or into watercourses. The Contractor shall provide and maintain suitable access to permanent sedimentation control structures to allow cleaning out in all weather conditions.

***Removal of Sediment***

#### **C211.09 WITHDRAWN**

### **TEMPORARY EROSION AND SEDIMENTATION CONTROL**

#### **C211.10 GENERAL**

1. The Contractor shall ensure that effective erosion and sedimentation control is provided at all times during the Contract.

***Contractor's Responsibility***

2. Runoff from all areas where the natural surface is disturbed by construction, including access roads, depot and stockpile sites, shall be free of pollutants as defined in The Protection of the Environment Operations Act 1997 (NSW) before it is either dispersed to stable areas or directed to natural watercourses. The Contractor shall be responsible for all temporary erosion and sedimentation control measures required for this purpose.

***Pollutant Free***

3. The Contractor shall provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Water shall not be allowed to pond on the works unless such ponding is part of an approved Erosion and Sedimentation Control Plan.

***Maintenance by Contractor***

#### **C211.11 TEMPORARY DRAINS**

1. Runoff from areas exposed during the work shall be controlled by construction of temporary contour drains and/or temporary diversion drains. Generally, a temporary contour drain or temporary diversion drain takes the form of a channel constructed across a slope with a ridge on its lower side. They may require progressive implementation and frequent alteration as the work progresses.

***Control of Runoff***

2. Contour drains shall be constructed as shown on the Drawings.

***Contour Drains***

3. Diversion drains shall be provided across haul roads and access tracks when such roads and access tracks are identified as constituting an erosion hazard due to their steepness, soil erodibility or potential for concentrating runoff flow. Diversion drains shall be formed to intercept and divert runoff from the road or track to stable outlets. Spacing of diversion drains shall not be greater than that required to maintain runoff at non-erosive velocities.

***Diversion  
Drains***

### **C211.12 TEMPORARY SEDIMENT TRAPS**

1. Temporary sediment-trapping devices shall be provided during construction to remove sediment from sediment-laden runoff flowing from areas of 0.5 hectares or more before the runoff enters natural watercourses or adjacent land.

***Sediment  
Traps***

### **C211.13 BATTER PROTECTION**

1. The Contractor shall take all necessary action to protect batters from erosion during the Contract.

***Contractor's  
Responsibility***

2. Scour of newly-formed batters during and after construction shall be minimised by diverting runoff from the batter until vegetation is established.

***Scour Control***

### **C211.14 MAINTENANCE AND INSPECTION**

1. The Contractor shall inspect all temporary erosion and sedimentation control works after each rain period and during periods of prolonged rainfall. Any defects revealed by such inspections shall be rectified immediately and these works shall be cleaned, repaired and augmented as required, to ensure effective erosion and sedimentation control thereafter.

***Contractor's  
Responsibility***

2. The Contractor shall provide and maintain access from within the road reserve or from other locations acceptable to the Superintendent, for cleaning out sedimentation control works.

***Access***

### **C211.15 REMOVAL**

1. Where revegetation is established before the end of the Contract, all temporary erosion and sedimentation control works shall be removed by the Contractor. All materials used for the temporary erosion and sedimentation control works shall be removed from the site or otherwise disposed by the Contractor to the satisfaction of the Superintendent.

***Contractor's  
Responsibility***

## **SPECIAL REQUIREMENTS**

**C211.16 RESERVED**

**C211.17 RESERVED**

**C211.18 RESERVED**

**C211.19 RESERVED**

**C211.20 WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C212  
Revision 3

## **CLEARING AND GRUBBING**



**SPECIFICATION C212 - CLEARING AND GRUBBING**

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## **SPECIFICATION C212 CLEARING AND GRUBBING**

### **C212.01 SCOPE**

1. The work to be executed under this Specification consists of the clearing of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards), all rubbish, the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees and stumps from the area defined in Clause C212.02. The work also includes the disposal, in accordance with Clause C212.05 and C212.06, of all materials that have been cleared and grubbed.

***Extent of Work***

2. In advance of clearing and grubbing operations, effective erosion and sedimentation control measures shall be implemented in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION.

***Erosion Control***

3. The clearing and grubbing required for boundary fencing does not form part of the work under this Specification.

### **C212.02 LIMITS OF CLEARING**

1. Unless otherwise specified or directed, the area to be cleared is that required by site regrading works, including the area occupied by the completed road formation and associated drainage works and erosion and sedimentation measures, plus a clearance of 2m beyond tops of cuts and toes of embankments.

***Limits of Clearing***

2. Before clearing commences, the limits of clearing shall be marked by pegs placed by the Contractor at 25m intervals around the area to be cleared.

***Indicator Pegs***

### **C212.03 CLEARING OPERATIONS**

1. The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards) all rubbish with the exception of certain trees marked for preservation.

***Extent***

2. The Contractor shall give the Superintendent written notice of one day of the intention to clear any area of the work. The Superintendent shall mark or indicate to the Contractor the trees that shall be preserved. The Contractor shall arrange for an inspection by Council's representative and shall obtain Council's approval to proceed with clearing and grubbing. The Contractor shall take protective measures during the operations of clearing and road construction to avoid damaging or destroying such trees.

***Trees to be preserved***

3. The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or directed by the Superintendent. No growing trees shall be destroyed or damaged by the Contractor other than those specified and those indicated by the Superintendent.

***Trees outside Limits of Work***

4. Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Superintendent, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with Clause C212.05.

***Unsound trees in Road Reserve***

5. Every precaution shall be taken to prevent timber from falling on private property and the Contractor shall dispose of any timber so fallen or produce the written consent of the owner to its remaining there. The cost of disposal of such fallen timber shall be borne by the Contractor.

***Debris in Private Property***

6. Damage of any kind, including damage to fencing or utilities, occurring during clearing operations shall be made good by the Contractor. The cost of making good such damage shall be borne by the contractor.

***Damage to Property***



**C212.04 GRUBBING**

1. All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing. **Extent**
2. Grubbing operations shall be carried out to remove all vegetation material. **Operations**
3. Holes remaining after trees and stumps have been grubbed shall be excavated to a sound base and backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground. **Backfill Holes**

**C212.05 CHIPPING OF CLEARED VEGETATION**

1. The Contractor shall produce a wood-chip mulch derived from the trees and shrubs cleared under this Specification. The wood-chip mulch produced shall be stockpiled for subsequent use in accordance with the Specification for LANDSCAPING or for use at other locations as appropriate. **Wood-chip Mulch**
2. The chipped material produced shall not have two orthogonal dimensions exceeding 75mm and 50mm. **Dimensions**

**C212.06 DISPOSAL OF MATERIALS**

1. Unless otherwise specified elsewhere, all materials cleared and grubbed in accordance with this Specification shall remain the property of the Principal. These materials shall be removed from the site and legally disposed of by the Contractor, if required by the Superintendent. **Removal from Site**
2. Unless otherwise approved by the Superintendent in writing, disposal of timber and other combustible materials by burning shall not be permitted. Where the Contractor obtains the prior written approval of the Superintendent, the Contractor shall comply with all Statutory requirements applicable to burning off, and any such burning off shall be carried out in such a manner that no damage is done to any trees outside the limits of clearing. Smoke resulting from such burning off shall not cause a traffic hazard. **Burning not Permitted**

**C212.07 WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

**C213**

Revision 3

## **EARTHWORKS**



## SPECIFICATION C213 - EARTHWORKS

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**SPECIFICATION C213 : EARTHWORKS****GENERAL****C213.01 SCOPE**

1. The work to be executed under this Specification consists of:- **Scope**
- (a) removal of topsoil
  - (b) all activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the Drawings and Specification.
  - (c) removal and replacement of any unsuitable material,
  - (d) any spoil or borrow activities associated with earthworks, and
  - (e) any additional processing of selected material for the selected material zone.

**C213.02 REFERENCE DOCUMENTS**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents**

**(a) Council Specifications**

C201	-	Control of Traffic
C211	-	Control of Erosion and Sedimentation
C212	-	Clearing and Grubbing
C220	-	Stormwater Drainage - General
C273	-	Landscaping

**(b) Australian Standards**

AS 1289.6.1.1	-	Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
AS 1289.3.3.1	-	Calculation of the plasticity index of a soil.
AS 1289.5.1.1	-	Determination of the dry density/moisture content relation of a soil using standard compactive effort.
AS 1289.5.7.1	-	Compaction Control Test Half density ratio and Half moisture variation (rapid method).
AS1289.5.4.1	-	Determination of Relative Compaction
AS 2187	-	Explosives - Storage, transport and use (SAA Explosive Code)
AS 2187.1	-	Explosives – Storage, transport and use – Storage
AS 2187.2	-	Explosives – Storage, transport and use – Use of Explosives

**(c) Other**

AUSTROADS	-	Explosives in Roadworks, Users Guide 1982.
EPA	-	Environmental Noise Control Manual.

**C213.03 WITHDRAWN****C213.04 PROTECTION OF EARTHWORKS**

1. The Contractor's responsibility for care of the Works shall include the protection of earthworks. **Contractor's Responsibility**

- |   |   |
|---|---|
| 2. The Contractor shall install effective erosion and sedimentation control measures in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION, prior to commencing earthworks, and shall maintain these control measures for the duration of the contract.   | <b><i>Erosion and Sedimentation Control</i></b> |
| 3. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.  | <b><i>Drainage of Working Areas</i></b>         |
| 4. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off with a smooth roller. | <b><i>Wet Weather Precautions</i></b>           |
| 5. Should insitu or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.  | <b><i>Wet Material</i></b>                      |

#### **C213.05 SETTING OUT OF EARTHWORKS**

- |  |   |
|--|---|
| 1. Before earthworks operations commence, batter profiles shall be established by the Contractor and the necessary pegs driven at 20 m intervals or at each cross section shown on the Drawings, whichever is the lesser. The chainage/station, offset from control line and slope distance to finished subgrade level, shall be clearly marked on each peg. | <b><i>Batter Profiles</i></b>                   |
| 2. The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at intervals of not more than 5 m of vertical height.   | <b><i>Profile Location</i></b>                  |
| 3. All pegs and batter profiles shall be maintained in their correct positions. They shall be removed by the Contractor on completion of the contract or separable part.   | <b><i>Retention and Removal of Pegs</i></b>     |
| 4. The foregoing shall be the minimum requirement. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes.   | <b><i>Additional Pegs</i></b>                   |
| 5. The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses C213.15 and C213.24.  | <b><i>Transitions Cuttings/ Embankments</i></b> |

#### **C213.06 STOCKPILE SITES**

- |   |  |
|---|--|
| 1. The Contractor shall obtain the written consent of the Superintendent to the use of any stockpile site which is not shown on the Drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile. | <b><i>Additional Stockpile Sites</i></b> |
| 2. Any clearing and grubbing required for these sites shall be carried out in accordance with the Specification for CLEARING AND GRUBBING. Temporary erosion and sedimentation control measures shall be taken in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION.                                   | <b><i>Clearing and Grubbing</i></b>      |
| 3. Restoration of stockpile sites following completion of the work shall be carried out in accordance with the Specification for LANDSCAPING.   | <b><i>Restoration</i></b>                |



## **REMOVAL OF TOPSOIL**

### **C213.07 SCOPE**

- |   |                       |
|---|-----------------------|
| 1. Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones.  | <b>Definition</b>     |
| 2. Removal of topsoil on any section of the Works shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the Works. Topsoil throughout the length of the work shall be removed and stockpiled separately clear of the work.  | <b>Prerequisites</b>  |
| 3. The work shall include the following:-<br><b>(a) Cuttings</b><br>Removal of the topsoil to a depth quoted in Limits and Tolerances Table or as directed by the Superintendent.<br><br><b>(b) Embankments</b><br>Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in Limits and Tolerances Table, or as directed by the Superintendent. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in Limits and Tolerances Table shall be removed to its full depth as directed by the Superintendent.<br><br><b>(c) Other Locations</b><br>Removal of topsoil as directed by the Superintendent. | <b>Extent of Work</b> |

### **C213.08 SURVEY AFTER REMOVAL OF TOPSOIL**

- |  |                                |
|--|--------------------------------|
| 1. Where payment is on a 'Schedule of Rates' basis, and unless alternative arrangements have been made by the Superintendent, after removing the topsoil the Contractor shall determine the surface levels in each cutting and embankment at sufficient locations to determine the volume of excavation for general earthworks and the volume of compacted fill. A schedule of these surface levels shall be submitted to the Superintendent for concurrence at least three working days before commencement of any work which will alter the ground surface as surveyed. Such work shall only commence with the approval of the Superintendent. | <b>Establish Surface Level</b> |
|--|--------------------------------|

### **C213.09 TOPSOIL STOCKPILES**

- |  |                           |
|--|---------------------------|
| 1. Where payment is on a 'Schedule of Rates' basis, at least three working days before stockpiling of topsoil at any site, the Contractor shall submit, for the approval of the Superintendent, a site survey which will be sufficient to subsequently measure the volume placed in stockpile. | <b>Site Survey</b>        |
| 2. The maximum height of stockpiles shall not exceed 2.5 m and the maximum batter slope shall not exceed 2:1.  | <b>Height and Batter</b>  |
| 3. Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.   | <b>Stockpiles Trimmed</b> |
| 4. To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent.   | <b>Erosion Control</b>    |
| 5. Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with the Specification for LANDSCAPING.  | <b>Seeding Stockpile</b>  |

## CUTTINGS

### C213.10 SCOPE

1. Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

**Extent of Work**

### C213.11 EXCAVATION

1. Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to Clauses C213.23, C213.26, C213.28, C213.29, C213.30 and C213.31.

2. Cuttings shall have batter slopes as shown on the Drawings or as redetermined by the Superintendent on the basis of site inspection and investigation during the excavation.

**Batter Slopes**

3. The tops of all cuttings shall be neatly "rounded".

4. In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters will generally require progressive flattening at the ends of cuttings due to the presence of less stable material.

**Batters to be Even**

5. In rock excavation cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds. Horizontal terraces at 200mm centres and 70mm deep shall be provided in batters that are not rock.

**Unstable Material**

6. Where, after the removal of Topsoil as specified in Clause C213.07, material of variable quality or moisture content is encountered, the Contractor shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of Clause C213.23.

**Blending Material**

### C213.12 BATTER TOLERANCES

1. The tolerances for the excavation of batters, measured at right angles to the design grade line, shall be  $\pm 300\text{mm}$ .

**Batter Tolerances**

2. If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the batter to suit the convenience of the Contractor, but such a change shall not be regarded as a re-determination of the batter slope under Clause C213.11. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the Superintendent's approval.

**Excavation beyond Batter Line**

**Contractor's Cost**

3. For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, the Superintendent may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock.

**Restoration of Batter Slope**

### C213.13 BENCHING IN CUTTINGS

1. Cut batters shall be benched as shown on the Drawings to provide drainage and erosion control on cut batters. Notwithstanding the tolerances permitted under Clause C213.12, bench widths shall not be less than those shown on the Drawings.

**Bench Construction**

2. Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Contract period.

**Bench Maintenance**

## C213.14 TREATMENT OF FLOORS OF CUTTINGS

1. The floors of cuttings shall be excavated, parallel to the designed grade line, to a designed floor level which shall be at the underside of the selected material zone or where there is no selected material zone, to the underside of the pavement subbase. The floors shall then be trimmed to a level of not more than 50 mm above or below the designed floor level.

**Excavation Level**

2. The Contractor shall rip or loosen all material in the floor to a minimum depth of 500mm below the designed floor level for the width of the selected material zone (or subbase layer, where no selected material zone). The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm.

**Floor Material Ripped**

3. Ripped or loosened material shall be made available for inspection by the Superintendent before recompaction commences. It shall be recompacted in accordance with Clause C213.36. No account shall be taken of the volume involved in loosening when measuring the volume of excavations.

**Inspection by Superintendent**

4. After recompaction, the floors of cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than 10 mm above or 40 mm below the designed floor levels.

**Level Tolerances**

## C213.15 TRANSITION FROM CUT TO FILL

1. After the removal of topsoil and before the excavation of any cutting commences the Contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of the selected material zone or pavement subbase.

**Intersection Line**

2. Following excavation to the cutting floor, a terrace shall be excavated for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 600mm below and parallel to the cutting floor, as shown in Figure C213.1.

**Terrace Construction**

3. The terrace shall extend into the cut to the point where the cutting floor is 600mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.

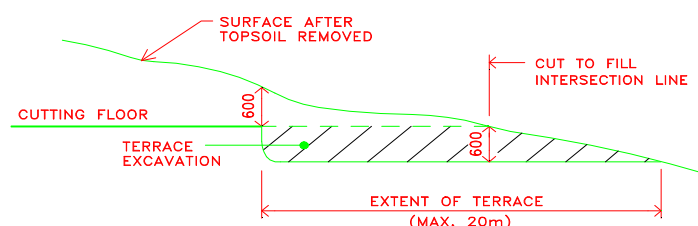
**Extent of Terrace**

4. The material excavated shall be either incorporated in the embankments or spoiled as directed by the Superintendent. Material incorporated in embankments shall be included in the excavated volume for General Earthworks and material spoiled shall be included in the excavated volume of Unsuitable Material to Spoil.

**Excavated Quantity**

5. The material placed above the terrace shall satisfy the requirements of Clause C213.23 and shall be compacted in accordance with Clause C213.36.

**Quality and Compaction**



**Figure C213.1 - Transition from Cut to Fill (Longitudinal Section)**

## BLASTING

### C213.16 GENERAL

1. When explosives are permitted to be used, the Contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all Government regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187, Parts 1 and 2. An application to blast must be lodged with the local Council Authority and any approval to blast may affect the temporary closure of affected roads. A separate Authority is required for the granting of temporary road closures. The requirements of the Environment Protection Authority (EPA) shall be complied with. **Contractor to Obtain Licences**
2. The Contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives. **Contractor's Responsibility**
3. Before the start of blasting operations, the Contractor, in the presence of the Superintendent, shall conduct a survey to determine and record the existing condition of all structures likely to be affected by any blast. **Pre-blast Survey**
4. Structures shall include public utilities. The survey shall include all structures within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure and to the Superintendent before blasting commences. **Extent of Survey**
5. The Contractor shall advise the Superintendent of the proposed maximum instantaneous charge and the Contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The Superintendent may direct amendments to the scope of the survey as a result of blast monitoring during the work. All costs associated with the surveys and reports shall be borne by the Contractor. **Amendment to Extent of Survey**
6. Before each blasting operation, the Contractor shall submit to the Superintendent written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures. **Proposed Blasting Procedure**
7. Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table C213.1: **Ground Vibration**

<b>Point of Potential Damage</b> (within 1km of blasting site)	<b>Peak Particle Velocity</b>
Completed and cured bridge structures or sub-structures (eg completed abutment),	10 mm/sec
Bridgeworks and structural retaining walls under construction,	10 mm/sec
Residential premises, schools, hospitals and other buildings	2 mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance	2 mm/sec

**Table C213.1 - Limiting Peak Particle Velocity**

- |   |                                   |
|---|-----------------------------------|
| 8. The Contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result.   | <b><i>Advice to Residents</i></b> |
| 9. Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.  | <b><i>Time Limits</i></b>         |
| 10. When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the formed road shall be closed to traffic and the appropriate signs erected in accordance with the Specification for CONTROL OF TRAFFIC. A standard warning procedure such as that given in the AUSTRROADS Explosives in Roadworks, Users Guide 1982, shall be established and observed at all times. | <b><i>Safety Precautions</i></b>  |

**C213.17 PRESPLITTING**

- |   |                             |
|---|-----------------------------|
| 1. Where pre-splitting is carried out the spacing of pre-split drill holes shall not exceed 750mm centre to centre. | <b><i>Pre-splitting</i></b> |
|---|-----------------------------|

**C213.18 BLASTING RECORDS**

- |   |                                  |
|---|----------------------------------|
| 1. The Contractor shall maintain accurate records of each blast showing the details listed below:- <ul style="list-style-type: none"><li>• Date and time of blast</li><li>• Location, number and diameter of holes loaded</li><li>• Depth of each hole loaded</li><li>• Inclination of holes</li><li>• Maximum and minimum burden</li><li>• Types of explosives used</li><li>• Charge distribution in each hole</li><li>• Maximum instantaneous charge</li><li>• Delay periods and sequence</li><li>• Total amount of charges in the blast</li><li>• Length and type of stemming in each hole</li></ul> | <b><i>Records to be kept</i></b> |
| 2. The records shall be prepared as holes are loaded and signed by the Powderman. A copy shall be provided to the Superintendent on the day of the blast.   | <b><i>Record Preparation</i></b> |

**C213.19 CONTROL OF AIR BLAST OVER-PRESSURE**

- |   |                                    |
|---|------------------------------------|
| 1. The Clause shall apply only where a noise sensitive location exists within 1km of the blasting site.   | <b><i>Incidence</i></b>            |
| 2. The Contractor's attention is drawn to the recommendations given in the EPA Noise Control Manual for the reduction of air blast over-pressure.   | <b><i>Noise Control Manual</i></b> |
| 3. The noise emanating from blasting operations shall not exceed an over-pressure level of 115 decibels (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time. | <b><i>Noise Limitations</i></b>    |

4. The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this Specification. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

***Monitoring of  
Air Blast Over-  
Pressure***

5. In the event that the measured air blast over-pressure exceeds the specified limits, the Contractor shall suspend further blasting work and shall submit to the Superintendent proposals detailing any additional steps and precautions the Contractor shall take to ensure that for any future blast, the limiting over-pressure shall not be exceeded. The Contractor shall not resume any blasting until such proposals have been submitted.

***Excessive Air  
Blast Over-  
Pressure***

## **C213.20 CONTROL OF GROUND VIBRATION**

1. The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table C213.1. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this Part of the Specification. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

***Monitoring  
Vibrations***

2. To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge as set out below.

***Blasting Site  
Relationship***

3. For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

***Maximum  
Instantaneous  
Charge***

$$MIC = 0.5 \left[ \frac{D}{\left[ \frac{p.p.v.}{1140} \right]^{-0.625}} \right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms

D = Distance in metres from charge to the point of potential damage

PPV = limiting peak particle velocity from Table C213.1

4. A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

5. For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Superintendent, if so requested.

***Adjustment of  
Blast Design***

## **UNSUITABLE MATERIAL**

### **C213.21 GENERAL**

1. Naturally unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Superintendent deems to be unsuitable as structural filling for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings which the Superintendent deems to be unsuitable for embankment construction.

***Definition***

2. Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable shall, as directed by the Superintendent, be incorporated in embankments in accordance with Clause C213.23 or spoiled in accordance with Clause C213.34.

***Extent of  
Excavation***

3. After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with Clause C213.36.

***Floor  
Inspection***

4. The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with Clause C213.35, of the quality specified in Clause C213.23. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with Clause C213.26 and compacted in accordance with Clause C213.36.

***Replacement  
Material***

5. Material which has become unsuitable because of inappropriate construction activities shall not be considered as naturally unsuitable.

***Contractor's  
Costs***

## **EMBANKMENT CONSTRUCTION**

### **C213.22 SCOPE**

1. Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with Clause C213.21, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the Drawings. It also includes any pretreatment such as breaking down or blending material or drying out material containing excess moisture.

***Extent of Work***

### **C213.23 EMBANKMENT MATERIAL**

1. Material for embankment construction shall be obtained from the cuttings within the Works, supplemented by borrow in accordance with Clause C213.35 if necessary. The material shall be free of tree stumps and roots and shall be capable of being compacted in accordance with Clause C213.36.

***Location and  
Quality***

2. The work shall be programmed so that material of the quality specified in Clause C213.26 and C213.30 for the upper zones of the formation is available when required.

***Selection of  
Material***

### **C213.24 FOUNDATIONS FOR EMBANKMENTS**

1. Following removal of topsoil in accordance with Clause C213.07, the embankment foundation area shall be made available for inspection by the Superintendent.

***Inspection***

2. Where the Superintendent considers that any underlying material is unsuitable, he may direct that it be removed and replaced in accordance with Clause C213.21.

***Unsuitable  
Material***

**a) Foundations for Shallow Embankments**

***Shallow  
Embankments***

1. Shallow embankments are those embankments of a depth less than 1.0 metre from the top of pavement to natural surface. After removal of topsoil the Contractor shall survey and work out the extent of the area of shallow embankments.

2. Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in Clause C213.36. The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

***Preparation of  
Foundations***

**b) Other Embankments**

1. For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in Clause C213.36.

***Preparation***

2. Where a bridging layer has been specified as a foundation treatment in the Contract documents, it shall be supplied and placed as part of General Earthworks. The bridging layer shall consist of free-draining granular material approved by the Superintendent which shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. Consideration should be given to the installation of a layer of geo-textile between the natural surface and the bridging layer. The compaction requirements of Clause C213.36 shall not apply to the bridging layer. Where it is necessary to import suitable material from off site and no suitable borrow source is available as provided in Clause C213.35, the supply and placing of the bridging layer shall be treated as a Variation to the Contract.

***Bridging Layer***

3. A bridging layer may also be employed, subject to the approval of the Superintendent, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in Clause C213.36. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design.

***Seepage from  
Foundations***

**C213.25 HILLSIDE EMBANKMENTS**

1. Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1 metre in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

***Horizontal  
Terraces***

2. No account shall be taken of the material removed in terracing when determining the General Earthworks excavated volume.

***Excavated  
Volume***

**C213.26 PLACING FILL FOR EMBANKMENT CONSTRUCTION**

1. The fill material for embankment construction shall be obtained from the cuttings within the work in accordance with Clause C213.11, supplemented by borrow when authorised by the Superintendent in accordance with Clause C213.35.

***Source of  
Material***

2. The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.

***Uniformity of  
Material***



- |  |  |
|--|--|
| <p>3. The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of Clause C213.36.</p>  | <p><b><i>Embankment<br/>Stability</i></b></p>                              |
| <p>4. Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with Clause C213.36. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25 per cent by volume of the filling consists of rock with any dimension larger than 150mm, the Superintendent may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in Clause C213.36 is attained.</p> | <p><b><i>Layer<br/>Thickness</i></b></p>                                   |
| <p>5. The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.</p>   | <p><b><i>Maximum Size<br/>Rock Pieces</i></b></p>                          |
| <p>6. Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Superintendent considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.</p>   | <p><b><i>Grading of Fill<br/>Material</i></b></p>                          |
| <p>7. Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer. The cost of any reworking shall be borne by the Contractor.</p>  | <p><b><i>Reworking<br/>Stony Patches<br/>Contractor's<br/>Cost</i></b></p> |
| <p>8. In placing embankment layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.</p>  | <p><b><i>Equipment<br/>Selection for<br/>Placement</i></b></p>             |

#### **C213.27 EMBANKMENT BATTERS**

- |   |  |
|---|--|
| <p>1. The batter slopes shown on the Drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Superintendent according to the Superintendent's assessment of the materials encountered.</p>  | <p><b><i>Batter Slopes</i></b></p>         |
| <p>2. When completed, the average planes of the batters of embankments shall conform to those shown on the Drawings or as determined by the Superintendent. No point on the completed batter shall vary from the specified slope line by more than <math>\pm 300\text{mm}</math> when measured at right angles to the grade line. However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the Drawings.</p> | <p><b><i>Slope<br/>Tolerances</i></b></p>  |
| <p>3. Undulations in the general plane of the batter shall not be permitted.</p>  | <p><b><i>Slope<br/>Undulations</i></b></p> |

#### **C213.28 ROCK FACING OF EMBANKMENTS**

- |   |   |
|---|---|
| <p>1. Where shown on the Drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.</p>   | <p><b><i>Extent</i></b></p>                   |
| <p>2. The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced.</p> | <p><b><i>Mechanical<br/>Interlock</i></b></p> |

3. The Contractor shall adjust his working methods and programme the work so as to obtain hard and durable rock of the specified dimensions as it is required. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter.

**Graded Filter**

4. The Contractor shall exercise extreme caution whilst placing the rock facing. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage down the batter. The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use.

**Caution in Placement**

### **C213.29 TRIMMING TOPS OF EMBANKMENTS**

1. The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

**Levels**

2. The tops of embankments at these levels shall be compacted to meet the requirements of Clause C213.36 and trimmed so that they do not vary more than 10 mm above or 40 mm below the levels as calculated above.

**Tolerances**

3. The tops of the embankment shall be neatly rounded.

### **C213.30 SELECTED MATERIAL ZONE**

1. A selected material zone shall be provided as indicated on the Drawings and it shall be free from stone larger than 100mm maximum dimension.

**Dimension and Quality**

2. The selected material shall be obtained from cuttings excavated under the Contract or from borrow areas as specified in Clause C213.35. If necessary, the Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this Clause.

**Winning Material**

3. The Contractor shall ensure that any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled at locations approved by the Superintendent for future use by the Contractor in the selected material zone until at least sufficient material is reserved to complete the selected material zone over the whole work. Should the Contractor fail to conserve material of the specified quality, the Superintendent may direct that material of equivalent quality be provided. The cost of providing such extra material shall be borne by the Contractor.

**Selection of Material****Contractor's Cost**

4. The Contractor shall have no right to monetary compensation or a claim for damages in respect of any loss the Contractor may claim to have suffered by reason of the Contractor's failure to reserve sufficient selected material or by reason of stockpiling material for the selected material zone.

**Cost of Handling**

5. The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. Compaction shall be as specified in Clause C213.36.

**Layer Thickness**

6. After placement the selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material which does not comply with the specified requirements of this Clause.

**Homogeneous Layers**

7. The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in Limits and Tolerances Table.

**Tolerances**

### **C213.31 FILL ADJACENT TO STRUCTURES**

1. Supply and placement of fill adjacent to structures shall be deemed to be part of General Earthworks.

**Payment**

2. For the purpose of this Clause, structures shall include bridges, precast and cast-in-place box culverts and retaining walls. Fill adjacent to other culverts and drainage structures shall be provided in accordance with the particular Specifications for STORMWATER DRAINAGE as appropriate.

**Structure  
Types**

3. No filling shall be placed against structures within 21 days after placing concrete in these structures, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the Contractor can demonstrate that 85% of the design strength of the concrete has been achieved.

### **C213.32 TREATMENT AT WEEPHOLES**

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

**Grading**

- (a) The maximum particle dimension shall not exceed 50mm
- (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.

2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes. Permeable geo-textile material shall be placed horizontally segregating the river gravel (broken stone) from the fill.

**Extent**

3. Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.

**Synthetic  
Membrane**

### **C213.33 SELECTED BACKFILL**

1. Selected backfill shall be placed adjacent to structures in accordance with Table C213.2. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS 1289.3.3.1, neither less than 2 nor more than 12.

**Quality**

<b>Structure Type</b>	<b>Selected Backfill</b>	
	<b>Width</b>	<b>Height</b>
Bridge abutments	2m	H
Cast-in-place Box Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining walls	H/3	H
(Where H = height of structure)		

**Table C213.2 - Selected Backfill, Width and Height**

- |   |   |
|---|---|
| 2. The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of Clause C213.36. | <b><i>Placement in Layers</i></b>       |
| 3. The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 metre in width, and the selected backfill shall be placed in accordance with Clause C213.26.  | <b><i>Horizontal Terraces</i></b>       |
| 4. Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within twenty-one days after placing concrete in the bridge deck, unless approved by the Superintendent.   | <b><i>Adjacent to Concrete Deck</i></b> |
| 5. In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by hand placing around or against such structures.   | <b><i>Spill through Abutments</i></b>   |
| 6. In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm.  | <b><i>Framed Structures</i></b>         |

**C213.34 SPOIL**

- |  |                                  |
|--|----------------------------------|
| 1. Spoil is surplus material from excavations under the Contract which is not required to complete the Works as specified or material from excavations under the Contract whose quality the Superintendent deems to be unacceptable for incorporation in the Works.  | <b><i>Definition</i></b>         |
| 2. Where there is surplus material the Superintendent may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in Clauses C213.26 and C213.36 for material in embankments. | <b><i>Use in Embankments</i></b> |
| 3. Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent within the specified working area for the Works or be removed and disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in Clause C213.36 for material in embankments or to such lesser extent as may be approved by the Superintendent.  | <b><i>Disposal of Spoil</i></b>  |

**C213.35 BORROW**

- |  |  |
|--|--|
| 1. Unless provided by the Contract, borrow will only be authorised by the Superintendent if, in constructing cuttings and embankments to the batter slopes specified or directed by the Superintendent or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in Clauses C213.23, C213.28, C213.29 or C213.31, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.   | <b><i>Borrow to be Authorized</i></b>          |
| 2. Where borrow material is required to complete the Works as specified, the location of borrow sites shall be as approved by the Superintendent, and the quality of material shall be acceptable to the Superintendent in accordance with Clauses C213.23, C213.28 or C213.31 as appropriate. The edges of borrow sites shall be no closer than 3 metres from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Superintendent, cut batter slopes not steeper than 4 to 1, and shall be left by the Contractor in a tidy and safe condition. | <b><i>Borrow Site Characteristics</i></b>      |
| 3. For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with the Specification for CLEARING AND GRUBBING and Clause C213.07. Restoration of borrow sites shall be carried out in accordance with the Specification for LANDSCAPING.  | <b><i>Site Preparation and Restoration</i></b> |

4. If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses C213.11, C213.12 and C213.14 as to the re-determination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

***Widening of  
Cutting***

## **COMPACTION AND QUALITY CONTROL**

### **C213.36 COMPACTION AND MOISTURE REQUIREMENTS**

1. In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

***Trimming and  
Compaction***

2. All earthworks shall be compacted to provide a relative compaction, determined by AS 1289.5.7.1 for standard compactive effort, of not less than 98 per cent standard or 95 percent modified.

***98%  
Compaction  
Requirements***

3. Unsuitable material shall be stockpiled as directed by the Superintendent and compacted by track rolling.

***Unsuitable  
Material***

3. At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is within the range set out in Limits and Tolerances Table of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1.

***Moisture  
Content***

Material which becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Superintendent, by the use of hydrated or quick lime at the Contractor's cost.

***Contractor's  
Cost***

Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material. The cost of transport to stockpile for drying out and later use shall be borne by the Contractor. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained. The cost of such wetting or drying the material to be compacted shall be borne by the Contractor.

5. Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

***Prompt  
Compaction***

6. Any material placed by the Contractor that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS 1289.5.7.1, shall be dried out and uniformly recompacted to the required relative compaction in accordance with this Clause before the next layer of material is placed. Alternatively, the Contractor may remove the layer of wetted material to a stockpile site for drying and later re-use. The cost of the removal to stockpile, drying out and reincorporation of the wet material shall be borne by the Contractor.

***Moisture  
Content above  
Optimum***

***Contractor's  
Cost***

### **C213.37 TEST LOCATIONS**

1. The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the Contractor shall work the area to ensure uniform moisture content and compaction of all material within the area.

***Contractor to  
Prepare Area***

2. The tests then taken shall be considered to represent the total volume of material placed within the lot.

***Test Repre-  
sentation***

3. Where the Superintendent considers that the material which is present has not achieved uniformity required by this Clause or Clause C213.26, he may take or direct further testing. The Superintendent shall nominate the area represented by the additional testing.

***Further Testing***

4. If such testing confirms that material not conforming to the Specification is present the cost of such tests shall be borne by the Contractor. The Contractor shall carry out remedial work as necessary to achieve conformance to the requirements of Clause C213.36.

***Contractor's Cost***

### **C213.38 DEFLECTION MONITORING**

1. Following completion of the formation to the underside of the selected material zone in accordance with Clause C213.24 and C213.26, and completion of the selected material zone in accordance with Clause C213.30, the Contractor shall make the work available in lots, for the Superintendent or Council to carry out deflection monitoring.

***Timing of Deflection Monitoring***

2. A lot for deflection testing shall consist of a continuous length of formation of at least 300 m and a single carriageway width which is generally homogeneous with respect to material and appearance. The Contractor shall identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent. The cost of preparing the surface for deflection monitoring is deemed to be included in the rate for General Earthworks.

***Lot Size***

### **C213.39 WITHDRAWN**

## **SPECIAL REQUIREMENTS**

**C213.40 RESERVED**

**C213.41 RESERVED**

**C213.42 RESERVED**

**C213.43 RESERVED**

**C213.44 RESERVED**

## LIMITS AND TOLERANCES

### C213.45 SUMMARY OF TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in the Table below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	<b>Batter Slopes</b>	± 300mm	C213.12
	a) Excavation		
	b) Embankment	± 300mm	C213.27
2.	<b>Floors</b>		
	a) Floor of Cutting	Parallel to the designed grade line and ± 50mm of the designed floor level	C213.14
3.	<b>Tops of Embankments</b>		
	Trimming tops of Embankments	Parallel to the designed grade line, +10mm or -40mm of the levels specified	C213.29
	<b>Shallow embankments</b>		
	Requirements of material in foundations	Moisture Content - within the range of <u>70</u> % to <u>90</u> % of optimum.	C213.24
	<b>Moisture Content</b>		
	Moisture Content of material placed in embankments:	(a) Material in upper zones of formation:- within the range <u>70</u> % to <u>90</u> % of optimum. (b) All other embankment material:- within the range <u>70</u> % to <u>90</u> % of optimum.	
4.	<b>Designed Grade and Crossfall</b>		
	Construction tolerances for Selected material	Zones are + <u>10</u> mm or - <u>40</u> mm of the designed grade and crossfall.	C213.30
5.	<b>Selected Material Zone</b>	Compacted thickness of each layer not exceed 150mm	C213.30
6.	<b>Embankments</b>	Compaction – 98% or as specified in AS 1289.5.7.1	C213.36
7.	<b>Scope –</b>	Cutting areas – 100mm Embankment areas- 100mm The depth below the natural surface to which the removal and measure of topsoil will apply	C213.07

**NOTE:** Plus (+) is towards the roadway/surface and minus (-) is away from the roadway/surface. Tolerances are measured at right angles to design surfaces.

**Table C213.3 - Limits and Tolerances**

### C213.46 WITHDRAWN

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C220

Revision 3

## **STORMWATER DRAINAGE**

GENERAL





## SPECIFICATION C220

## STORMWATER DRAINAGE - GENERAL

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## SPECIFICATION C220 : STORMWATER DRAINAGE - GENERAL

### GENERAL

#### C220.01 INTRODUCTION

1. Drainage works shall form a complete system carrying water through and away from the Works. **Purpose**

2. This is the general Specification common and applicable to all types of drainage lines, open drains, kerb and gutter, and drainage structures and shall be read in conjunction with drainage Specifications:

C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C223	-	Drainage Structures
C224	-	Open Drains, including Kerb and Gutter

as applicable to particular Contracts.

#### C220.02 SCOPE

1. The work to be executed under this Specification consists of: **Scope**

- (a) preparation for stormwater drainage construction,
- (b) temporary drainage during construction,
- (c) siting of pipes, pipe arches and box culverts.
- (d) all activities and quality requirements associated with excavation, bedding and backfilling,
- (e) all concrete work associated with stormwater drainage.

#### C220.03 EXTENT OF WORK

Details of the work are shown on the Drawings.

#### C220.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents  
Standards Test  
Methods**

##### (a) Other Council Specifications

C211	-	Control of Erosion and Sedimentation
C213	-	Earthworks
C271	-	Concrete Works

##### (b) Australian Standards

AS 1289.5.7.1	-	Compaction Control Test Half density ratio and Half moisture variation(rapid method)
AS 1289.5.1.1		Determination of the dry density/moisture content relation of a soil using standard compactive effort

**(d) NSW Government Legislation****C220.05 TEMPORARY DRAINAGE DURING CONSTRUCTION**

- |   |                                    |
|---|------------------------------------|
| 1. All drainage works carried out by the Contractor shall comply with the Specification for CONTROL OF EROSION AND SEDIMENTATION.   | <b>Control</b>                     |
| 2. The Contractor shall make adequate provision for runoff flows at drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities. | <b>Contractor's Responsibility</b> |
| 3. The Contractor shall not implement any proposals to dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of Council by way of approved Drawings or written instruction.   | <b>Limitations</b>                 |

**C220.06 WITHDRAWN****C220.07 EXCAVATION**

- |   |   |
|---|---|
| 1. Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with the Specification for EARTHWORKS.   | <b>Topsoil</b>                                |
| 2. Excavation shall be undertaken in compliance with all relevant legislation. The Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with these Acts.  | <b>Safety</b>                                 |
| 3. Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority to the method of excavation before commencing excavation.   | <b>Approval by Public Utility Authorities</b> |
| 4. Excavation by blasting, if permitted by Council, shall be carried out in accordance with Blasting requirements in the Earthworks Specification and table 2.13.1. The Contractor shall comply with other requirements concerning blasting operations in the Specification for EARTHWORKS.   | <b>Blasting Operation</b>                     |
| 5. Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed by the Contractor.   | <b>Excavation Level</b>                       |
| 6. Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable shall be removed and disposed in accordance with the Specification for EARTHWORKS by the Contractor and replaced with backfill material in accordance with the requirements of this Specification and the Specifications for particular culvert types. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert. | <b>Unsuitable Material</b>                    |
| 7. The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with the Specification for EARTHWORKS.  | <b>Spoil</b>                                  |

**C220.08 BACKFILLING**

Backfilling shall be carried out in accordance with the requirements of the relevant culverts or drainage structures Specifications and to the compaction requirements specified below.

**C220.09 COMPACTION**

1. Foundations, bedding and backfilling shall be compacted to the following requirements when tested in accordance with AS1289. **Standard**

	Relative Compaction
Foundations or trench base to a depth of 150mm below foundation levels	98%
Material replacing unsuitable material	98%
Bedding material	98%
Selected backfill and ordinary backfill material	
• below 1.5m of finished surface	98%
• within 1.5m of finished surface	98%
Backfill material within the selected material zone	98%

2. All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced. **Layers**

3. At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 70 per cent nor more than 90 per cent of the apparent optimum moisture content, as determined by AS 1289.5.7.1. **Moisture Content**

4. When compacting adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage to any culvert or drainage structure. **Precautions**

**C220.10 CONCRETE WORK**

1. For all concrete work, the Contractor shall comply with the Specification for CONCRETE WORKS in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection. **Specification**

**C220.11 SPRAYED CONCRETE**

1. If sprayed concrete has been specified, shown on the Drawings or directed by the Superintendent, it shall comply with requirements in the Specification for CONCRETE WORKS. **Standard**

**C220.12 WITHDRAWN**

## LIMITS AND TOLERANCES

### C220.13 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C220.1 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	<b>Relative Compaction (Standard)</b>		
	(a) Foundations or trench base to a depth of 150mm below foundation levels	98%	C220.09
	(b) Material replacing unsuitable material	98%	C220.09
	(c) Bedding material	98%	C220.09
	(d) Selected backfill and ordinary backfill material:		C220.09
	• below 1.5m of finished surface	98%	
	• within 1.5m of finished surface	98%	
	(e) Backfill material within the selected material zone	98%	C220.09
2.	<b>Backfill</b>		
	(a) Layers	≤ 150mm	C220.09
	(b) Moisture Content	>70%, ≤90%	C220.09

**Table C220.1 - Summary of Limits and Tolerances**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C221  
Revision 3

## PIPE DRAINAGE





## SPECIFICATION C221 - PIPE DRAINAGE

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## PIPE DRAINAGE

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## SPECIFICATION C221 : PIPE DRAINAGE

### GENERAL

#### C221.01 SCOPE

1. This Specification covers the supply and installation of pipes for stormwater drainage.
2. This Specification should be read in conjunction with the specification for STORMWATER DRAINAGE - GENERAL. **Associated Specifications**
3. The work to be executed under this Specification consists of supply of pipes , bedding, installation and backfilling. **Extent of Work**
4. Steel pipes are not to be used **Steel Pipes**

#### C221.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents**

##### (a) Council Specifications

##### Specifications

- |      |   |                               |
|------|---|-------------------------------|
| C213 | - | Earthworks                    |
| C220 | - | Stormwater Drainage - General |
| C230 | - | Subsurface Drainage - General |
| C271 | - | Minor Concrete Works          |

##### (b) Australian Standards

##### Standards

- |                |   |  |
|----------------|---|--|
| AS 1141.11     | - | Particle size distribution by sieving.   |
| AS 1254        | - | Unplasticized PVC (UPVC) pipes and fittings for storm or surface water applications. |
| AS 1289.3.3.1  | - | Calculation of the plasticity index of a soil.                                       |
| AS 1289.4.3.1  | - | Determination of the pH value of a soil - Standard method.                           |
| AS 1289.4.4.1  | - | Determination of the electrical resistivity of sands and granular materials.         |
| AS 1289.5.4.1  | - | Determination of relative compaction   |
| AS 1289.5.6.1  | - | Compaction control test - Density index method for a cohesionless material.          |
| AS 1397        | - | Steel sheet and strip - Hot-dipped zinc coated or aluminium/zinc coated.             |
| AS/NZS4680     | - | Hot-dipped galvanised (zinc) coatings on fabricated ferrous articles.                |
| AS/NZS 4534    | - | Zinc and zinc/aluminium alloy coatings on steel wire                                 |
| AS 1761        | - | Helical lock-seam corrugated steel pipes.  |
| AS 1762        | - | Helical lock-seam corrugated steel pipes - Design and installation.                  |
| AS 2032        | - | Code of practice for installation of UPVC pipe systems.                              |
| AS/NZS 2041    | - | Buried corrugated metal structures.  |
| AS 2042        | - | Corrugated steel pipes, pipe arches and arches - Design and installation.            |
| AS/NZS 3750.15 | - | Paints for steel structures - Inorganic zinc silicate paint.                         |
| AS 3725        | - | Loads on buried concrete pipes.  |
| AS 4058        | - | Precast concrete pipes (pressure and non-pressure)                                   |
| AS 4139        | - | Fibre reinforced concrete pipes and fittings.  |

**(c) RTA Test Methods****Test Methods**

- T102 - Pretreatment of Samples of Road Materials by Compaction.

**GENERAL REQUIREMENTS****C221.03 GENERAL**

- |   |  |
|---|--|
| 1. Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent that cracking load testing, as required by the appropriate Australian Standards and this Specification has been carried out and the representative specimens have satisfied the cracking load test requirements.   | <b>Load Testing</b>                        |
| 2. The cost of these tests is deemed to be part of the supply and installation  | <b>Costs</b>                               |
| 3. The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.   | <b>Excavation<br/>Drainage</b>             |
| 4. Culverts shall be installed within 10mm of the grade line and within 10mm of the horizontal alignment specified on the Drawings. The Contractor shall relay any culvert which is not within these tolerances.  | <b>Tolerances</b>                          |
| 5. At the discharge end of culverts terminating at pits and headwalls a 3m length of 100mm diameter subsurface drain shall be laid in the trench 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with the Specification for SUBSURFACE DRAINAGE. | <b>Subsurface<br/>Drain</b>                |
| 6. Where the Contractor proposes to travel construction plant in excess of 5 tonnes gross mass over culverts, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to the Superintendent for prior approval.   | <b>Construction<br/>Plant<br/>Movement</b> |

**REINFORCED CONCRETE AND FIBRE REINFORCED CONCRETE PIPES****C221.04 PIPES**

- |   |  |
|---|--|
| 1. Reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the Drawings.   | <b>Reinforced<br/>Concrete Pipes<br/>Fibre<br/>Reinforced<br/>Pipes<br/>Joints</b> |
| 2. Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the Drawings.  |  |
| 3. Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints as recommended by the manufacturer. |  |

**C221.05 CONDITIONS OF INSTALLATION**

- |  |  |
|--|--|
| 1. Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition. | <b>Formation to<br/>Subgrade<br/>Level</b> |
| 2. Installation shall be in accordance with this Specification and AS3725 and AS3725 Supplement 1 for Type HS3 support.  |  |
| 3. For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified below. The trench shall not be excavated wider than 1.4 times the                       | <b>Normal Trench<br/>Conditions</b>        |

external diameter of the pipe plus 300mm.

4. Pipes laid in wide trench conditions will be deemed to be in embankment conditions. Wide trench conditions apply when, for a single pipe, the width of trench,  $W \geq D + 1$  metre where  $D$  is the pipe diameter. For multi-cell pipes wide trench conditions apply when the width of trench,  $W \geq \Sigma D + \Sigma S + 1$  metre where  $S$  is the square spacing between the pipelines.

### **Wide Trench Conditions**

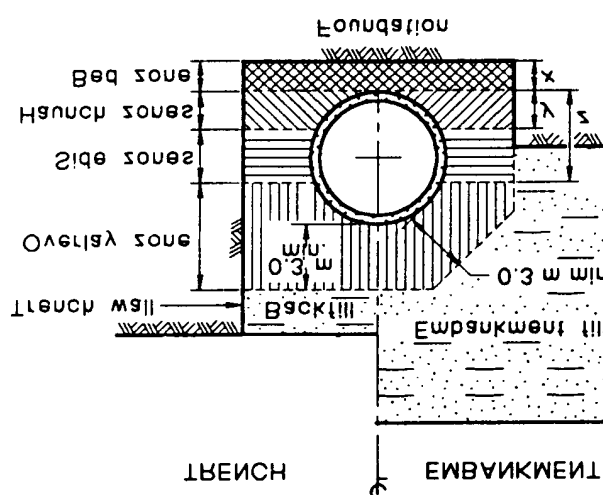
## **C221.06 BEDDING**

1. Unless otherwise shown on the Drawings, the bedding requirements shall be as set out in this clause.

### **Requirements**

2. Figure C221.1 indicates the proportionate dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions.

### **Bedding Dimensions**



where,  $Z \geq 0.7D$   
 $Y = 0.3D$   
 $X = 100$  for  $D \leq 1500$   
 $X = 150$  for  $D > 1500$   
 $D$  = External Diameter of Pipe

**Figure C221.1**  
**Pipe Installation Conditions**

3. Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table C221.2, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

**Material  
Requirements**

Sieve size mm	Weight passing %
19.0	100
2.36	50 - 100
0.60	20 - 90
0.30	10 - 60
0.15	0 - 25
0.075	0 - 10

**Table C221.2  
Bedding Material Grading Limits**

4. The Contractor shall advise the Superintendent of the source of bedding material.

**Source**

5. Bedding material in the bed and haunch zones shall be placed and compacted in layers not exceeding 150mm in thickness. Bedding material shall be compacted to a minimum relative compaction of 95 per cent as determined by Test Method T166 (standard compactive effort), or if the material is a cohesionless material to a minimum density index of 70 per cent as determined by AS 1289.5.6.1. The top of the bedding material shall be shaped accurately to house the pipe.

**Compaction  
Requirements**

6. Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.

**Cementitious  
Stabilisation****C221.07 INSTALLATION****(a) General**

1. Pipes shall be laid with the socket end placed upstream. Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m. The minimum pipe to be used at culvert ends shall be 2.4m.

**Positioning of  
Pipes**

2. Lifting holes in all pipes shall be sealed by an approved method before the commencement of backfilling.

**Seal Lifting  
Holes****(b) Joints in Reinforced Concrete Pipes****(i) Rubber Ringed Joints**

1. Before making the joint, the spigot and socket and the rubber ring shall be clean and dry except for any lubricants recommended by the manufacturer.

**Clean and Dry  
Material**

2. The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the Superintendent. **Procedure**

3. The joint shall be tested to ensure that the rubber ring has rolled evenly into place. **Joint Test**

**(ii) Flush or Butt Joints**

1. Flush or butt joints shall be used only where required to extend existing culverts. If pipes with flush or butt joints are required, the ends of the pipes shall be butted together. The joints shall be sealed with proprietary rubber sleeves, supplied and installed in accordance with the manufacturer's recommendations. **Jointing**

**(c) Joints in Fibre-Reinforced Cement Pipes**

**(i) New Pipes**

1. Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in Clause C221.07(b). Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions. **Procedure**

**(ii) Direct Side Connections to Other Pipes**

1. Direct side connections to other pipes shall be as detailed on the Drawings.

**C221.08 BACKFILL**

1. Backfill to the side and overlay zones shall consist of Selected Backfill as defined in the Specification for EARTHWORKS. It shall be placed around the pipe to the dimensions shown in Figure C221.1 and compacted in accordance with the requirements in the Specification for STORMWATER DRAINAGE - GENERAL. The remainder of the trench to the underside of the selected material zone as specified in the Specification for EARTHWORKS shall be backfilled with material satisfying the requirements for embankment material as defined in the Specification for EARTHWORKS. Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in the Specification for EARTHWORKS. **Procedure**

2. Backfilling on both sides of the culvert and both sides of the wingwalls shall be carried out simultaneously. Backfilling and compaction shall commence at the pipe or wall. **Sequence**

3. All backfilling operations shall conform to the requirements in the Specification for STORMWATER DRAINAGE - GENERAL. **Associated Specification**

**C221.09     WITHDRAWN**

**C221.10     WITHDRAWN**

**C221.11     WITHDRAWN**

**C221.12     WITHDRAWN**

**C221.13     WITHDRAWN**

**C221.14     WITHDRAWN**

**C221.15     WITHDRAWN**

**C221.16     WITHDRAWN**

**C221.17     WITHDRAWN**

**C221.18     WITHDRAWN**

### **UPVC PIPES**

#### **C221.19     CULVERT MATERIALS**

1.        Unplasticised PVC (UPVC) Pipes and Fittings shall be manufactured in accordance with AS 1254. ***Specification***

#### **C221.20     INSTALLATION**

1.        The materials utilised, the excavation requirements, bedding, backfill and jointing requirements for UPVC pipes are those set out in Section 7 of AS 2032. Installation of all UPVC pipes shall comply with the requirements of this Australian Standard.

### **SPECIAL REQUIREMENTS**

**C221.21     RESERVED**

**C221.22     RESERVED**

**C221.23     RESERVED**

**C221.24     RESERVED**

**C221.25     RESERVED**



## LIMITS AND TOLERANCES

## C221.26 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	<b>Culvert Position</b>		
	(a) Grade Line	$\pm 10\text{mm}$	C221.03
	(b) Horizontal Alignment	$\pm 10\text{mm}$	C221.03
2.	<b>Bedding</b>		
	(a) Compacted Layers	$< 150\text{mm}$	C221.06
3.	<b>Installation</b>		
	(a) Normal Trench	$< 1.4 \times \text{External Diameter} + 300\text{mm}$	C221.05
	(i) Trench Width		
	(b) Pipe Length	$> 1.2\text{m}$	C221.07a

Table C221.2 - Limits and Tolerances

# DEVELOPMENT CONSTRUCTION SPECIFICATION

**C222**  
Revision 3

## **PRECAST BOX CULVERTS**



## SPECIFICATION C222 - PRECAST BOX CULVERTS

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## SPECIFICATION C222 : PRECAST BOX CULVERTS

### GENERAL

#### C222.01 SCOPE

##### *Scope*

1. This Specification covers the installation of precast concrete box culverts and should be read in conjunction with the Specification for STORMWATER DRAINAGE - GENERAL.

2. The work to be executed under this Specification consists of:

##### *Extent of Work*

- (a) preparation of foundations;
- (b) provision of bedding;
- (c) construction of base slabs;
- (d) installation of precast culvert units;
- (e) headwalls and wingwalls;
- (f) backfilling against structures;
- (g) provision and removal of coffer dams;
- (h) excavation of inlet and outlet channels.

#### C222.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

##### *Documents Standards Test Methods*

##### **(a) Other Council Specifications**

- C213 - Earthworks
- C220 - Stormwater Drainage - General
- C224 - Open Drains, including Kerb and Gutter
- C242 - Flexible Pavements
- C271 - Minor Concrete Works

##### **(b) Australian Standards**

- AS1597.1 - Precast reinforced concrete box culverts - Small culverts
- AS1597.2 - Precast reinforced concrete box culverts - Large culverts
- ISO 9002 AS/NZS ISO 9002 Quality Systems - Model for Quality Assurance in Production, Installation and Servicing.

### MATERIALS

#### C222.03 CULVERT UNITS, LINK AND BASE SLABS

##### *Supply*

1. The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS 1597.1 for small culverts not exceeding 1200mm width and 900mm depth and AS 1597.2 for large culverts from 1500mm span and up to and including 4200mm span and 4200mm height with the following alterations or additional requirements:

- (a) Proof load testing shall be arranged by the Contractor in batches as specified in either AS 1597.1 or AS1597.2 as appropriate.
- (b) Lifting holes, galvanised lifting points or steel lifting eyes shall be provided in the culvert units, link and base slabs.
- (c) The end units shall have factory installed starter bars for headwall and wingwall construction.
- (d) Delivery and unloading shall be the Contractor's responsibility.

2. The Supplier shall implement and maintain a Quality System in accordance with ISO 9002 to ensure materials and manufacture conform to the appropriate Standards.

3. A conformance certificate for the box culvert units shall be submitted at least 3 working days prior to despatch.

4. Each unit shall be marked at time of manufacture with:

- (a) Type and size
- (b) Casting date
- (c) Manufacturer's name
- (d) Inspection pass and date.

#### **C222.04 CONCRETE**

1. The concrete and reinforcement for cast-in-situ base slabs shall comply with the Specification for MINOR CONCRETE WORK. **Quality**

#### **C222.05 FILL**

##### **A SELECTED BACKFILL**

1. The quality of selected backfill shall comply with the requirements in AS 1597.2. **Quality**

##### **B ORDINARY BACKFILL**

1. Ordinary backfill is approved material obtained from culvert excavations, cuttings and/or borrow areas which is in accordance with the requirements for the upper 1.0m of embankment construction as detailed in the Specification for EARTHWORKS. **Quality**

##### **C SELECT FILL**

Select fill for this specification shall comply with the requirement of unbound base material from Specification for Flexible Pavements C242. **Quality**

#### **C222.06 WITHDRAWN**

### **CONSTRUCTION**

#### **C222.07 WITHDRAWN**

#### **C222.08 EXCAVATION**

1. Excavation shall be carried out in accordance with the provisions in the Specification for STORMWATER DRAINAGE - GENERAL. **Specification**

- |   |                            |
|---|----------------------------|
| 2. The trench width shall be the width of the base slab plus 500mm minimum each side. | <b><i>Trench Width</i></b> |
|---|----------------------------|

**C222.09 FOUNDATIONS**

- |   |                                     |
|---|-------------------------------------|
| 1. Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the Drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed.  | <b><i>Rock Foundations</i></b>      |
| 2. Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material. | <b><i>Additional Excavation</i></b> |
| 3. Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock.  | <b><i>Uniform Surface</i></b>       |
| 4. Earth foundations shall be finished to line and level to the underside of bedding shown on the Drawings. Care shall be taken to avoid disturbing material below this level.  | <b><i>Line and Level</i></b>        |
| 5. All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Superintendent and backfilled in accordance with the Specification for STORMWATER DRAINAGE - GENERAL.   | <b><i>Unsuitable Material</i></b>   |

**C222.10 BEDDING****(a) In-Situ Base Slabs**

- |  |                             |
|--|-----------------------------|
| 1. No bedding material shall be placed until the foundations have been inspected and approved by the Superintendent.   | <b><i>Inspection</i></b>    |
| 2. Bedding shall be mass concrete as shown on the Drawings.  | <b><i>Type</i></b>          |
| 3. Mass concrete bedding shall be of the same compressive strength as for the base slab and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of $\pm 10$ mm in level and $\pm 5$ mm in line. The bedding shall be finished to a smooth surface. | <b><i>Mass Concrete</i></b> |

**(b) Precast Base Slabs**

- |   |  |
|---|--|
| 1. Precast base slabs shall not be used |  |
|---|--|

### C222.11 IN-SITU BASE SLABS

1. Cast-in-situ base slabs shall be constructed to the dimensions shown on the Drawings and in accordance with the requirements of the Specification for MINOR CONCRETE WORKS C271. The invert levels shall be within -10mm to +10mm, grade 5mm in 2.5m (1 in 500) and plan position  $\pm 50$ mm.

**Construction**

2. Recesses to accommodate the walls of the precast crown units shall be formed in the base slab to the dimensions shown on the Drawings.

**Recesses for Walls**

### C222.12 INSTALLATION OF PRECAST UNITS

1. Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa and the Contractor has produced documentary evidence to the Superintendent that proof load testing, as required by AS 1597.1 or AS 1597.2 as appropriate, has been carried out and the representative specimens satisfied the proof load test requirements. The cost of these tests is deemed to be part of the supply and installation Pay Item.

**Proof Load Testing**

2. Precast crown units shall be placed on a bed of mortar in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout.

**Mortar Bed in Recess**

3. Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit.

**Mortar Bed on Supports**

4. In the case of multi-cell culverts, a nominal 15mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.

**Gap Between Cells**

5. All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

**Curing of Joints**

### C222.13 BACKFILLING

1. All bracing and formwork shall be removed prior to backfilling.

**Formwork**

2. Selected fill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with the Specification for EARTHWORKS.

**Selected Fill**

3. No fill shall be placed against wingwalls until 21 days after casting.

**Wingwalls**

4. Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

**Sequence**

5. Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m before the backfill is placed.

**Horizontal Terraces**

### C222.14 EXCAVATION OF INLET AND OUTLET CHANNELS

1. Excavation of inlet and outlet channels shall be carried out as shown on the Drawings and shall extend to join the existing stream bed in a regular manner as detailed in the Specification for OPEN DRAINS INCLUDING KERB AND GUTTER.

**Extent**



### C222.15 CONSTRUCTION LOADING ON CULVERTS

1. Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32MPa.
2. Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

***Traffic Over  
Culvert***

***Loading  
Restrictions***

## LIMITS AND TOLERANCES

### C222.16 SUMMARY OF TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarised in the Table below:

Item	Activity	Tolerance	Spec Clauses
1.	<b>Mass Concrete Bedding</b>		
	a) Level	± 10mm	C222.10
	b) Line	± 5mm	C222.10
2.	<b>Culvert Location</b>		
	a) Invert Level	±10mm	C222.11
	b) Grade	5mm in 2.5m (1 in 500)	C222.11
	c) Plan Position	±50mm	C222.11

**Table C222.1 - Summary of Limits and Tolerances**

## SPECIAL REQUIREMENTS

**C222.17 RESERVED**

**C222.18 RESERVED**

**C222.19 RESERVED**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

**C223**  
Revision 3

## **DRAINAGE STRUCTURES**



## SPECIFICATION C223 - DRAINAGE STRUCTURES

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## SPECIFICATION C223 : DRAINAGE STRUCTURES

### GENERAL

#### C223.01 SCOPE

1. This Specification covers the construction of drainage structures and shall be read in conjunction with the Specification for STORMWATER DRAINAGE - GENERAL and other drainage Specifications as applicable:

***Associated Specifications***

- |      |  |
|------|--|
| C221 | - Pipe Drainage                          |
| C222 | - Precast Box Culverts                   |
| C224 | - Open Drains, including Kerb and Gutter |

2. The work to be executed under this Specification consists of the construction of headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators, batter drains and other supplementary structures as shown on the Drawings.

***Extent of Work***

#### C223.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

##### (a) Council Specifications

- |      |  |
|------|--|
| C213 | - Earthworks                             |
| C220 | - Stormwater Drainage - General          |
| C221 | - Pipe Drainage                          |
| C222 | - Precast Box Culverts                   |
| C224 | - Open Drains, including Kerb and Gutter |
| C271 | - Minor Concrete Works                   |

##### (b) Australian Standards

- |         |   |
|---------|---|
| AS 3996 | - Metal access covers, road grates and frames |
|---------|---|

##### (c) RTA Specifications

- |      |  |
|------|--|
| 3204 | - Preformed Joint Fillers for Concrete Road Pavements and Structures |
|------|--|

### CONSTRUCTION

#### C223.03 GENERAL

1. Drainage structures shall be constructed in concrete and in accordance with the Specification for MINOR CONCRETE WORKS C271.

***Concrete Work***

2. All structures shall be constructed as soon as practicable and shall be completed not later than 28 days after the construction of the associated culverts, unless otherwise approved by the Superintendent.

***Time for  
Completion***

#### C223.04 ALIGNMENT

1. Unless otherwise shown on the Drawings, headwalls and pits shall be constructed

parallel to the road centreline and wingwalls at 135° to the headwall.

2. The wingwalls and headwalls shall be splayed so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall where the culvert is laid skew to the road unless shown otherwise on the drawings. **Skew Angle**

3. Energy dissipators shall be constructed on the axis of the culvert. **Energy Dissipators**

#### **C223.05 HEADWALLS AND WINGWALLS**

1. The wingwalls shall be constructed to retain the batters effectively. Where the dimensioned drawings do not satisfy this requirement the Superintendent shall be notified before the headwalls and wingwalls are constructed. The Superintendent shall direct the Contractor as to the action to be taken. **Batter Retention**

2. Where rock is encountered at the bottom of excavations for wingwalls and headwalls, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown in the Drawings, but must be not less than 150mm into sound rock. **Rock Foundations**

#### **C223.06 PITS**

1. All new pits, including gully grates and frames complying with AS 3996, shall be constructed to the details shown on the Drawings. Modification of existing pits is only to be carried out if such is shown on the Drawings. **Modification**

2. Where pits and drop structures are deeper than 1.2m the Contractor shall install suitable galvanised step irons at a vertical spacing of 300mm in one wall of the pit, for the full depth of the pit. **Step Irons**

#### **C223.07 PRECAST UNITS**

1. Where precast units are provided in the design they shall be handled and installed in accordance with the manufacturer's instructions. **Manufacturer's Instructions**

2. If the Contractor proposes to use precast units, detailed drawings and complete details of installation procedures shall be submitted for the approval of the Superintendent. **Contractor's Responsibility**

3. Unless otherwise approved by the Superintendent, precast units shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out. **Delivery**

#### **C223.08 JOINTING**

1. Where drainage structures abut concrete paving, kerb and gutter or other concrete structures, a 10mm wide joint shall be provided between the structure and paving, or kerb and gutter or other concrete structures. The joint shall consist of preformed jointing material complying with RTA Specification 3204. **Preformed Jointing Material**

#### **C223.09 MASS CONCRETE BEDDING**

1. Mass concrete bedding shall not be placed on earth or rock foundations until the foundations have been inspected and approved by the Superintendent. Following such approval, the surface of the foundation shall be dampened and a layer of concrete not less than 50mm thick, shall be placed over the excavated surface and shall be finished to a smooth even surface. **Foundation Inspection**

### C223.10 BACKFILL

- |  |                                |
|--|--------------------------------|
| 1. Backfilling shall not commence until the compressive strength of concrete has reached at least 15MPa unless otherwise approved by the Superintendent.   | <b>Commence-<br/>ment</b>      |
| 2. Selected backfill shall be placed against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure.   | <b>Selected<br/>Backfill</b>   |
| 3. Selected backfill shall consist of a granular material in accordance with the requirements in the Specification for EARTHWORKS C213.  | <b>Composition</b>             |
| 4. Special care shall be exercised to prevent wedge action against vertical surfaces during the backfilling. Where the sides of the excavation are steeper than 4 horizontally to 1 vertically they shall be cut in the form of successive horizontal terraces at least 600mm in width, as the backfill is placed. | <b>Horizontal<br/>Terraces</b> |
| 5. Backfill on both sides of wingwalls up to stream bed level shall be carried up to level simultaneously. Backfilling and compaction shall commence at the wall. Compaction shall be in accordance with the Specification for STORMWATER DRAINAGE – GENERAL C220.   | <b>Procedure</b>               |

### SPECIAL REQUIREMENTS

C223.11 RESERVED

C223.12 RESERVED

C223.13 RESERVED



## LIMITS AND TOLERANCES

### C223.14 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C223.1 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	<b>Cut-off Walls</b> Depth into sound rock	>150mm	C223.05
2.	<b>Mass Concrete Bedding</b>	>50mm	C223.09

Table C223.1 - Table of Limits and Tolerances

### C223.15 WITHDRAWN

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C224

Revision 3

**OPEN DRAINS  
INCLUDING KERB & GUTTER**



## SPECIFICATION C224 - OPEN DRAINS, INCLUDING KERB AND GUTTER

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**SPECIFICATION C224 : OPEN DRAINS, INCLUDING KERB AND GUTTER****GENERAL****C224.01 SCOPE**

1. The work to be executed under this Specification consists of the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions.

**Scope**

2. This Specification should be read in conjunction with the Specification for STORMWATER DRAINAGE - GENERAL, and other drainage Specifications as applicable:

C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C223	-	Drainage Structures
C226	-	Vehicular Crossings

**C224.02 DEFINITION**

1. Open drains are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerbs and gutters.

**Definition****C224.03 REFERENCE DOCUMENTS**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods****(a) Council Specifications**

C211	-	Control of Erosion and Sedimentation
C220	-	Stormwater Drainage - General
C221	-	Pipe Drainage
C222	-	Precast Box Culverts
C271	-	Minor Concrete Works
C273	-	Landscaping
C213	-	Earthworks

**(b) Australian Standards**

AS 1141.22	-	Method for sampling and testing aggregates - Wet/dry strength variation
AS 1289.5.7.1	-	Compaction control test Hilf density ratio and hilf moisture variation (rapid method)
AS 2876	-	Concrete kerbs and channels (gutters) - Manually or machine placed

**(c) RTA Specifications**

3204	-	Preformed Joint Fillers for Concrete Road Pavements and Structures.
------	---	---

## UNLINED OPEN DRAINS

### C224.04 GENERAL

- |    |   |                                  |
|----|---|----------------------------------|
| 1. | Unlined open drains shall be constructed in accordance with the drawings.   | <b><i>Drawings</i></b>           |
| 2. | Open drains shall be extended as necessary to lead the water clear of the work to natural drainage depressions, culverts, or pits connected to underground drainage systems. The drains shall follow existing watercourses and depressions in the natural surface, unless other locations are shown on the Drawings | <b><i>Open Drains</i></b>        |
| 3. | All work shall be undertaken in accordance with the requirements of the Specification for CONTROL OF EROSION AND SEDIMENTATION.   | <b><i>Control of Erosion</i></b> |

### C224.05 TYPES

- |    |  |  |
|----|--|--|
| 1. | Catch drains shall be provided above the tops of cuttings or the toes of embankments where shown on the Drawings before construction of the adjacent roadway. The edges of catchdrains shall not be less than 2m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains.   | <b><i>Catch Drains</i></b>                   |
| 2. | Minor diversion and contour drains shall be constructed where shown on the Drawings or directed by the Superintendent. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain.   | <b><i>Diversion &amp; Contour Drains</i></b> |
| 3. | Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the Drawings. Their construction is deemed to be part of earthworks.  | <b><i>Table Drains</i></b>                   |
| 4. | Inlet, outlet and diversion channels shall be excavated as shown on the Drawings and, unless indicated otherwise, shall extend to join the existing stream bed in a regular manner to the Superintendent's satisfaction. The channel shall be excavated to the full width of the structure but the existing stream bed shall be preserved as far as possible outside the limits of the excavation. | <b><i>Channels</i></b>                       |

### C224.06 CONSTRUCTION

- |    |   |   |
|----|---|---|
| 1. | The Contractor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site. Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally. | <b><i>Contractor's Responsibility</i></b> |
| 2. | Any excess material shall be legally and responsibly disposed of by the Contractor.   | <b><i>Excess Material</i></b>             |
| 3. | Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with the Specification for LANDSCAPING.  | <b><i>Revegetation</i></b>                |

## LINED OPEN DRAINS

### C224.07 GENERAL

- |    |   |                       |
|----|---|-----------------------|
| 1. | Lined open drains include concrete gutters/channels and kerb and gutter.  |                       |
| 2. | Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain. | <b><i>Profile</i></b> |

3. Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining. Other than for lined open drains on pavement courses, the relative compaction shall be in accordance with Earthworks Specification.

**Compaction of Foundations**

#### **C224.08 CONCRETE LINING**

1. Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with the Specification for MINOR CONCRETE WORKS. In wet areas weepholes shall be provided in the concrete at intervals as determined by the Superintendent.

**Method**

#### **C224.09 STONE PITCHING**

1. Stone Pitching shall consist of sound durable rock not less than 100mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface. The exposed surface of each stone or block shall be approximately flat and not less than 0.05 square metres in area. Spaces between adjacent stones or blocks shall not exceed 20mm in width.

**Rock Quality and Placing**

2. Concrete shall be 25mpa in accordance with Minor Concrete Works and 100mm thick or the thickness of the largest rock used in stone pitching whichever is the greater.

**Concrete**

#### **C224.10 BATTER DRAINS**

1. Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the Drawings.

**Type**

2. The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0mm to -50mm from the batter line at the underside of topsoil.

**Installation**

3. Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the rim of the trough.

**Compaction**

4. When topsoil is placed it shall be 75mm thick for either side of drain and flush with the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 1000mm and laid perpendicular to the line of the drain, pinned down as provided in the Specification for LANDSCAPING.

**Topsoil and Turfing**

#### **C224.11 PROPRIETARY PRODUCTS**

1. Proprietary products shall only be used if shown on the drawings. Where specified, they must be used strictly in accordance with the manufacturer's instructions.

**Manufacturer's Instructions**

#### **C224.12 KERB AND GUTTER**

1. Kerb and/or gutters may be constructed in fixed forms, by extrusion or by slip forming, in accordance with AS 2876.

**Method**

2. The foundation, concrete quality, curing and testing details shall be in accordance AS 2876.

**Construction Details**

3. The top and face of the finished kerb and gutter shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities.

**Finish**

4. The level at any point on the surface of the gutters shall be within  $\pm 5$ mm of design levels when a straight edge 3m long is laid on top of or along the face of the kerb or on the surface of gutters, the surface shall not vary more than 3mm from the edge of the straight

**Tolerances**



5. Unless shown otherwise on the Drawings, contraction joints, shall be formed every 3m of gutter length for a minimum of 90 per cent of cross sectional area. The joint shall be tooled 20mm in depth to form a neat groove of 5mm minimum width.

## Contraction Joints

6. For kerbs and/or gutters constructed in fixed forms unless shown otherwise on the Drawings, expansion joints shall be 15mm in width for the full depth of the kerb and gutter and shall be constructed at intervals not exceeding 15m.

## Expansion Joints

7. Expansion joints shall be installed and shall consist of a joint filler complying with RTA Specification 3204 where the gutter abuts against retaining walls and overbridges.

8. Where kerbs and/or gutters are cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and/or gutter.

### Adjacent Concrete Pavement

9. House stormwater outlets shall be provided and/or extended through the kerb as shown on the Drawings and shall be in accordance with the standard drawing figure C224.1 and C224.2.

## Stormwater Outlets

### Standard Drawing - House Stormwater outlet through roll kerb

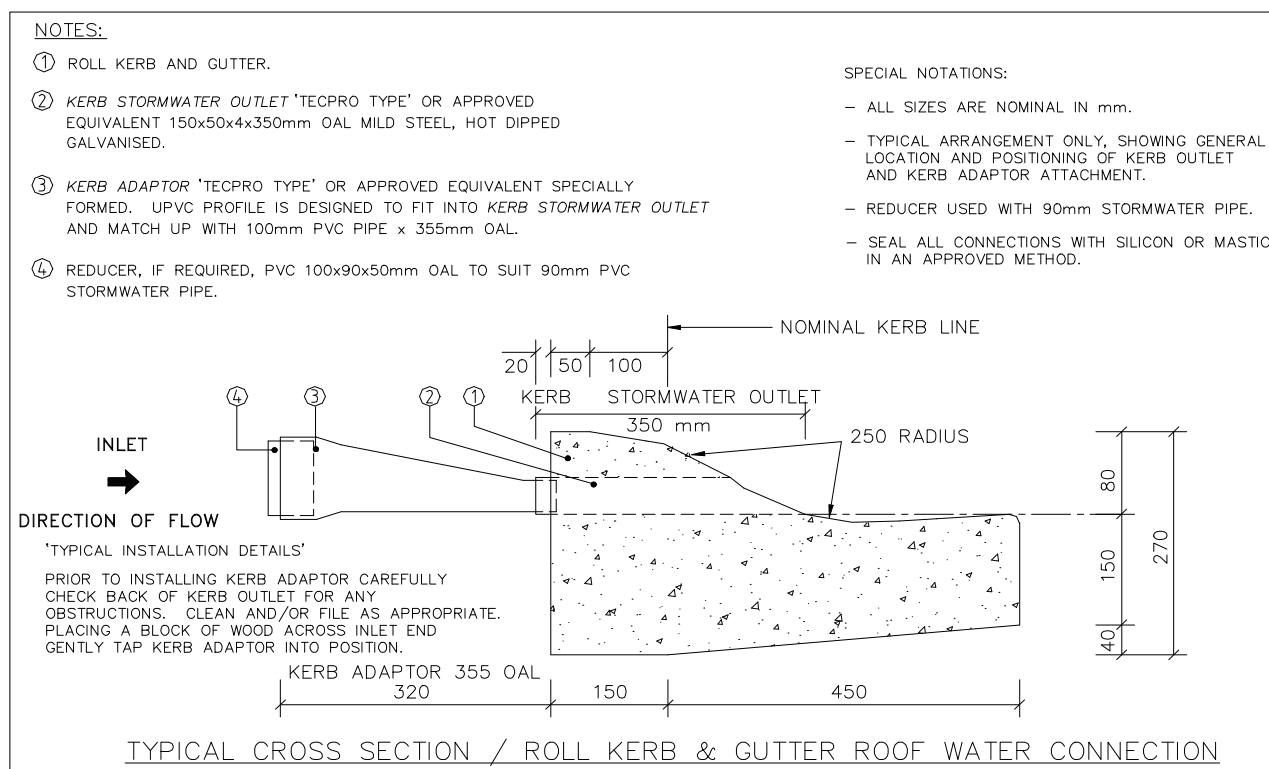


Figure C224-1

### Standard Drawing - House Stormwater outlet through Standard kerb

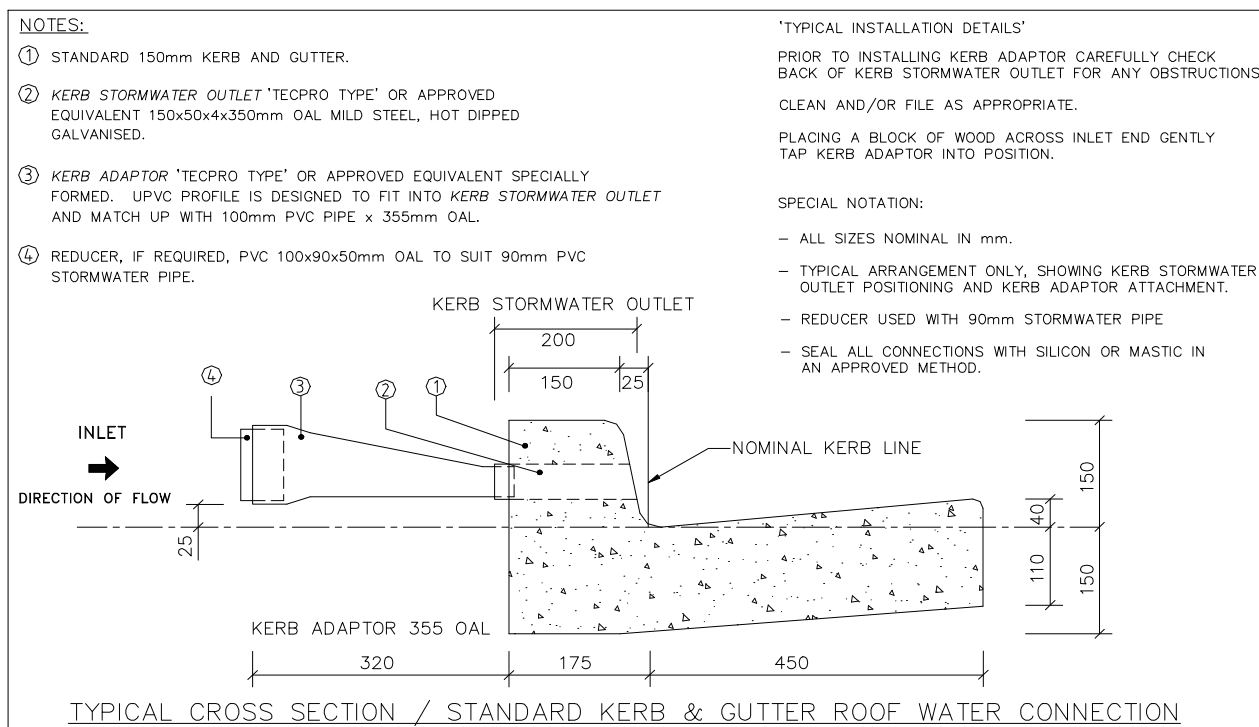


Figure C224-2

10. Opposite all driveways, where shown on the Drawings or where directed by the Superintendent, barrier kerb shall be discontinued to provide for vehicular or pedestrian access. At such locations, kerb laybacks shall be constructed in accordance with C226 Vehicular Crossings. Footpath crossovers shall be constructed to meet the laybacks as shown in C226 Vehicular Crossings, or reinstated to match existing materials where not otherwise shown.

**Vehicular or  
Pedestrian  
Access**

## ROCK FILLED WIRE MATTRESSES AND GABIONS

### C224.13 GENERAL

1. Rock-filled wire mattresses and gabions shall be placed at the locations shown on the Drawings. Installation shall be in accordance with the manufacturer's instructions. A filter fabric shall be placed between the wire cage and the material being protected.
2. All wire used in mattresses and gabions is to be heavily galvanised and provided with plastic coating.

**Location and  
Filter Fabric**

**C224.14 MATERIALS****(a) Filter Fabric**

- |    |  |               |
|----|--|---------------|
| 1. | A chemically and biologically stable filter fabric such as Bidim U34 or equivalent filter fabric approved by the Superintendent shall be used.                       | <b>Type</b>   |
| 2. | Samples, manufacturer's specification and instructions on installation shall be submitted to the Superintendent seven days before the intended use of filter fabric. | <b>Sample</b> |

**(b) Rock Fill Material**

- |    |   |                            |
|----|---|----------------------------|
| 1. | The rock fill shall consist of clean hard rock with a minimum wet strength of 100 kilonewtons and a maximum wet/dry strength variation of 45 per cent as determined by AS 1141.22.  | <b>Rock Quality</b>        |
| 2. | Rock fill for gabions shall have particle sizes between 100mm and 200mm. Fill material shall be placed by hand and shall be tightly packed with a minimum of voids. Fill material shall be levelled off 25mm to 50mm above the top of the mesh to allow for settlement.   | <b>For Gabions</b>         |
| 3. | Rock fill for wire mattresses shall have particle sizes between 75mm and 125mm . When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled to be 25mm to 50mm above the top of the mesh to allow for settlement and to provide an even, tight and smooth surface of the required contour. | <b>For Wire Mattresses</b> |

**C224.15 ASSEMBLY AND ERECTION**

- |    |   |                  |
|----|---|------------------|
| 1. | Before laying out the gabions or wire mattresses, filter fabric shall be placed on the founding material. The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300mm and filled with rock fill.                     | <b>Procedure</b> |
| 2. | If specified in the design, the edges of wire mattresses shall be firmly tied to galvanised star pickets driven a minimum of 900mm into the surrounding ground at 1m maximum intervals and the star pickets cut off level with the top of the mattress. |                  |
| 3. | The filter fabric shall have 300mm laps at joins.   |                  |

## LIMITS AND TOLERANCES

## C224.16 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	<b>Open Drains - General</b> Catch Drain Location	≥2m from top of cuttings or toes of embankments	C224.05
2.	<b>Open Drains - Lining</b> (a) Compaction of Foundation	>95%	C224.07
3.	<b>Stone Pitching</b> (a) Rock Dimensions	>100mm thickness	C224.09
	(b) Exposed Surface Area	>0.05 sq m	C224.09
	(c) Spaces between Stones	<20mm width	C224.09
4.	<b>Batter Drains</b> (a) Rim line	+0mm, -50mm from batter line	C224.10
5.	<b>Kerb and Gutter</b> (a) Level of gutter surface	Level ≤±5mm of design level	C224.12
	(b) Surface uniformity	Deviation of kerb and gutter surface from 3m straight edge ≤3mm	C224.12
6.	<b>Rock Fill for Gabions and Wire Mattresses</b> (a) Wet Strength	>100kN	C224.14b
	(b) Wet/Dry Strength variation	<45%	C224.14b
	(c) Particle size for Gabions	>100mm <200mm	C224.14b
	(d) Fill Level	>25mm <50mm above top of mesh	C224.14b
	(e) Particle size for Wire Mattresses	>75mm <125mm	C224.14b
7.	<b>Erection of Wire Mattresses</b> (a) Star pickets for ties	Depth in ground >900mm Spacing <1m	C224.15
	(b) Trench Depth for upstream edge	Depth >300mm	C224.15
	(c) Filter fabric overlap	>300mm	C224.15

Table C224.1 - Summary of Limits and Tolerances

## SPECIAL REQUIREMENTS

**C224.17    RESERVED**

**C224.18    RESERVED**

**C224.19    RESERVED**

**C224.20    WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C225

Revision 3

## **CYCLEWAYS AND FOOTPATHS**



**SPECIFICATION C226  
CYCLEWAYS AND FOOTPATHS**

<b>CLAUSE</b>	<b>CONTENTS</b>	<b>PAGE</b>
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C225.03	REFERENCE DOCUMENTS .....	2
<b>CONSTRUCTION OF CYCLEWAYS AND FOOTPATHS</b>		<b>2</b>
C225.04	GENERAL .....	2



## SPECIFICATION C225 CYCLEWAYS AND FOOTPATHS

### GENERAL

#### C225.01 SCOPE

- The Work to be executed under this Specification consists of the construction of all cycleways and footpaths within Singleton Shire.

#### C225.02 WITHDRAWN

#### C225.03 REFERENCE DOCUMENTS

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.:

**(a) Australian Standards**

- AS 3600 Concrete structures
- AS 1304 Welded wire reinforcing fabric for concrete
- AS1428 Code of practice of design rules for access by the disabled

**(b) Council Specifications**

- C271 Minor Concrete Works
- D1 Geometric Road Design

### CONSTRUCTION OF CYCLEWAYS AND FOOTPATHS

#### C225.04 GENERAL

- Concrete shall be placed on compacted material (minimum density ratio of 95%) having a smooth uniform surface. **Placement**
- The cycleway or footpath is to finished with a non-slip surface. **Jointing and Finishing**
- All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds for a minimum period of 3 days. During this time the work must be adequately protected from traffic and any other causes likely to damage the concrete. **Curing**
- Reinforcement shall be used where the cycleway or footpath crosses a vehicular crossing. Reinforcement in these locations is to conform to Council's specification C226 – Vehicular Crossings. **Reinforcement**
- All cycleways and footpaths are to conform to the following minimum requirements:

**Table C225.1**

	Minimum Concrete Thickness	Concrete Strength	Reinforcement	Compacted Gravel
<b>Footpaths</b>	100mm	20MPa		75mm
<b>Cycleways</b>	125mm	20MPa	F62 mesh	75mm

Notes:

Where a footpath or cycleway crosses an unconstructed driveway it shall conform to Specification C226 – Vehicular Crossings.

- If filling is required it is to be compacted to a minimum density ratio of 95% prior to gravel being placed. **Filling Compaction**
- Access ramps, in accordance with Standard Drawing Figure C225.1 shall be provided at points where the cycleway and/or footpath intersects with a road. **Disabled Access Ramps**

## STANDARDS DRAWING - ACCESS RAMP

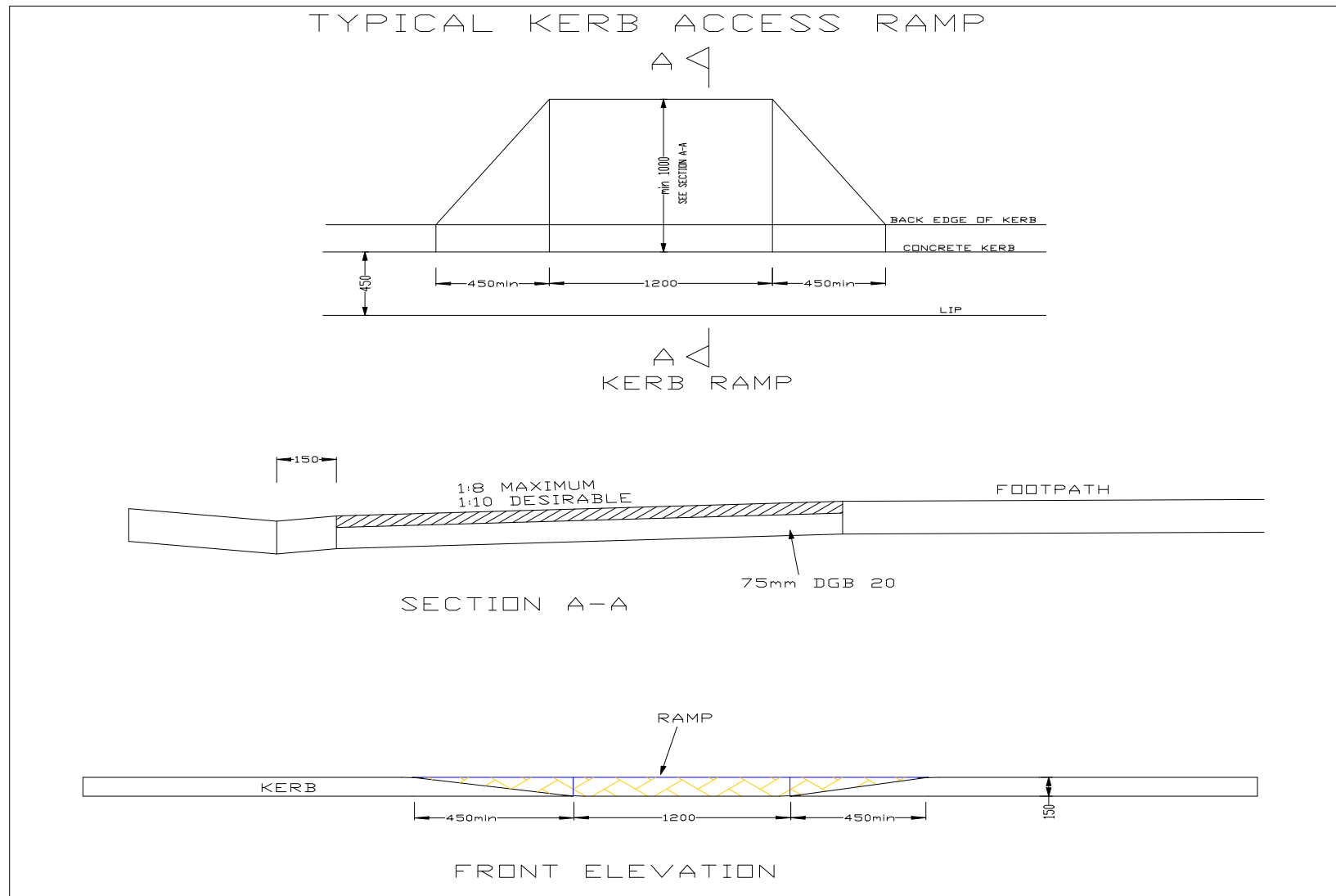


Figure C225-1

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C226

Revision 3

## **VEHICULAR CROSSINGS (Driveways)**



**SPECIFICATION C226  
VEHICULAR CROSSINGS**

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<b>DETERMINATION OF THE APPROPRIATE VEHICULAR CROSSING .....</b>		<b>2</b>
C226.04	PURPOSE OF CROSSING .....	2
C226.05	CATEGORIES OF VEHICULAR CROSSINGS .....	2
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C226.07	GENERAL LAYOUT REQUIREMENTS.....	3
C226.08	VEHICULAR CROSSING LOCATIONS.....	3
C226.09	SIGHT DISTANCE REQUIREMENTS AT DRIVEWAY EXITS.....	5
<b>CONSTRUCTION OF VEHICULAR CROSSINGS.....</b>		<b>5</b>
C226.10	GENERAL .....	5

## SPECIFICATION C226 VEHICULAR CROSSINGS

### GENERAL

#### C226.01 SCOPE

1. The Work to be executed under this Specification consists of the layout and construction of all vehicular crossings (access driveways) within Singleton Shire.

#### C226.02 WITHDRAWN

#### C226.03 REFERENCE DOCUMENTS

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.: **Standards**

(a) **Australian Standards**

AS 2890.1	Parking facilities – Off-street car parking
AS 3600	Concrete structures
AS 1304	Welded wire re-enforcing fabric for concrete

### DETERMINATION OF THE APPROPRIATE VEHICULAR CROSSING

#### C226.04 PURPOSE OF CROSSING

1. The first step in selecting the appropriate vehicular crossing is determining what type of parking facility the crossing will be used to access. Parking Facilities are classified in Table C226.1. **Parking area classifications**

Table C226.1

Class of Parking Facility	Parking Facility Use
1	Urban Residential and employee parking (all day parking)
2	Sports facilities, entertainment centres, hotels and motels (medium term parking)
3	Shopping Centres, supermarkets, hospitals and medical centres (generally short term parking)
4	Rural Property Accesses

#### C226.05 CATEGORIES OF VEHICULAR CROSSINGS

1. To determine the vehicular crossing widths and restrictions on their location along frontage roads, crossings are categorised as set out in the table C226.2. **Category**

Table C226.2

Class of Parking Facility	Frontage Road Type	Vehicular Crossing Category			
		Number of Parking Spaces (see note 1)			
		<25	25 to 100	101 to 300	>300
1	Arterial, Sub Arterial or Collector	1	2	3	4
	Local	1	1	2	3
2	Arterial, Sub Arterial or Collector	2	2	3	4
	Local	1	2	3	4
3	Arterial, Sub Arterial or Collector	2	3	4	4
	Local	1	2	3	4
4	Arterial, Sub Arterial or Collector	5	5	5	5
	Local	5	5	5	5

**Notes:**

When multiple access points serve a car park, each crossing is to be designed on the basis of the number of parking spaces effectively served by that vehicular crossing.

**C226.06 VEHICULAR CROSSING WIDTHS**

1. Having established the category of the crossing to the facility, the crossing width is selected from Table C226.3:

**Widths****Table C226.3**

Category	Entry Width	Exit Width	Separation of Crossings
1	3.6 to 6m	Combined	N/A
2	6 to 9m	Combined	N/A
3	6m	4 to 6m	1 to 3m
4	6 to 8m	6 to 8m	1 to 3m
5	3.6m at the property gate. 4.8m to 9.6m (double entry) at the culvert if necessary		

**C226.07 GENERAL LAYOUT REQUIREMENTS**

1. Except for urban dwelling houses, reversing to public streets is prohibited.
2. A vehicle exiting the access must be clearly visible to all traffic on the public road.
3. A number of land use types have specific requirements for driveways see Table C226.4:

**Reversing****Table C226.4**

Land Use	Requirements
Shopping Centres	Separate driveways to be provided for service vehicles and for car parking.
Car Tyre Retail Outlets	A combined entry/exit driveway of 6 to 9m is to be provided.
Drive-in-Liquor Stores	Separate entry/exit driveways are to be provided, each with a minimum width of 4m and with a minimum separation of 1m
Road Transport Facilities & Container Depots	Separate driveways for car parking and trucks are to be provided.
Service Stations	Separate driveways are to be provided as follows: <ul style="list-style-type: none"> <li>• Entry driveway width = 8-10m</li> <li>• Exit driveway width = 8-10m</li> <li>• Minimum spacing between a pair of driveways = 10m</li> </ul>

**(a) Urban Driveways****Widening**

1. Consideration is to be given to widening the driveway at the road to allow turning movements from the kerbside lane without affecting traffic in the frontage roadway.

**(b) Rural Driveways****Rural Access Layout**

Property entrance gates must be set back from the edge of gravel shoulder of the road a distance of 9m (6m absolute minimum with Council approval), to permit entering vehicles to stand clear of the road shoulder whilst waiting to enter the traffic stream (see Standard Drawing 226.5). The access is to be constructed from the edge of the shoulder of the road to the edge of the property.

2. A drainage pipe should be provided if there is a drain at the side of the road that carries water (minimum pipe size 375mm diameter).

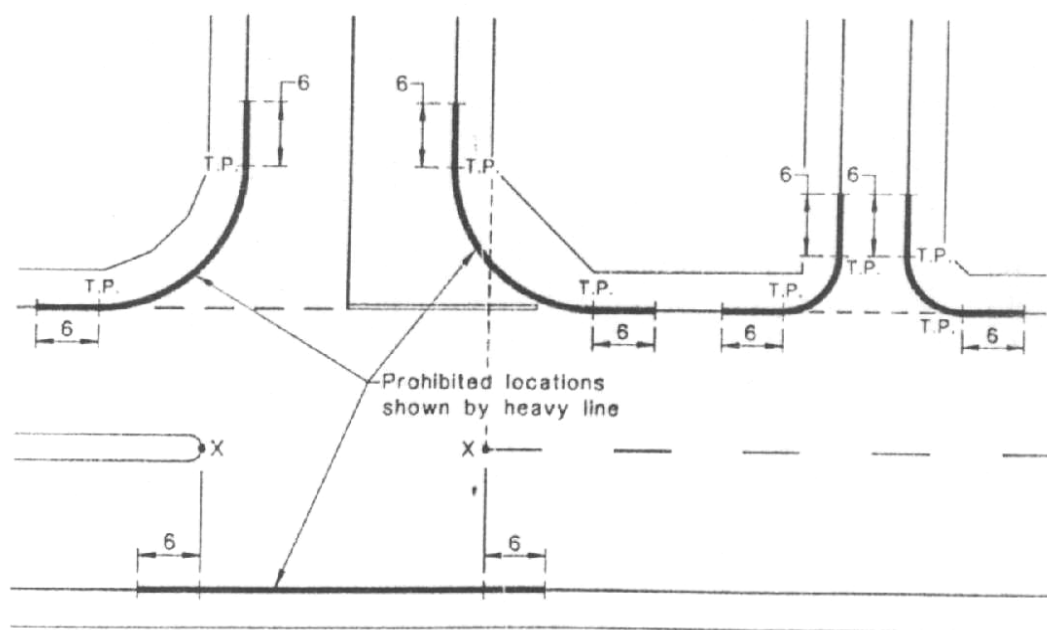
**Drainage Pipes on Rural Accesses**

Pipes are to be laid on 100mm of sand or crusher dust at minimum 1% grade and have a minimum cover of 150mm of gravel over it. Water must be channelled into and out of the pipe. Concrete headwalls are to be provided on each end of the pipe.

**C226.08 VEHICULAR CROSSING LOCATIONS**

1. At unsignalised intersections of sub-arterial, collector or local roads with each other or with an arterial road, category 1, 2 and 5 crossings should not be located in the sections shown by heavy lines in the Figure C226.1.

Standard Drawing Figure C226.1



Note:

The points marked 'x' are at the intersection of the main road centreline and the prolongation of the side road property line.

2. At signalised intersections, the minimum distance from the intersection, measured from the property boundary along both legs, should be increased as necessary to locate driveways beyond the influence of normal queue lengths at the intersections. If this is not practicable, either of the following must be provided:
  - An arrangement which confines traffic to turning left when both leaving or entering the driveway, or
  - A signalised driveway which is co-ordinated with the intersection signals, or
  - Other traffic management means of providing for safe and efficient operation of the driveway.
3. Driveway categories 3 and 4 should not be located:
  - On arterial roads unless entrances and exits are designed and constructed as intersection treatments catering adequately for all projected traffic flows,
  - Closer to intersections than permitted for category 1, 2 and 5 driveways,
  - Opposite other developments generating a large amount of traffic, unless all projected traffic flows are provided for in a properly designed and constructed intersection treatment, including the installation of signals if necessary,
  - Where right turning traffic entering the property would obstruct through traffic, or
  - Where traffic using the driveway will interfere with or block the operation of bus stops, taxi ranks, loading zones or pedestrian crossings.

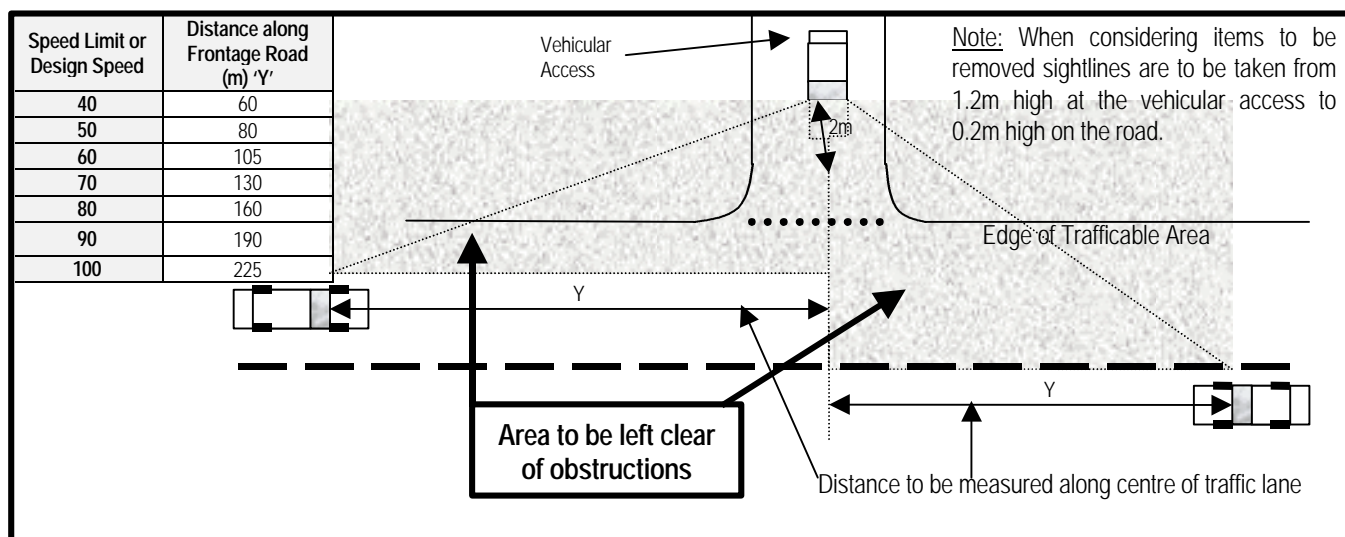


**C226.09 SIGHT DISTANCE REQUIREMENTS AT DRIVEWAY EXITS**

1. Rural driveway exits shall be located so that the sight distance along the frontage road available to drivers leaving the property is at least that shown in the Figure C226.2:

**Intersection  
Sight Distance**

**Standard Drawing Figure C226.2**



2. For urban driveway exits the optimum (maximum) sight distance of vehicles exiting the driveway shall be taken into consideration.

**CONSTRUCTION OF VEHICULAR CROSSINGS****C226.10 GENERAL****(a) Urban Driveways**

- All urban driveways shall be constructed using plain concrete.
- All formwork shall consist of timber or steel forms, which are straight and true, and to required dimensions, with no surface irregularities, and securely supported to prevent movement during pouring and curing. Formwork surfaces are to be coated with form oil for clean stripping of concrete.
- Concrete shall be placed on compacted material (minimum density ratio of 95%) having a smooth uniform surface.
- Grooved "dummy" and expansion joints shall be provided as detailed on the standard drawings. The vehicular crossing is to be finished with a non-slip surface.
- All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds for a minimum period of 3 days. During this time the work must be adequately protected from traffic and any other causes likely to damage the concrete.
- Reinforcement shall be placed in accordance with AS 3600 or as may be directed by the Superintendent due to construction circumstances. All reinforcement shall conform to AS 1304 and be free of excessive rust, oil, grease or other detrimental material. All steel is to be overlapped 250mm and securely tied at joints to provide a rigid matrix and correct load transfer. Steel is to be supported by "bar chairs" (and "supporting plates" if necessary) to provide the specified clearances at a maximum 1.0m spacing.
- Any existing adjacent footpath is to be re-profiled to match the new driveway. The existing footpath profile is to be maintained whenever possible.

**Formwork  
Requirements**

**Placement**

**Jointing and  
Finishing**

**Curing**

**Reinforcement**

**Adjacent  
Footpaths**

## VEHICULAR CROSSINGS

8. All urban driveways are to conform to the minimum requirements specified in Table C226.5.

**Table C226.5**

Parking Facility Type	Minimum Concrete Thickness	Concrete Strength	Mesh Type	Mesh Layers and Position	Compacted Gravel
1	125mm	20MPa	F-62	1 layer - 30mm cover	75mm
2,3	150mm	20MPa	F-72	2 layers - 30mm from top and 50mm from bottom	100mm

9. Where vehicular crossings are placed into an existing kerb and gutter, the existing kerb and gutter shall be removed entirely and reconstructed with a layback in accordance with the standard drawings. The new kerb and gutter shall be joined to the existing kerb and gutter by use of expansion joints. The developer shall be responsible for the re-instatement of any affected road pavement and wearing surface to Council specifications.

***Driveways in Existing Kerb and Gutters***

10. Council is to be notified prior to the removal of any sandstone kerb and gutter. As this type of kerb and gutter is usually found in the heritage area, special approval is required by Council's Development and Environmental Services Department

***11. Existing Sandstone Kerb & Gutter***

**(b) Rural Driveways**

1. The following thickness of gravel is to be placed and compacted to a minimum density ratio of 95%:

***Gravel Depth & Compaction***

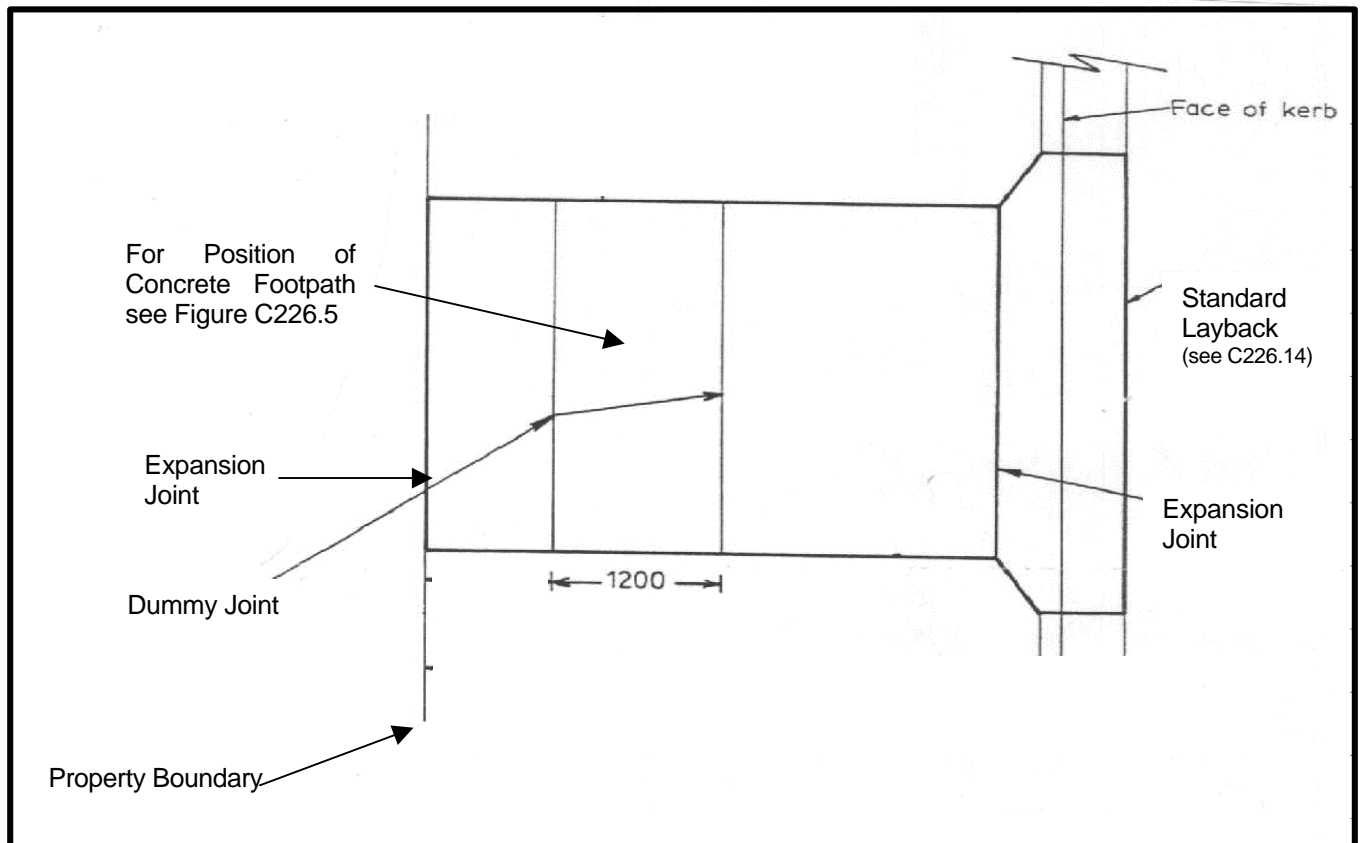
<u>Number of Lots Served</u>	<u>Thickness of Gravel</u>
1	100mm
2	150mm
3	150mm
4	150mm
>4	200mm

2. If filling is required it is to be compacted to a minimum density ratio of 95% prior to gravel being placed.

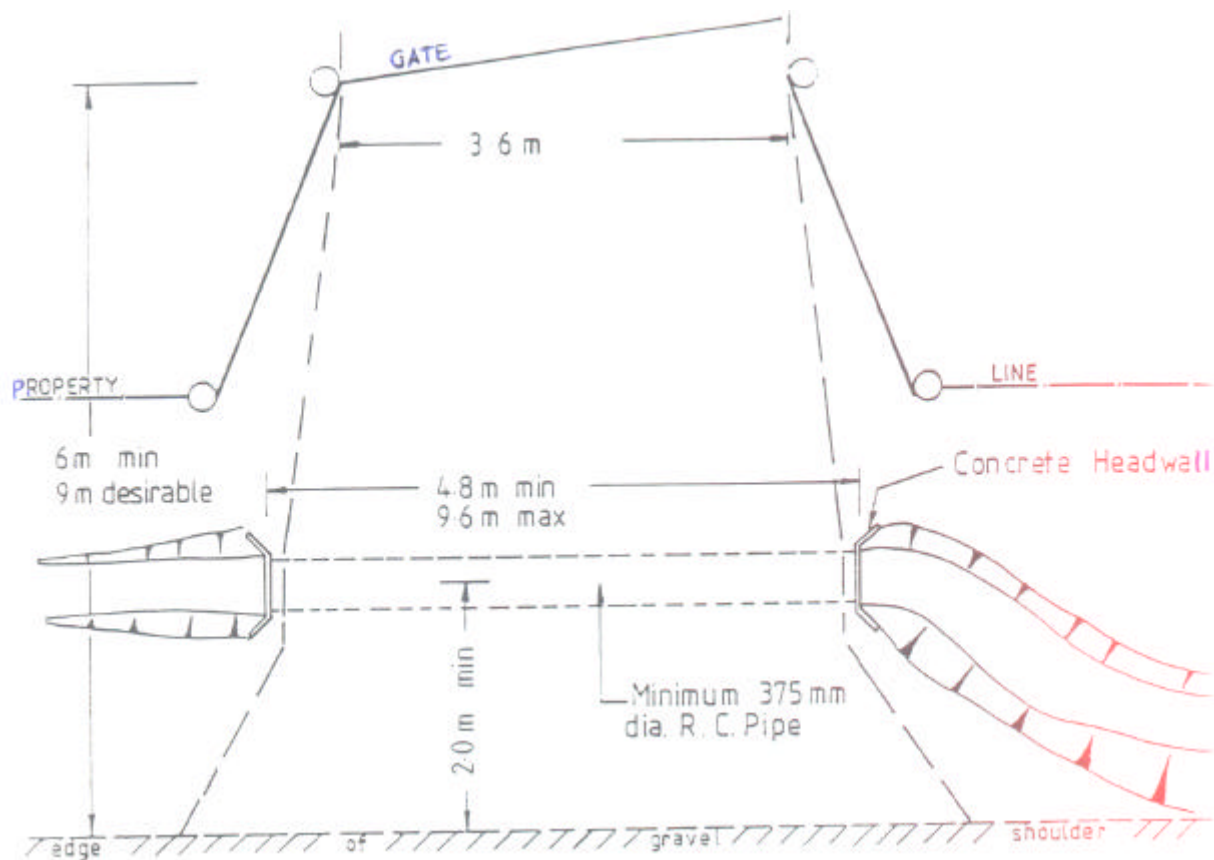
***Filling Compaction Wearing Surface***

3. Rural Accesses are to be bitumen sealed if they lead to a bitumen sealed road, or if they are on a grade steeper than 5%.

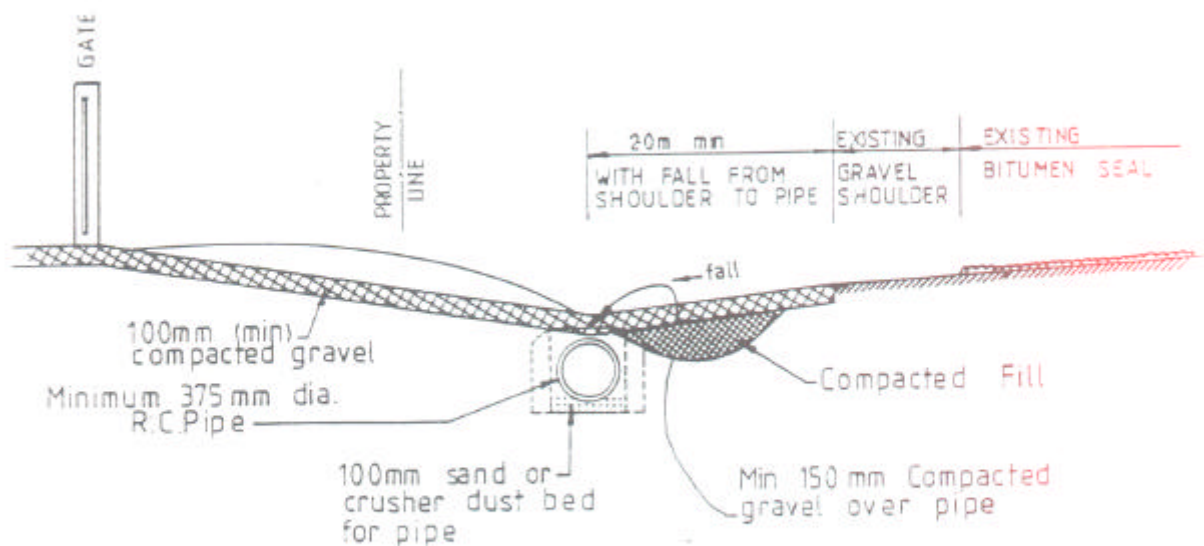
**Standard Drawing – Figure C226.3**  
**Urban Residential / Commercial Driveway**



Standard Drawing – Figure C226.4  
Standard Rural Crossings

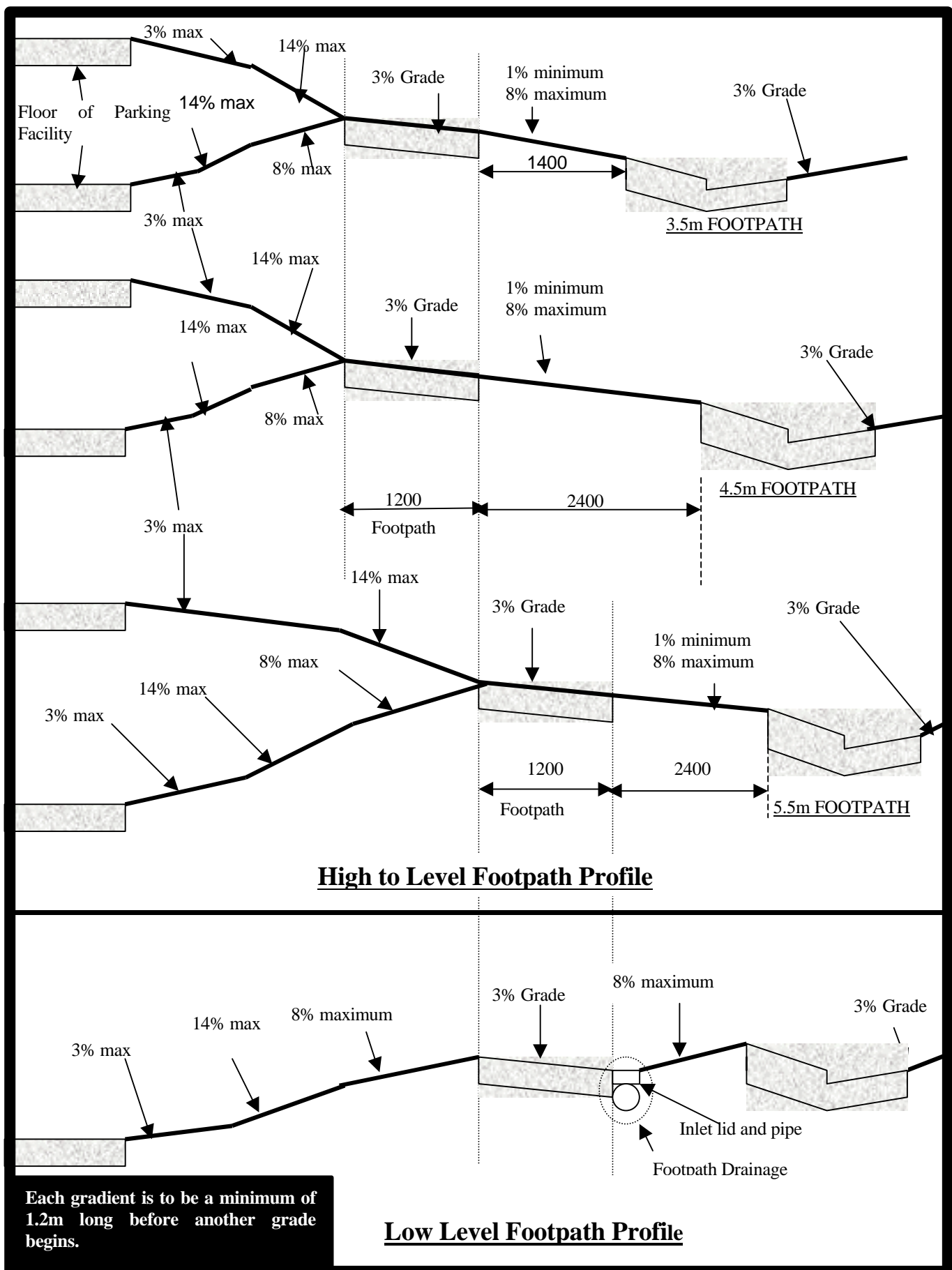


Typical Layout Plan

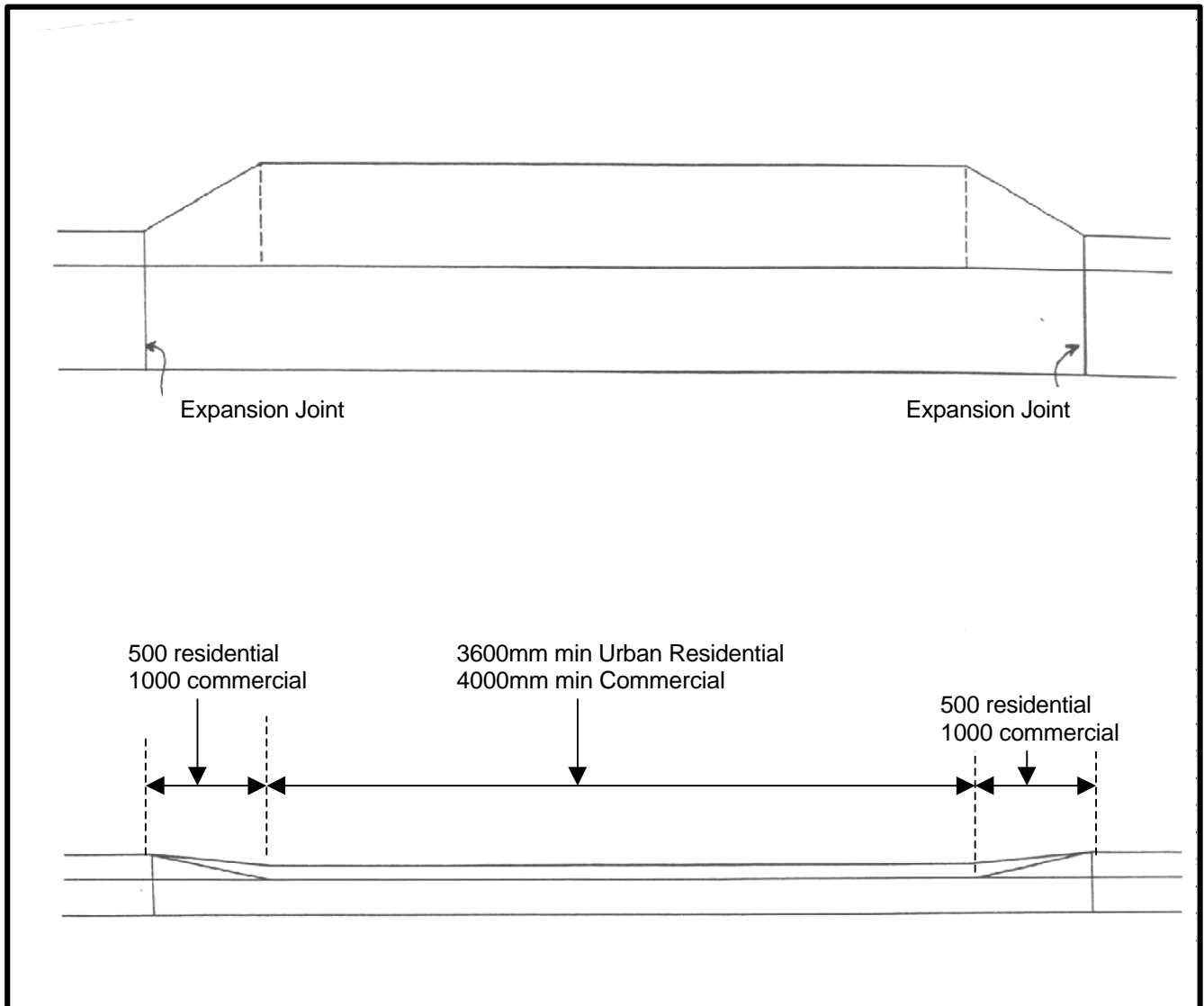


Section Through Middle of Access

**Standard Drawing – Figure C226.5**  
**Driveway Profiles**



Standard Drawing – Figure C226.6  
Standard Gutter and Layback



# DEVELOPMENT CONSTRUCTION SPECIFICATION

C230

Revision 3

## **SUBSURFACE DRAINAGE GENERAL**





**SPECIFICATION C230 - SUBSURFACE DRAINAGE-GENERAL**

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## SPECIFICATION C230 : SUBSURFACE DRAINAGE - GENERAL

### GENERAL

#### C230.01 INTRODUCTION

1. This is the general specification common and applicable to all types of subsurface drainage and shall be read in conjunction with subsurface drainage specifications: *Purpose*

C231	-	Subsoil and Foundation Drains
C232	-	Pavement Drains
C233	-	Drainage Mats

as applicable to particular contracts.

#### C230.02 SCOPE

1. The work to be executed under this Specification consists of:
- (a) preparation for subsurface drainage construction;
  - (b) siting of subsurface drainage facilities;
  - (c) the supply of all materials associated with the provision of the subsurface drainage system;
  - (d) all activities and quality requirements associated with the supply, placement and compaction of filter material;
  - (e) the provision of a detailed record of all subsurface drain installations;
  - (f) the marking on the ground of the location of all subsurface drains.

#### C230.03 EXTENT OF WORK

1. Details of the work are shown on the Drawings.

#### C230.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

##### (a) Council Specifications

C211	-	Control of Erosion and Sedimentation
C213	-	Earthworks
C271	-	Minor Concrete Works

##### (b) Australian Standards

AS 1141.11	-	Particle size distribution by dry sieving.
AS 1141.22	-	Wet/dry strength variation.
AS 1289.5.5.1	-	Determination of minimum and maximum dry density of a cohesionless material.

- AS/NZS 1477 - Unplasticised PVC pipes and fittings for pressure applications
- AS 2439.1 - Perforated plastics drainage and effluent pipe fittings - Perforated drainage pipe and associated fittings.
- AS 2758.1 - Aggregates and rock for engineering purposes - Concrete aggregates
- ASTM-D2434-68 Test method for permeability of granular soils (constant head)

(c) RTA Specifications

- MR1160 - Supply and Delivery of Seamless Tubular Filter Fabric

(d) RTA Test Methods

- T102 - Pretreatment of Samples of Road Materials by Compaction
- T103 - Pretreatment of Road Materials by Artificial Weathering

### **C230.05 TEMPORARY DRAINAGE DURING CONSTRUCTION**

1. All drainage works carried out by the Contractor shall comply with the Specification for CONTROL OF EROSION AND SEDIMENTATION. **Erosion Control**
2. The Contractor shall make adequate provision for runoff flows at subsurface drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities. **Contractor's Responsibility**
3. The Contractor's material and equipment shall be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows. **Location of Equipment**

### **C230.06 SITING AND SET OUT OF WORK**

1. Before commencing construction of any subsurface drainage activity, the Contractor shall set out on site the position of the work to the location and levels shown on the Drawings, and shall present this set-out for inspection by the Superintendent. **Set-out**
2. The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions. **Amendments to Planned Work**
3. Should the Contractor propose changes to the location, length, designed levels, conditions of installation or cover to suit the Contractor's construction procedures, the Contractor shall present the proposed set-out in addition to the designed set-out for consideration by the Superintendent. No changes shall be made unless the prior written approval of the Superintendent is obtained. **Proposed Changes by Contractor**

### **C230.07 EXCAVATION**

1. Excavation shall be undertaken in compliance with all relevant legislation. The Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with all legislation. **Safety**
2. Where public utilities exist in the vicinity of drainage works the Contractor shall obtain the approval of the relevant authority to the method of excavation before commencing excavation. **Approval by Public Utility Authorities**
3. Excavation by blasting, if permitted, shall be carried out in accordance with specification for Earthworks. **Blasting Operation**

## SUBSURFACE DRAINAGE

---

4. Trenches shall be excavated to the line, grade, width and depth shown on the Drawings or as directed by the Superintendent. The bottom of the trench shall be constructed so that no localised ponding can occur. All loose material shall be removed by the Contractor.

***Excavation Level***

5. Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable shall be removed and disposed in accordance with the Specification for EARTHWORKS by the Contractor and replaced with backfill material in accordance with the requirements of this Specification. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level or grade of the pipe.

***Unsuitable Material***

6. The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with the Specification for EARTHWORKS.

***Spoil***

### **C230.08 BACKFILLING**

1. Backfilling shall be carried out in accordance with the requirements of the relevant subsurface drainage structures Specifications.

***Detail***

### **C230.09 OUTLET STRUCTURES FOR SUBSURFACE DRAINAGE**

1. Subsurface drainage pipes shall be connected to discharge into gully pits or to outlet structures as shown on the Drawings or as directed by the Superintendent.

***Discharge***

2. Outlets, including those discharging into gully pits, shall be made rodent proof using galvanised wire netting if required in the Drawings.

***Rodent Proof***

3. The outlet shall be located so that erosion of the adjacent areas does not occur or shall be protected by the placement of selected stone or similar treatment.

***Erosion Control***

4. Outlet pipes from curtain drains shall be unslotted. At no point shall an outlet pipe be higher than the pipe at the end of the curtain drain.

***Outlet Pipe***

5. All concrete used in the construction of outlet structures shall conform to the requirements of the Specification for MINOR CONCRETE WORKS.

***Concrete Specification***

## **MATERIALS**

### **C230.10 CORRUGATED PLASTIC PIPE**

1. Corrugated plastic pipe shall be Class 1000 complying with AS2439.1 of >100mm diameter unless otherwise indicated on the Drawings. All pipe shall be slotted except where shown on the Drawings.

***Specification***

2. Joints, couplings, elbows, tees and caps shall also comply with AS2439.1 and only the manufacturer's recommended fittings shall be used.

***Fittings***

3. The Contractor shall obtain from the Manufacturer a Test Certificate demonstrating compliance with AS2439.1.

***Compliance***

### **C230.11 OTHER TYPES OF SUBSURFACE DRAINAGE**

1. Where a Contractor wishes to use a subsurface drainage pipe other than corrugated plastic pipe, he shall submit full details of the type of pipe, certification from the manufacturer of its suitability and quality and written acceptance by the Council for its use in each particular application. Certification of the suitability of any pipe will address the crushing strength, flexural strength, jointing system and slotting details.

***Submit for Approval***

**C230.12 FILTER MATERIAL****(a) General**

1. The types of filter material covered by this Specification shall include: **Types**
- (a) Type A filter material for use in trench drains and Type B drainage mats
  - (b) Type B filter material for use in trench drains and Type B drainage mats
  - (c) Type C filter material comprising crushed rock for use in Type A drainage mats
  - (iv) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats
2. All filter material shall consist of clean, hard, tough, durable particles.

**(b) Type A Filter Material (nominal 5mm crushed rock which complies with table C230.1)****Grading**

1. Type A filter material shall be sound durable crushed rock complying with the following requirements:

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Material passing AS sieve	Per cent by mass
	6.7mm	100
	4.75mm	85 to 100
	2.36mm	0 to 40
	1.18mm	0 to 5
	425um	0 to 2

**Table C230.1 - Type A Filter Material****(c) Type B Filter Material ( clean filter sand which complies with table C230.2)**

1. Type B filter material shall be granular material complying with the following grading requirements: **Grading**

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Material passing AS sieve	Per cent by mass
	4.75mm	100
	2.36mm	95 to 100
	425um	20 to 80
	300um	0 to 30
	150um	0 to 2
	75um	0 to 0.1

**Table C230.2 - Type B Filter Material**

2. In addition to the above grading requirements, Type B filter material shall have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS 1289.5.5.1 and then tested in accordance with Test Method ASTM-D2434-68, of at least 8 metres per day after three hours of flow.

**Coefficient of  
Saturated  
Permeability**

3. After treatment in accordance with Test Method T103 and five cycles of compaction in accordance with Test Method T102, Type B filter material shall not vary from its original grading before such treatment by more than the following amounts:

**Grading  
Variation**

AS Sieve	Variation From Grading Before Treatment (per cent of mass)
2.36mm	± 3
1.18mm	± 1
425um	± 1
300um	± 1
150um	± 0.5
75um	± 0.1

**Table C230.3 - Type B Filter Material Variation**

**(d) Type C Filter Material**

1. Type C filter material shall be crushed rock complying with the following requirements:

**Grading**

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Maximum particle size	37.5mm
	Maximum passing the 9.5mm AS Sieve	5% by mass
	Maximum (D90:D10)*	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%
<p><b>*NOTE:</b> The D90 value shall be determined by sieving the material using 75mm, 53mm, 37.5mm, 26.5mm, 19mm, 13.2mm and 9.5mm AS sieves, as appropriate, and then plotting the results on a graph of AS sieve size v percentage passing. The plotted points shall be joined by straight lines and the D90 value shall be determined as the theoretical sieve size corresponding to 90 per cent passing.</p> <p>D10 denotes the theoretical size of a sieve through which 10 per cent of the material would pass and shall be determined from the same graph used to determine the D90 value.</p>		

**Table C230.4 - Type C Filter Material**

**(e) Type D Filter Material**

1. Type D filter material shall be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS2758.1 and the following requirements:

**Grading**

TEST METHOD	PROPERTY	REQUIREMENT
AS 1141.11	Maximum particle size	75mm
	Maximum passing the 9.5mm AS sieve	5% by mass
	Maximum (D90 : D10)	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

**Table C230.5 - Type D Filter Material****C230.13 GEOTEXTILE****(a) General**

1. The geotextile, other than seamless tubular filter fabric, shall consist of a needle punched felt which shall be manufactured from synthetic materials other than polyamide. It shall be bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents.

**Properties**

2. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of seven (7) days. The geotextile shall be stored in an ultraviolet light - proofed container prior to use. Should the geotextile be exposed to ultraviolet light for a period in excess of seven days, the geotextile shall be removed from the site and not used in the works unless directed by the Superintendent.

**Ultra Violet  
Light Resistant**

3. The geotextile shall be capable of retaining particles of particle size greater than 100 microns.

**Particle  
Retention**

4. The minimum mass of geotextiles for different types of subsurface drainage shall be as follows:

**Mass**

TYPE OF SUBSURFACE DRAINAGE	MINIMUM MASS OF GEOTEXTILE (Grams per square metre)
Trench Drains and Drainage Mats	250

**Table C230.6 - Geotextile Mass**

### (b) Seamless Tubular Filter Fabric

### Specification

1. Seamless tubular filter fabric shall be used to enclose all slotted pipes and shall comply with MR Form 1160.

2. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying will be removed and replaced so as to eliminate any damaged lengths. Fitting of the seamless tubular filter fabric shall be in accordance with the following requirements:-

### Fitting

#### 1. *PROCEDURE FOR FITTING SEAMLESS TUBULAR FILTER FABRIC TO SLOTTED PIPE*

Seamless tubular filter fabric shall be fitted to slotted pipe immediately before the slotted pipe is to be laid in its final position in the work.

The filter fabric shall be initially pulled over and onto a short length of smooth pipe of internal diameter between 20mm and 30mm greater than the external diameter of the slotted pipe to be enclosed by filter fabric. The short, larger diameter pipe shall be referred to as the 'mandrel'.

The pipe to be enclosed by the filter fabric shall be passed through the mandrel. The filter fabric shall be slipped on to the pipe as the pipe emerges from the mandrel leaving enough overhang of the filter fabric to make a suitable joint with the filter fabric on the adjacent pipe. The filter fabric shall be firmly held to the forward end of the pipe so that it can not slip back along the pipe.

The pipe shall be pulled right through the mandrel allowing the filter fabric to progressively slip over the pipe. The filter fabric shall be restrained from easily slipping off the mandrel thus ensuring the filter fabric is stretch fitted onto the pipe.

When the end of the pipe emerges from the mandrel, the filter fabric shall be clamped to that end of the pipe so that the filter fabric can not slip down the pipe. The filter fabric shall remain clamped to each end of the pipe to ensure the filter fabric remains stretch fitted onto the pipe when the pipe is placed in its final position in the drain. The filter fabric shall be cut cleanly leaving enough overhang off the end of the pipe to make a fully covered join with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

#### 2. *PRECAUTIONS TO BE TAKEN WHEN USING SLOTTED PIPE FITTED WITH SEAMLESS TUBULAR FILTER FABRIC*

Slotted pipe fitted with seamless tubular filter fabric shall not be dragged over the ground. If carried, the pipe shall be lifted clear of the ground and the filter fabric shall be protected from damage at all times.

Seamless tubular filter fabric which has been so damaged as to affect its filtering properties shall be removed from the pipe and replaced with undamaged filter fabric.

If at any time during the installation of a slotted pipe it is found that the enclosed filter fabric has become loose on the pipe it shall be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric shall be removed from the pipe and replaced with undamaged filter fabric.



## RECORDING OF DRAINAGE

### C230.14 RECORDING OF SUBSURFACE DRAINAGE INFORMATION

1. The Contractor shall keep a detailed record of all subsurface drainage pipes and the completed subsurface drainage systems shall be shown on the work-as-executed plans to be returned to the Superintendent upon completion of the Contract. **Work As Executed Plans**

2. In addition, the Contractor shall prepare a subsurface drainage information sheet or sheets at the completion of construction of each drain or drainage system and shall submit the subsurface drainage sheet or sheets to the Superintendent within five working days of the completion of the drain or drainage system. **Information Sheet**

3. The information to be included in the subsurface drainage information sheets shall include: **Detail**

Date of completion of drain construction:

Drain Number:

Type of Drain:

Pipe Size:

Pipe Type:

Filter Type:

Grade of Drain:

Locations of Cleanouts:

Locations of Outlets:

Geotextile-

Sheet	Yes/No
-------	--------

Seamless Tubular Filter Fabric	Yes/No
--------------------------------	--------

Response Time:

NOTE: Response Time shall be the time taken for water to travel from the inlet end of a drain or from a cleanout leading to a drain to the outlet end of the drain.

4. The costs associated with the preparation of Subsurface Drainage Sheets shall be borne by the Contractor. **Contractor's Costs**

## SPECIAL REQUIREMENTS

**C230.15 RESERVED**

**C230.16 RESERVED**

**LIMITS AND TOLERANCES****C230.17 SUMMARY OF LIMITS AND TOLERANCES**

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C230.7 below.

<b>Item</b>	<b>Activity</b>	<b>Tolerances</b>	<b>Spec Clause</b>
1.	<b>Excavation by Blasting</b> Peak particle velocity	≤25mm/sec	C230.07
2.	<b>Outlets</b> Spacing	Max 150m	C230.09
3.	<b>Filter Material</b>		
	(a) Type A	Table C230.1	C230.12
	(b) Type B	Tables C230.2 and C230.3	C230.12
	(c) Type C	Table C230.4	C230.12
	(d) Type D	Table C230.5	C230.12
4.	<b>Geotextile</b>		
	(a) Exposure to sunlight	≤7 days	C230.13

**Table C230.7 - Table of Limits and Tolerances**

**C230.18 WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C231

Revision 3

## **SUBSOIL AND FOUNDATION DRAINS**

**SPECIFICATION C231 - SUBSOIL AND FOUNDATION DRAINS**

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## SPECIFICATION C231 : SUBSOIL AND FOUNDATION DRAINS

### GENERAL

#### C231.01 SCOPE

- |    |   |                                 |
|----|---|---------------------------------|
| 1. | The work to be executed under this Specification covers the excavation, bedding, installation and backfilling of subsoil and foundation drains. | <b>Scope</b>                    |
| 2. | This Specification should be read in conjunction with the Specification for SUBSURFACE DRAINAGE - GENERAL.                                      | <b>Associated Specification</b> |

#### C231.02 TERMINOLOGY

- |    |   |                          |
|----|---|--------------------------|
| 1. | Subsoil drains are intended for the drainage of ground water and/or the pavement in cuttings.                               | <b>Subsoil Drains</b>    |
| 2. | Foundation drains are required for the drainage of seepage, springs and wet areas within and adjacent to the foundations.   | <b>Foundation Drains</b> |
| 3. | Subsoil and foundation drains shall be constructed where and as shown on the Drawings or as directed by the Superintendent. | <b>Location</b>          |

#### C231.03 REFERENCE DOCUMENTS

- |    |   |   |
|----|---|---|
| 1. | Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. | <b>Documents<br/>Standards Test<br/>Methods</b> |
|----|---|---|

##### (a) Council Specifications

- |      |                                 |
|------|---------------------------------|
| C213 | - Earthworks                    |
| C230 | - Subsurface Drainage - General |

##### (b) Australian Standards

- |               |  |
|---------------|--|
| AS 1289.5.1.1 | Soil compaction and density tests – Determination of the dry density/moisture content relation of a soil using standard compactive effort. |
| AS 1289.5.7.1 | Soil compaction and density tests - Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method).               |

#### C231.04 ORDER OF CONSTRUCTION

##### (a) Subsoil Drains

- |          |   |                               |
|----------|---|-------------------------------|
| 1.       | Subsoil drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, subsoil drains shall be constructed after completion of stabilisation except that, where excessive ground water is encountered, they may be constructed prior to stabilisation of the subgrade. | <b>Timing of Work</b>         |
| 2.       | Where a Selected Material Zone is specified and excessive ground water is encountered, subsoil drains may be installed in two stages as follows:  | <b>Two Stage Construction</b> |
| Stage 1: | Standard subsoil drains installed below the base of the cutting prior to placement of select material in the Selected Material Zone.  |                               |

Stage 2: Extension of subsoil drain to top of the Selected Material Zone after placement of selected material.

**(b) Foundation Drains**

1. Foundation drains shall be constructed after completion of clearing and stripping operations, and preceding the commencement of embankment construction.

***Timing of Construction***

**CONSTRUCTION**

**C231.05 SUBSOIL DRAINS**

**(a) Excavation**

***Associated Specification***

1. Excavation shall be undertaken in accordance with the requirement of the Specification for SUBSURFACE DRAINAGE - GENERAL.

2. Trenches for subsoil and foundation drains shall be excavated to the line, grade, width and depth as shown on the Drawings or as directed by the Superintendent.

***Dimensions and Grade***

3. The bottom of the trench shall be excavated to the same grade as the design pavement surface in the direction of the trench except where the grade of the design pavement surface in the direction of the trench is less than 0.5 per cent. In which case the trench depth shall be increased to provide a minimum grade of fall in the trench of 0.5 per cent. The bottom of the trench shall be excavated so that no localised ponding of water occurs.

***Minimum Grade***

4. If at any location the trench is excavated below the specified floor level, the trench shall be backfilled with non-porous subgrade material so that when the subgrade material is compacted to a relative compaction, determined by AS1289.5.1.1 AND AS1289.5.7.1, of at least 95 per cent, the bottom of the trench shall be at the specified floor level.

***Over-excavation***

5. Where a subsoil drain is constructed in two stages, the excavation for Stage 2 shall be carried out after placement and compaction of the selected material zone or the stabilised subgrade layer. The Stage 2 trench shall be excavated to the same line and width as the Stage 1 trench and to a depth to provide a clean, full contact with the filter material placed in Stage 1. All excavated material shall be disposed to waste or incorporated into fills.

***Two Stage Construction***

**(b) Laying of Pipe**

***Bedding***

1. The 100mm diameter corrugated slotted plastic piping, complying with the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

2. The type of filter material shall be as shown on the Drawings or as directed by the Superintendent.

***Filter Material***

3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

***Joints and Capping***

**(c) Backfilling**

***Filter Material***

1. The trench shall be backfilled with filter material to the level specified. The type of filter material shall be as shown on the Drawings or as directed by the Superintendent. The filter material shall be placed and compacted in layers with a maximum compacted thickness of 300mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance to the pipe.

2. The filter material shall be compacted for its full depth to a relative compaction of not less than 100 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1. **Compaction of Filter Material**

3. The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with selected backfill material, conforming to the requirements of the Specification - EARTHWORKS, compacted for its full depth to a relative compaction of not less than 100 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1. **Select Material**

4. Where shown on the Drawings or as directed by the Superintendent, a geotextile conforming with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric. **Geotextile**

**(d) Outlets** **Pipes and Structures**

1. Outlets are to be provided at maximum intervals of 150m. Where possible, subsoil drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

**(e) Cleanouts** **Location**

1. Cleanouts are to be provided at the commencement of each run of subsoil drain line and at intervals of approximately 60m or as shown on the Drawings.

2. Details of the required cleanout construction are shown on the Drawings. The standard CI caps as shown on the Drawings shall be supplied by the Contractor. **Details**

**C231.06 FOUNDATION DRAINS**

**(a) Excavation**

1. Excavation shall be undertaken in accordance with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL and Clause C231.05 of this Specification. **Associated Specification**

**(b) Laying of Pipe**

1. The 100mm diameter corrugated slotted plastic piping, complying with the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade. **Bedding**

2. The type of filter material shall be as shown on the Drawings or as directed by the Superintendent. **Filter Material**

3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. **Jointing of Pipe**

**(c) Backfilling**

1. The trench shall be backfilled with filter material in accordance with the provisions of Clause C231.05(c). **Filter Material**

2. The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with suitable earth backfill material, compacted for its full depth to a relative compaction of not less than 95 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1. **Earth Backfill and Compaction**

3. Where shown on the Drawings or as directed by the Superintendent, a geotextile, conforming with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric.

***Geotextile***

**(d) Outlets**

1. An outlet structure in accordance with the detail shown on the Drawings and the Specification for SUBSURFACE DRAINAGE - GENERAL shall be constructed at the discharge end. The outlet shall be located so that erosion of the adjacent area does not occur or shall be protected by the placement of selected stone in the splash zone of the outlet.

***Construction Detail***

## **SPECIAL REQUIREMENTS**

**C231.07 RESERVED**

## **LIMITS AND TOLERANCES**

**C231.08 SUMMARY OF LIMITS AND TOLERANCES**

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C231.1 below.

<b>Item</b>	<b>Activity</b>	<b>Tolerances</b>	<b>Spec Clause</b>
1.	<b>Excavation</b> Trench Grade	≥0.5%	C231.05(a)
2.	<b>Subsoil Drain Backfill</b>		
	(a) Layer thickness	300mm max	C231.05(c)
	(b) Compaction (Relative) Filter and Backfill material	100% standard	C231.05(c)
3.	<b>Outlet Spacing</b>	150m max	C231.05(d)
4.	<b>Cleanout Spacing</b>	60m approx	C231.05(e)
5.	<b>Foundation Drain Backfill</b>		
	(a) Layer thickness	300mm max	C231.05(c)
	(b) Compaction (Relative) Filter material	100% Standard	C231.05(c)
	Backfill material	>95% Standard	C231.06(b)

**Table C231.1 - Table of Limits and Tolerances**

**C231.09 WITHDRAWN**



# DEVELOPMENT CONSTRUCTION SPECIFICATION

C232

Revision 3

## PAVEMENT DRAINS

## SPECIFICATION C232 - PAVEMENT DRAINS

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## SPECIFICATION C232 : PAVEMENT DRAINS

### GENERAL

#### C232.01 SCOPE

- |  |                                 |
|--|---------------------------------|
| 1. This Specification covers the installation of Sub-Pavement Drains, Intra-Pavement Drains and Edge Drains.     | <b>Scope</b>                    |
| 2. Pavement drains shall be constructed where and as shown on the Drawings or as directed by the Superintendent. | <b>Location</b>                 |
| 3. This Specification should be read in conjunction with the Specification for SUBSURFACE DRAINAGE - GENERAL.    | <b>Associated Specification</b> |

#### C232.02 TERMINOLOGY

- |  |                            |
|--|----------------------------|
| 1. Sub-Pavement Drains are intended for the drainage of the pavement layers. | <b>Sub-Pavement Drains</b> |
| 2. Edge Drains are intended for the drainage of rigid pavements.             | <b>Edge Drains</b>         |

#### C232.03 REFERENCE DOCUMENTS

- |  |   |
|--|---|
| 1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. | <b>Documents<br/>Standards Test<br/>Methods</b> |
|--|---|

##### (a) Council Specifications

- |      |   |                               |
|------|---|-------------------------------|
| C213 | - | Earthworks                    |
| C230 | - | Subsurface Drainage - General |
| C242 | - | Flexible Pavements            |
| C245 | - | Asphaltic Concrete            |

##### (b) Australian Standards

- |               |   |  |
|---------------|---|--|
| AS 1289.3.3.1 | - | Calculation of the plasticity index of a soil.   |
| AS 1477       | - | Unplasticised PVC (UPVC) pipes and fittings for pressure applications.   |
| AS 1289.5.1.1 | - | Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort. |
| AS 1289.5.7.1 | - | Soil compaction and density tests – Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method).               |

##### (c) RTA Specifications

- |      |   |  |
|------|---|--|
| 3555 | - | Slotted Fibre Reinforced Concrete Pipes for Subsurface Drainage. |
|------|---|--|

**C232.04 ORDER OF CONSTRUCTION****(a) Sub-Pavement Drains**

1. Sub-pavement drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, sub-pavement drain shall be constructed after completion of stabilisation except that where excessive ground water is encountered, sub-pavement drains may be constructed prior to stabilisation of the subgrade.

**Timing of Construction**

2. Where a Selected Material Zone is specified and excessive ground water is encountered, sub-pavement drains may be installed in two stages as follows:

**Stage Construction**

Stage 1: Standard sub-pavement drains installed below the base of the cutting prior to placement of select material in the Selected Material Zone.

Stage 2: Extension of sub-pavement drain to top of the Selected Material Zone after placement of selected material.

**(b) Edge Drains**

1. Edge Drains shall be constructed after the construction of the rigid pavement and before the placement and compaction of verge material.

**Timing of Construction**

**CONSTRUCTION****C232.05 SUB-PAVEMENT DRAINS****(a) Excavation**

1. Trenches 300mm wide shall be trimmed to the required line and to a depth of 600mm below the bottom of the subbase or below the base of the cutting where two stage construction of the Sub-Pavement Drain is required.

**Trench Dimensions**

2. The bottom of the trench shall be to the same grade as the design pavement surface except where the grade of the roadway is less than 0.5 per cent, in which case the depth of the trench shall be increased to provide a grade of 0.5 per cent in the trench. The bottom of the trench shall be excavated so that no localised ponding of water occurs.

**Trench Grade**

3. Where two stage construction of the sub-pavement is required, excavation for Stage 2 shall be carried out after placement and compaction of the Selected Material Zone. The Stage 2 trench shall be to the same line and width as Stage 1 and to a depth sufficient to provide a clean, full contact with the previously placed filter material. All excavated material shall be disposed to waste or incorporated into fills.

**Two-Stage Construction**

**(b) Laying of Pipe**

1. The 100mm diameter corrugated slotted plastic piping, complying with the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

**Filter Bed**

2. The type of filter materials shall be as shown on the Drawings or as directed by the Superintendent.

**Type**

3. Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

**Jointing**

**(c) Backfilling**

1. The trench shall be backfilled with filter material to the level specified. The type of filter material shall be as shown on the Drawings or as directed by the Superintendent. The filter material shall be placed and compacted in layers with a maximum compacted thickness not exceeding 300mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance of the pipe.

***Filter Material***

2. The filter material shall be compacted for its full depth to a relative compaction of not less than 100 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1.

***Compaction***

3. On the outlet section of pipes discharging through the fill batters the trench shall be backfilled with the nominated filter material to a depth of 50mm above the pipe. The balance of trench shall be backfilled with earth backfill material of maximum particle size of 50mm and shall be compacted for the full depth to a relative compaction of 95 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1.

***Pipe Outlet***

4. In case of sub-pavement drains of two stage construction, when it is not practical to place the Pavement Layers or the Selected Material Zone immediately after the construction of Stage 1, the filter material placed to the top of Stage 1 shall be protected from scour and/or contamination by covering with a 50mm thick plug of compacted select fill material having a maximum particle size of 25mm and Plasticity Index of not more than twelve as determined by AS 1289.3.3.1.

***Temporary Plug over Filter Material***

This plug, any contaminated filter material and any select material covering shall be removed and replaced with the nominated filter material and compacted immediately ahead of the placement of the pavement layer. All excavated material shall be disposed to waste or incorporated in fills.

**(d) Cleanouts**

1. Cleanouts are to be provided at the commencement of each run of sub-pavement drain line and at intervals of approximately 60m or as shown on the Drawings.

***Location***

2. Details of the required cleanout construction are shown on the Drawings. The standard CI caps as shown on the Drawings shall be supplied by the Contractor.

***Details*****(e) Outlets**

1. Outlets are to be provided at maximum intervals of 150m. Where possible sub-pavement drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

***Location***

2. The outlet shall be made rodent proof in accordance with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL.

***Rodent Proof***

3. The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

***Erosion Control*****C232.06 WITHDRAWN****C232.07 EDGE DRAINS****(a) Excavation**

1. The verge material shall be trimmed to subgrade level and to the minimum width shown on the Drawings. The bottom of the trench is to be constructed at the same grade as the roadway and in such a manner that localised ponding of water does not occur.

***Width and Level***

- 
2. Where the grade of the roadway is less than 0.5 per cent the trench shall be excavated to provide a minimum grade of 0.5 per cent. **Grade**
3. When the pipe is to discharge through the fill batter a suitable trench shall be excavated to provide the required grade. **Discharge Pipe**
- (b) Laying of Pipe**
1. Generally, 65mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric, complying with the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be used for edge drains. **Slotted Plastic Pipe**
2. Where any part of a shoulder consists of material other than concrete, slotted fibre reinforced cement pipe, designated 100DMR as specified in RTA Specification 3555, shall be used. Fibre reinforced cement pipes shall be joined with the socket ends facing upstream and the ends of each pipe shall be securely held against the vertical face of the rigid pavement. At least seven days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes against the rigid pavement for the approval of the Superintendent. **Slotted Fibre Cement Pipe**
3. The pipe shall be laid on a prepared bed to the specified line and level. **Prepared Bed**
4. Joints in the pipe shall be kept to a minimum number and shall be made using an external joint coupling approved by the Superintendent. **Jointing**
5. The inlet end of the pipe shall be fitted with a cap. **Inlet Cap**
6. The outlet section of a pipe from the vertical face of the rigid pavement to an outlet in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with mastic. **Outlet Pipe**
- (c) Backfilling**
1. The pipe shall be covered with Type B filter material to the dimensions shown on the Drawings. **Filter Material**
2. Mechanical compaction of this filter material is not required, however after placement of the filter material it shall be soaked with water. Where necessary additional filter material shall be added and soaked to provide the final dimensions shown on the Drawings. **Soaking of Filter Material**
3. Backfilling over the edge drain shall be done in such a manner as to avoid damage or disturbance of the pipe. Backfill material shall be selected material as required for verges and in accordance with the requirements of the Specification EARTHWORKS. Backfilling shall be compacted to a relative compaction of not less than 100 per cent as determined by AS1289.5.1.1 AND AS1289.5.7.1. **Procedure and Compaction**
- (d) Cleanouts**
1. Cleanouts are to be provided at the commencement of each run of edge drain line and at intervals of approximately 60m or as shown on the Drawings. **Location**
2. Details of the required cleanout construction are shown on the Drawings. The standard CI caps as shown on the Drawings shall be supplied by the Contractor. **Construction Detail**
- (e) Outlets**
1. Unless otherwise shown on the Drawings outlets are to be provided at maximum intervals of 150m. Where possible edge drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the Drawings shall be constructed at the discharge end. **Location**
-

2. The outlet shall be made rodent proof in accordance with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL. **Rodent Proof**
3. The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet. **Erosion Control**

## SPECIAL REQUIREMENTS

### C232.08 RESERVED

## LIMITS AND TOLERANCES

### C232.09 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C232.1 below.

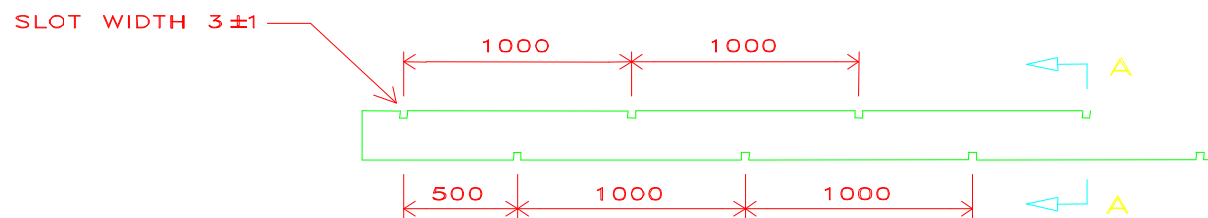
Item	Activity	Tolerances	Spec Clause
1.	<b>Excavation</b> Trench Grade	≥0.5%	C232.05(a) C232.07(a)
2.	<b>Sub-Pavement Drain Backfill</b>		
	(a) Layer thickness	300mm max	C232.05(c)
	(b) Compaction (Relative)		
	Filter material	100% Standard	C232.05(c)
	Backfill material	>95% Standard	C232.05(c)
3.	Cleanout Spacing	60m approx	C232.05(d) C232.07(d)
4.	Outlet Spacing	150m max	C232.05(e) C232.06(d) C232.07(e)
5.	Intra-Pavement Drain		
	(a) Alignment	Deviation <100mm from specified line at any point.	C232.06(b)
6.	<b>Edge Drains</b>		
	Compaction (Relative) Backfill material	100% Standard	C232.07(c)

Table C232.1 - Table of Limits and Tolerances

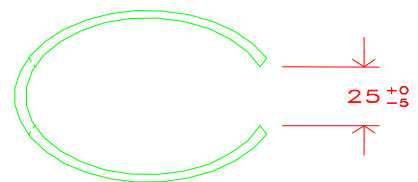
### C232.10 WITHDRAWN

## ANNEXURE C232A

## SLOTTING DETAILS FOR THICK WALLED UNPLASTICISED PVC PLASTIC PIPE



PLAN



SECTION A-A

Diagram not to scale  
Dimensions are in millimetres



# DEVELOPMENT CONSTRUCTION SPECIFICATION

C233

Revision 3

## **DRAINAGE MATS**

## SPECIFICATION C233 - DRAINAGE MATS

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## SPECIFICATION C233 : DRAINAGE MATS

### GENERAL

#### C233.01 SCOPE

- |  |                                 |
|--|---------------------------------|
| 1. The work to be executed under this Specification covers the installation of Drainage Mats (Blankets).       | <b>Scope</b>                    |
| 2. This Specification should be read in conjunction with the Specification for 'SUBSURFACE DRAINAGE - GENERAL. | <b>Associated Specification</b> |

#### C233.02 TERMINOLOGY

- |  |                    |
|--|--------------------|
| 1. Type A drainage mats are intended to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. | <b>Type A Mats</b> |
| 2. Type B drainage mats are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.  | <b>Type B Mats</b> |

#### C233.03 REFERENCE DOCUMENTS

- |  |   |
|--|---|
| 1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. | <b>Documents<br/>Standards Test<br/>Methods</b> |
|--|---|

##### (a) Council Specifications

C230                      -      Subsurface Drainage - General

##### (b) Australian Standards

AS1289.5.1.1	Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
AS 1289.5.7.1	Soil compaction and density tests – Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method).

#### C233.04 ORDER OF CONSTRUCTION

- |  |                    |
|--|--------------------|
| 1. Type A drainage mats shall be constructed after the site has been cleared and grubbed and before commencement of embankment construction. | <b>Type A Mats</b> |
| 2. Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.          | <b>Type B Mats</b> |

### CONSTRUCTION

#### C233.05 TYPE A MATS

- |   |                   |
|---|-------------------|
| 1. Type A drainage mats shall be constructed under embankments as and where shown on the Drawings or as directed by the Superintendent. | <b>Location</b>   |
| 2. After the embankment foundation has been trimmed and any necessary trench  | <b>Placing of</b> |

drains installed, a geotextile complying with the requirement of the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be laid on the embankment foundation. The area of geotextile laid shall be sufficient to cover the area of the Type A drainage mat and an additional amount for enclosing the sides of the drainage mat after the filter material has been placed. Laps of minimum width of 500mm shall be provided at each join in the geotextile.

***Geotextile***

3. Type C filter material or Type D filter material, as shown on the Drawings or as determined by the Superintendent, shall be placed on the geotextile and compacted to the satisfaction of the Superintendent. The minimum thickness of the compacted filter material shall be 300mm plus an allowance for the expected consolidation of the embankment foundation under the embankment load or 500mm if the amount of the expected total consolidation of the embankment foundation is not known. The filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250mm.

***Placing of  
Filter Material***

4. After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat.

***Securing of  
Geotextile***

5. An additional layer of geotextile shall be placed on the drainage mat under the base of any rock facing which may be placed as part of the embankment construction. The additional layer of geotextile shall extend beyond the outside and inside faces of the bottom layer of rock.

***Geotextile  
under Rock  
Facing***

6. Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent layers of filter material, earth filling or rock facing. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of the Superintendent. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

***Damaged  
Geotextile******Contractor's  
Cost***

7. Type A drainage mats shall extend 2m beyond the toes of embankments and such extensions shall be covered by a 300mm thick layer of Type C filter material or Type D filter material, as determined by the Superintendent. This protective layer shall be placed immediately after completion of construction of each drainage mat.

***Protective  
Layer***

8. Outlets from Type A drainage mats may be surface outlets at the toes of embankments or piped outlets connected to other drainage systems. Where piped outlets are constructed they shall conform to the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL.

***Outlets***

## **C233.06 TYPE B MATS**

1. Type B drainage mats shall be constructed in cuttings as and where shown on the Drawings or as directed by the Superintendent. Type B drainage mats shall be constructed for the full width of cuttings and for the pavement width in other locations.

***Location and  
Width***

2. After the subgrade material has been compacted and trimmed, a geotextile complying with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL, shall be laid on the subgrade. Laps of minimum width of 500mm shall be provided at each join in the geotextile.

***Placing of  
Geotextile***

3. Slotted fibre reinforced cement pipe, designated 100DMR, and complying with the Specification for PAVEMENT DRAINS, shall be laid on the geotextile at a distance of 200mm from and parallel to the longitudinal edges of the drainage blanket as shown in the Drawings.

***Fibre  
Reinforced  
Cement Pipe***

4. Type A filter material shall be placed on the geotextile and compacted to achieve a relative compaction, determined by AS1289.5.1.1 AND AS1289.5.7.1, of at least 100 per cent. Alternatively, the Superintendent may approve the use of a coarser filter material

***Placing of  
Filter Material***

having a maximum particle size of 75mm and a maximum D90/D10 ratio of three.

5. The thickness of the compacted filter material shall be as shown on the Drawings or as directed by the Superintendent. If the required thickness of compacted filter material is greater than 250mm, the filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250mm.

***Thickness of  
Filter Material***

6. After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing pavement layers over the drainage mat.

***Securing of  
Geotextile***

7. Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent pavement layers. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of the Superintendent. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

***Damaged  
Geotextile***

***Contractor's  
Cost***

8. The surface of the completed drainage mat shall be at the design level for the top of the drainage mat with a tolerance of plus zero and minus 40mm.

***Surface Level  
Tolerance***

9. Outlet structures where specified, or where directed by the Superintendent, shall be in accordance with the requirements of the Specification for SUBSURFACE DRAINAGE - GENERAL.

## **SPECIAL REQUIREMENTS**

**C233.07    RESERVED**

## **LIMITS AND TOLERANCES**

**C233.08    SUMMARY OF LIMITS AND TOLERANCES**

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C233.1 below.

<b>Item</b>	<b>Activity</b>	<b>Tolerances</b>	<b>Spec Clause</b>
1.	<b>Filter Material</b>		
	(a) Layer thickness	250mm max	C233.05 C233.06
	(b) Compaction (Relative) Type A filter material	100% Standard	C233.06
2.	<b>Type B Mats</b>		
	(a) Design level at top of mat	+0, -40mm	C233.06

**Table C233.1 - Table of Limits and Tolerances**

**C233.09    WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C241

Revision 3

## **STABILISATION**



**SPECIFICATION C241  
STABILISATION**

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## SPECIFICATION C241 STABILISATION

### GENERAL

#### C241.01 SCOPE

1. This specification defines the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

2. The work to be executed under this Specification consists of the supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade layer (including materials for the selected material zone, and selected backfill), at specified locations in the work and the spreading, compaction, trimming and curing of such materials.

**Scope**

3. This Specification provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table C241.1.

PAVEMENT COURSE OR SUBGRADE ZONE OR LAYER	STABILISING BINDER
PAVEMENT COURSE Base and Subbase	Blended Stabilising Agent
SUBGRADE ZONE OR LAYER Selected Material Zone	Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill) Cement
Other Subgrade Layers	Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill) Cement
Selected Backfill Zone	Blended stabilising agent Hydrated Lime (pugmill)

**Table C241.1  
TYPES OF PAVEMENT COURSES, SUBGRADE ZONES  
OR LAYERS AND STABILISING BINDER**

4. The pavement course or subgrade zone or layer to be stabilised shall be as specified in the Specifications for FLEXIBLE PAVEMENTS, or as indicated on the Drawings.

**Associated  
Specifications**

**C241.02 REFERENCE DOCUMENTS**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

**(a) Council Specifications**

C201	-	Control of Traffic
C213	-	Earthworks
C220	-	Stormwater Drainage - General
C242	-	Flexible Pavements

**(b) Australian Standards**

AS 1141.11	-	Method of sampling and testing aggregates - Particle size distribution by dry sieving.
AS 1289.5.7.1	-	Compaction control test Half density ratio and half moisture variation (rapid method)
AS 1289.5.8.1	-	Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode.
AS 1289.4.2.1	-	Determination of the sulphate content of a natural soil and the sulphate content of the ground water.
AS 1289.6.1.1	-	Soil strength and consolidation tests - Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen.
AS/NZS 2350.4	-	Setting time of Portland and blended cements.
AS 2350.9	-	Determination of residue of 45 micrometre sieve.
AS 3582.1	-	Supplementary cementitious materials for use with portland and blended cement - Fly ash.
AS 3582.2	-	Supplementary cementitious materials for use with portland cement - Slag - Ground granulated iron blastfurnace.
AS 3583.3	-	Supplementary cementitious materials for use with portland cement - Determination of loss on ignition.
AS 3583.6	-	Supplementary cementitious materials for use with portland cement - Determination of relative water requirement and relative strength.
AS 3583.12	-	Supplementary cementitious materials for use with portland cement - Determination of available alkali.
AS 3583.13	-	Supplementary cementitious materials for use with portland cement - Determination of chloride ion content.
AS 3583.14	-	Supplementary cementitious materials for use with portland cement - Determination of insoluble residue content.
AS 3972	-	Portland and blended cements

**(c) RTA Test Methods**

T432	-	Rate of Slaking of Quicklime
------	---	------------------------------

**INSPECTION, SAMPLING AND TESTING****C241.03 MATERIALS PROPOSED FOR USE IN THE WORK**

1. The Contractor shall provide a certificate from a laboratory with appropriate NATA registration stating that the stabilisation mix(s) submitted and the mix constituents comply with the mix nominated in Annexure C241A and that the stabilised material meets the

**Contractor's  
Responsibility**

requirements of the Specification for FLEXIBLE PAVEMENTS if incorporated into the works as a pavement layer or alternatively the Specification for EARTHWORKS or STORMWATER DRAINAGE GENERAL.

#### **C241.04 MATERIALS USED IN THE WORK**

1. Regular inspection, sampling and testing of pavement and subgrade materials shall be undertaken by the Contractor while stabilisation is in progress in accordance with this Specification.

***Sampling and Testing***

### **MATERIALS**

#### **C241.05 CEMENT**

1. The type of cement used as a constituent in a blended stabilising agent shall comply with AS 3972.

***Type***

2. Cement shall be from a source included in the New South Wales Government Quality Assurance Scheme at time of production.

***NSW QA Scheme***

3. The Contractor shall nominate the brand and source of all cementitious materials.

***Nominated Brand and Source***

4. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any time.

***Proof of Quality***

5. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Contractor shall arrange a re-test, to ensure the cement still complies with AS3972, before the cement is used in the work. The cost of retesting cement, which has been stored for a period in excess of three months, shall be borne by the Contractor. Test results shall be forwarded to the Superintendent for approval at least 2 days in advance of usage of the material.

***Storage in Excess of 3 months***

#### **C241.06 QUICKLIME**

1. Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

***Properties***

- |                    |   |
|--------------------|---|
| (i) Available Lime | The content of calcium oxide, determined by AS 3583.12, shall not be less than 85 per cent.   |
| (ii) Slaking Rate  | The active slaking time shall not be greater than twenty minutes and the temperature rise on slaking, determined from the average of four samples tested in accordance with Test Method T432, shall not be less than 40°C in six minutes. |

2. The particle size distribution of the quick lime determined by AS 1141.11 shall comply with the following requirements in Table C241.2.

***Particle Size***

A. S. SIEVE	PER CENT PASSING
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

**Table C241.2**  
**Particle Size Distribution of Quicklime**

**C241.07      HYDRATED LIME**

1. Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties: **Properties**

- |       |                                    |   |
|-------|------------------------------------|---|
| (i)   | Available Lime                     | The content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80 per cent. |
| (ii)  | Form                               | The material shall be in powder form.   |
| (iii) | Residue on Sieving (Particle Size) | The residue on a 300 micron sieve, determined by AS 3583.14, shall not exceed 2 per cent.       |

2. The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

- (a) Percentage of calcium hydroxide
- (b) Fineness - Percentage by mass passing the 45 micron sieve (AS 2350.9).
- (c) Source.

**C241.08      GROUND GRANULATED BLAST FURNACE SLAG**

1. The ground granulated blast furnace slag shall conform to AS3582.2.

2. The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (b) Relative strength (28 days) (AS 3583.6).
- (c) Source.

**C241.09      FLYASH**

1. Flyash shall conform to AS3582.1.

2. The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (b) Loss on ignition (AS 3583.3).
- (c) Source.

**C241.10      BLENDED STABILISING AGENTS**

1. The Contractor may utilise an approved blended stabilising agent. Handling and storage requirements of the Supplier shall be complied with by the Contractor who shall also arrange for sampling of the agent as required by the Superintendent.

**Requirements****APPROVED BLENDED STABILIZING AGENTS**

	%
Ground granulated slag and hydrated lime	85:15
Cement & flyash blends	80:20

2. The mass of components of the nominated blended stabilising agent shall not vary by more than  $\pm 3$  per cent from the blend percentages nominated in the mix design described in Annexure C241A.

3. When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

**Properties**

- (a) Source of each component.
- (b) Fineness - percentage by mass passing the 45 micron sieve (AS 2350.9).
- (c) Setting time (AS2350.4).

**C241.11      WATER**

1. Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than:

**Quality**

- (a) 300 parts per million of chloride ion, determined by AS 3583.13.
- (b) 200 parts per million of sulphate ion, determined by AS1289.4.2.1.
- (c) 1 percent by mass of undissolved solids.

2. Water accepted as potable (complies with NHMRC Guidelines 1996) and fit for human consumption will not require testing to confirm suitability.

**Potable****STABILISATION PROCESSES****C241.12      GENERAL**

1. The Contractor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work 14 days prior to commencement of the work. This submission, hereafter called the Work Plan, will nominate the sequence of operations, widths of stabilisation passes and provision for traffic if appropriate.

**Proposed  
Equipment  
and  
Procedures**

2. Notwithstanding submission to the Superintendent of the Contractor's equipment and stabilisation procedures, the work shall meet all the Specification requirements, and Statutory Requirements for Occupational Health and Safety, and the Contractor shall perform such tests as specified as the work proceeds, to ensure compliance. Costs of such tests shall be borne by the Contractor.

**Compliance  
Contractor's  
Cost**

3. Stabilisation of pavement materials shall not proceed during wet weather or if rain

**Weather**

## STABILISATION

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is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.

**Conditions**

### C241.13 APPLICATION OF STABILISING AGENT

#### a. Stationary Mixing Plant

1. Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the Superintendent.

**Application Rate**

2. Application rate measured in kilograms per tonne of product shall be monitored and recorded for every 100 tonnes of production.

**Measurement**

3. The achieved accuracy of application rate shall be  $\pm 5$  per cent of the nominated rate nominated in Annexure C241A.

4. The stabilising agent incorporated in excess of the nominated rate shall be at no cost to the Principal.

**Over Spread Contractor's Cost**

#### b. In-Situ

1. The incorporation of stabilising agent is to follow a process where stabilising agent is spread on the pavement in advance of the specialist mixing equipment.

**Application Process**

2. Spreading shall be carried out using the mechanical spreader nominated in the Work Plan and subsequently approved by the Superintendent. Annexure C241A nominates the spread rate.

**Spreading Rate**

3. The actual spread rate shall be within  $\pm 5$  per cent of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500m<sup>2</sup> of pavement treated (whichever is less) in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable 4 sided tray placed on the pavement and between the wheels of the mechanical spreader. The rate of stabilising agent spread shall be calculated by dividing the mass collected (kg) by the area of the tray (m<sup>2</sup>).

**Tolerances**

4. Where spreading vehicles are fitted with load cells, the Contractor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Contractor shall record this data for each run and make it available to the Superintendent promptly. Such action will not cancel the Contractor's obligation to undertake prescribed testing of spread rate if required by the Superintendent.

**Load Cells**

5. The stabilising agent spread in excess of the nominated rate shall be at no cost to the Principal.

**Over Spread Contractor's Cost**

6. Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property.

**Wind**

7. Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised.

**Construction Traffic**

8. Any spillage of the stabilising agent on site or at any loading location related to the site shall be removed as soon as possible and within 24 hours of such spillage.

**Spillage**

**C241.14 MIXING****a. Stationary Mixing Plant**

- |    |   |  |
|----|---|--|
| 1. | The stationary mixing plant shall be purpose built for the process of mixing road making materials. All equipment shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material.  | <b>Equipment</b>                         |
| 2. | The plant shall provide for the controlled and metered inclusion of water into the mix.   | <b>Control of Water</b>                  |
| 3. | The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall meet the Superintendent's requirements and shall be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS1289.6.1.1, with a pair of test specimens tested for each 400 tonnes of production and at full cost to the Contractor. | <b>Uniform Mixture Contractor's Cost</b> |

**b. In-situ**

- |    |  |  |
|----|--|--|
| 1. | Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. A minimum of 2 passes of the mixing equipment is required. Each pass should be arranged so that an overlap of ½ machine width is developed on each longitudinal run. As mixing tips wear they shall be replaced so as to maintain mixing efficiency consistent with that demonstrated during the trial section. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in a such manner as to provide a uniformly moist mix to a target moisture content. | <b>Equipment</b>                           |
| 2. | The mixing equipment shall provide for the controlled and metered inclusion of water as part of the mixing process.  | <b>Uniform Mixture</b>                     |
| 3. | The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.  | <b>Control of Water</b>                    |
| 4. | The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.  | <b>Disturbance</b>                         |
| 5. | The Superintendent may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content. Such additional work shall be carried out at no cost to the Principal.   | <b>Additional Mixing Contractor's Cost</b> |

**C241.15 FIELD WORKING PERIOD**

- |    |   |                                  |
|----|---|----------------------------------|
| 1. | The time period from addition of water during the mixing process until the completion of compaction is nominated as the Field Working Period. This period may vary significantly with variations in the type of stabilising agent.  | <b>Definition</b>                |
| 2. | The nominated Field Working Period shall be provided in Annexure C241A for the stabilising agent approved for the works. The Nominated Field Working Period shall be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for modified compaction procedures decreases by more than 2 percent. This testing shall be undertaken utilising AS 1289.5.7.1 and samples of the materials representative of those to be utilised in the works. | <b>Based on Laboratory Tests</b> |
| 3. | The Contractor will complete the compaction process within the Nominated Field  | <b>Compaction</b>                |



## STABILISATION

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Working Period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions.

***within Field  
Working  
Period***

### **C241.16 TRIMMING AND COMPACTION**

1. After mixing the layer shall be trimmed and compacted in accordance with the Specification for FLEXIBLE PAVEMENTS to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in Clause C241.18(a).

***Level  
Tolerance***

2. Subsequent secondary trimming may be undertaken in preparation for primer seal with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurring will not be accepted. The Contractor's survey control methods as stated in the Work Plan will be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in Clause C241.18(b). When required by the Superintendent survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary trimming.

***Secondary  
Trimming***

3. All trimmed material having been cut to waste shall be used as fill or spoiled as directed by the Superintendent.

***Trimmed  
Material***

4. Where an additional stabilized layer is to be placed above an existing stabilized layer, the surface shall be left sufficiently rough by indentation left by padfoot roller (10mm-20mm) in order to prevent lamination.

5. Measurements with a 3 metre straight edge shall be taken at a minimum of 10 randomly selected stations so as to represent each 200 metre lane length or part thereof. Deviation of the surface from the bottom of a 3 metre straight edge placed in any direction will meet the tolerance shown in Clause C241.18(a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

***Straight Edge  
Test***

6. The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.7.1 is not less than as detailed in the Specification for FLEXIBLE PAVEMENTS, EARTHWORKS or STORMWATER DRAINAGE GENERAL as appropriate.

***Compaction***

7. To provide true relative compaction assessments the lots shall be sampled and tested within the nominated field working period in accordance with AS 1289.5.7.1.

***Test Method***

8. The maximum wet density (modified compaction) will be determined by sampling immediately after the determination of field density and testing will be undertaken within 2 hours of sampling. A determination of maximum wet density (modified compaction) representing the full layer depth is required for each sampling location when calculation of relative compaction is undertaken.

***Wet Density***

9. The field density may be determined by in-situ sand replacement testing in accordance with AS 1289.5.8.1.

***In-Situ Dry  
Density***

**C241.17 JOINTS**

1. Joints are defined in this Specification to comprise interfaces between work episodes that are separated in time by more than the nominal field working period for the nominated stabilisation mix design. The work plan shall be formulated to negate the use of longitudinal joints. A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the nominated field working period.

***Joint Type***

2. All transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. Transverse joints shall be overlapped by a minimum of 2 metres. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work.

***Cutting Back***

3. The level and shape of the joints shall be within the limits specified in Clause C241.18.

***Finish*****C241.18 TOLERANCES****(a) Levels and Surface Trim**

1. The surface level after primary trimming shall be within the tolerance of the final trim or where secondary trimming is proposed within +10mm and +30mm of the levels shown on the Drawings.

***Primary Trimming***

2. The surface level after secondary trimming shall be within a tolerance of  $\pm 10$ mm of the levels shown on the Drawings.

***Secondary Trimming***

3. The pavement surface immediately prior to sealing shall be of a quality such that deviation under a 3 metre straight edge does not exceed 12mm.

**(b) Layer Thickness**

1. The final thickness of the stabilised layer at any point shall be within a tolerance of +20mm and -10mm of the nominated layer thickness.

***Minimum Thickness***

2. The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200m length of a lot. The average thickness shall not be less than that required to meet the specified final thickness tolerances after trimming.

***Average Thickness***

3. The layer thickness shall be measured at the edges of the stabilising run before compaction commences. The layer thickness shall be measured relative to the finished design level.

***Method of Measurement*****(c) Width**

1. The width measured at any point of the stabilised layer shall be not less than the specified width as shown in the Drawings by more than 50mm.

***Minimum Width***

2. The average width of the layer shall be determined from measurements at 3 sites selected at random by the Superintendent over any 200m length of a lot and shall be not less than the specified width.

***Average Width*****C241.19 CURING**

1. The Contractor shall submit to the Superintendent details of the proposed method of curing as part of the Work Plan.

***Notice***

## STABILISATION

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2. The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a seal.

***Water Curing***

3. Water curing shall consist of frequent light uniform spraying that will not produce significant run off or flooding on sections of the area. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

***Caution***

4. Under this specification provision for curing up to the period indicated in Annexure C241A shall be the responsibility of the Contractor at cost to the Contractor.

***Curing Period***

## LIMITS AND TOLERANCES

### C241.20 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses of this Specification are summarised in Table C241.3 below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Quicklime</b>		
	a) Available Lime	>85% Calcium Oxide content	C241.06
	b) Slaking Rate	Active Slaking time < twenty minutes, and temperature rise on slaking not less than 40°C in six minutes (for an average of four samples).	C241.06
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve 96-100% for 9.5mm Sieve 70-100% for 4.75mm Sieve 0-90% for 2.36mm Sieve	C241.06
2.	<b>Hydrated Lime</b>		
	a) Available Lime	>80% Calcium Hydroxide	C241.07
	b) Particle Size	<2% residue on a 300 micron Sieve	C241.07
3.	<b>Blended Stabilising Agents</b>	Blend percentages shall not vary by more than $\pm 3\%$ from those nominated in Annexure C241A	C241.10
4.	<b>Water</b>		
	a) Chloride ion content	<300 PPM Chloride ion	C241.11
	b) Sulphate ion content	<200 PPM Sulphate ion	C241.11
	c) Undissolved solids	<1 percent by mass of undissolved solids	C241.11
5.	<b>Application of Stabilising Agent</b>		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within $\pm 5\%$ of the nominated rate	C241.13

## STABILISATION

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Item	Activity	Tolerances	Spec Clause
6.	<b>Trimming and Compaction</b>		
	a) Surface Level	After primary trimming be within +10mm and +30mm of levels shown on Drawings  After secondary trimming be $\pm 10$ mm of levels shown on Drawings	C241.18(a)
	b) Layer Thickness	Final thickness of layers shall not vary more than +20mm and -10mm of required thickness	C241.18(b)
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing	C241.18(a)
7.	<b>Joints</b>		
	Transverse Overlap	> 2m overlap of transverse joints	C241.17
8.	<b>Width</b>		
	a) Width of Stabilised Layer	At any point, the width shall be not less than 50mm short of the width shown on the Drawings with an average width always greater than that shown on the Drawings.	C241.18(c)

**Table C241.3 - Summary of Limits and Tolerances**

## SPECIAL REQUIREMENTS

<b>C241.21</b>	<b>RESERVED</b>
<b>C241.22</b>	<b>RESERVED</b>
<b>C241.23</b>	<b>RESERVED</b>
<b>C241.24</b>	<b>WITHDRAWN</b>

## ANNEXURE C241A

## STABILISATION MIX DESIGN

Type of Stabilising Agent	.....
	.....
	.....
Nominal Percentage of Stabilising Agent by Mass	..... %
Spread Rate of Stabilising Agent for contractual purposes	..... (kg/m <sup>2</sup> )
Depth of Compacted Layer to be Stabilised	..... (mm)
Nominated Field Working Period	..... (hrs)
Maximum Field Working Period	..... (hrs)
Nominated Target Unconfined Compressive Strength (UCS) (7 day natural curing)	(Maximum variation ± 10%) ..... MPa
Average Test Result	..... MPa
Nominated Target CBR Value (4 day soaked) for stabilised modified subgrade	..... %
Average Test Result	..... %
Period for Contractor's Curing	..... (days)
Nominated Granular Material(s)	..... (type)
Source of Nominated Granular Material	.....

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C242

Revision 3

## **FLEXIBLE PAVEMENTS**





## SPECIFICATION C242 - FLEXIBLE PAVEMENTS

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## SPECIFICATION 242 : FLEXIBLE PAVEMENTS

### GENERAL

#### C242.01 SCOPE

1. The work to be executed under this Specification consists of the supply, spreading, compaction and trimming of base and subbase courses of flexible and semi-rigid (bound) pavements to the specified levels and thicknesses as shown on the Drawings.

#### C242.02 TERMINOLOGY

- |  |                           |
|--|---------------------------|
| <p>(a) Materials designated as 'base' require the provision of a wearing surface comprising either a sprayed bituminous seal or asphalt.</p> <p>(b) Materials designated as 'subbase' require a covering course of 'base'. The subbase may consist of one or more layers.</p> <p>(c) A flexible pavement consists of a base and a subbase constructed of unbound materials. For the purpose of this Specification it also includes "semi-rigid" pavements.</p> <p>(d) A semi-rigid pavement is one where the base and/or the subbase are constructed of lightly bound materials.</p> <p>(e) Bound material incorporates a binder to produce structural stiffness.</p> <p>(f) Modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness.</p> <p>(g) Unsealed Pavements shall conform with the requirements for NGS.</p> | <p><b>Definitions</b></p> |
|--|---------------------------|

#### C242.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

##### (a) Council Specifications

- |      |   |                              |
|------|---|------------------------------|
| C241 | - | Stabilisation                |
| C244 | - | Sprayed Bituminous Surfacing |

##### (b) Australian Standards

- |               |   |   |
|---------------|---|---|
| AS 1141.14    | - | Methods of sampling and testing aggregates - Particle shape, by proportional calliper.  |
| AS 1141.22    | - | Methods of sampling and testing aggregates - Wet/dry strength variation.  |
| AS 1289.3.1.1 | - | Soil classification tests - Determination of the liquid limit of a soil - Four point Casagrande method.                         |
| AS 1289.3.3.1 | - | Soil classification tests - Calculation of the plasticity index of a soil.  |
| AS 1289.3.6.1 | - | Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving. |

- AS 1289.3.6.3 - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer.
- AS 1289.5.2.1 - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort.
- AS 1289.5.3.1 - Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus.
- AS 1289.5.4.1 - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio.
- AS 1289.6.1.1 - Soil strength and consolidation tests - Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen.
- AS 1289.5.1.1 - Methods of testing soils for engineering purposes – Soil compaction and density tests – Determination of the dry density moisture content relation of a soil using standard compactive effort

**(c) RTA Test Methods**

- T114 - Maximum Dry Compressive Strength of Road Materials
- T116 - Unconfined Compressive Strength - Remoulded Material
- T130 - Dry Density Moisture Relations for Mixtures of Road Materials and Cement.
- T131 - Unconfined Compressive Strength
- T160 - Benkelman Beam Deflection Test
- T171 - Modified Texas Triaxial Compression Test

**C242.04 PAVEMENT STRUCTURES**

- |  |  |
|--|--|
| 1. Flexible or semi-rigid pavement material types and layer thicknesses shall be as shown on the Drawings. | <b><i>Material Types and Layer Thickness</i></b> |
|--|--|

**C242.05 INSPECTION, SAMPLING AND TESTING**

- |  |   |
|--|---|
| 1. Inspection, sampling and testing of the pavement shall be undertaken by the Contractor in accordance with the requirements of this Specification before, during and after the construction of the pavement. Testing shall be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel. | <b><i>Contractor's Responsibility</i></b> |
| 2. The Contractor shall provide the Superintendent with written notice when testing is being carried out and copies of all test reports for approval to proceed.   | <b><i>Written Notice</i></b>              |
| 3. Field density tests shall be carried out in accordance with AS 1289.5.3.1.  | <b><i>Density Tests</i></b>               |

**MATERIALS**

**C242.06 GENERAL**

- |   |  |
|---|--|
| 1. The Contractor shall submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any binder. These details shall be submitted to the Superintendent, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this Specification. If the proposed base or subbase is a bound material, the Contractor shall submit a completed Annexure C241A contained in the Specification for STABILISATION. | <b><i>Details of Proposed Base and Subbase to be Submitted</i></b> |
|---|--|

2. No material shall be delivered until the Superintendent has approved the source of supply. The Superintendent shall only approve a source of supply after it has been approved by Council. **Source of Supply**
3. If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor shall inform the Superintendent in writing of the proposed changes. No delivery of material produced under the altered proposal shall take place without the approval of the Superintendent. The cost of testing associated with any altered proposal shall be borne by the Contractor. **Variations by Contractor**  
**Contractor's Cost**
4. At least fourteen days before placement of the material on site, the Contractor shall submit to the Superintendent a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this Specification. **NATA Certificate**
5. Ongoing testing of materials during delivery and construction shall be undertaken on samples taken from the site. These results are to be submitted to the Superintendent. **Sampling on-site**
6. The Superintendent shall provide all test results to Council.

**C242.07 WITHDRAWN**

**C242.08 UNBOUND BASE AND SUBBASE**

1. Unbound materials, including blends of two or more different materials, shall consist of granular material which does not develop significant structural stiffness when compacted. Material produced by blending shall be uniform in grading and physical characteristics. **Granular Material**
2. Unbound crushed rock materials are designated as follows: **Crushed Rock**  
 DGB20 20mm nominal sized densely graded base  
 DGS20 20mm nominal sized densely graded subbase  
 DGS40 40mm nominal sized densely graded subbase
3. Unbound natural gravel materials are designated as follows: **Natural Gravel**  
 NGB20 20mm nominal sized natural gravel base  
 NGS20 20mm nominal sized natural gravel subbase  
 NGS40 40mm nominal sized natural gravel subbase
4. The combination of DBG20 base and NGS20 subbase is not permissible. The acceptable material types for each Road Hierarchy class are given in Table C242.2. **Material Types**

Traffic Category	Acceptable Base Material	Acceptable Subbase Material	Hierarchy
A	DGB20	DGS20, DGS40	Urban sub-arterial, Urban Collector Urban Local 2 Urban Local 1 Rural sub-arterial Rural Collector
B	DGB20, NGB20	DGS20, DGS40, NGS20, NGS40	Rural Local 1,2,3 & lanes

**Table C242.2 - Acceptable Pavement Material Types**

5. Base materials shall comply with the requirements of Table C242.3.

**Base**

Test Method	Description	Base Material Requirements	
		DGB20	NGB20
AS 1289.3.6.1	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - - 100 95-100 70-90 - 50-70 - 35-55 - -	- - - 100 93-100 - 71-87 - 47-70 35-56 14-32 6-20
AS 1289.3.6.3	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36mm sieve)  A. Pass 425µm sieve % B. Pass 75µm sieve % Pass 425µm sieve C. Pass 13.5µm sieve % Pass 75µm sieve	35-55 35-55  35-60	- -  -
AS 1289.3.1.1	Liquid Limit (if non plastic) ▼	max 20	max 20
AS 1289.3.3.1	Plastic Limit (if plastic)	max 20	max 20
AS 1289.3.3.1	Plasticity Index	max 6	max 6
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	min 1.7 MPa	min 1.7 MPa
AS 1141.14	Particle Shape by Proportional Calliper % mis-shapen (2 : 1)	max 35	-
AS 1141.22	Aggregate Wet Strength ◇	min 80	
AS 1141.22	Wet/Dry Strength Variation ◇  Dry - Wet % Dry  For category 1 or 2a	max 35	-
AS 1289.6.1.1	4 day Soaked CBR (98% Modified Compaction)	-	80

**Table C242.3 - Unbound Base Material Properties**

**NOTES ON TABLE C242.3:**

Material consisting of river stone shall not be used for base material.

▼ The maximum value of the Liquid Limit may be increased to 23 for non-plastic material, provided that the value determined is not influenced by the presence of adverse constituents.

◇ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested.

6. Subbase materials shall comply with the requirements of Table C242.4

**Subbase**

Test Method	Description	Subbase Material Requirements			
		DGS20	DGS40	NGS20	NGS40
AS 1289.3.6.1	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - - 100 95-100 70-90 - 50-70 - 35-55 - -	- 100 - - 50-85 - - 30-55 - 25-50 - -	- - - 100 96-100 - 65-89 - 47-80 32-67 14-42 6-26	- 100 95-100 80-97 - - 48-85 - 35-73 25-58 10-33 3-21
AS 1289.3.6.3	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36mm sieve)  A. Pass 425µm sieve %  B. Pass 75µm sieve % Pass 425µm sieve  C. Pass 13.5µm sieve % Pass 75µm sieve	  35-55  35-55  35-60	  35-60  35-60  35-65	  -  -  -	  -  -  -
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	min 1.0 MPa	min 1.0 MPa	1.0 MPa	1.0 MPa
AS 1289.3.3.1	Plasticity Index	max 12	max 12	max 12	max 12
AS 1141.14	Particle Shape by Proportional Calliper % mis-shapen (2 : 1)	max 35	max 35	-	-
AS 1141.22	Aggregate Wet Strength ♦	min 50kN	min 50kN	-	-
AS 1141.22	Wet/Dry Strength Variation ♦  <u>Dry - Wet</u> % Dry	max 60	max 60	-	-
AS 1289.6.1.1	4 day Soaked CBR (98% Modified Compaction)	-	-	40	40

**Table C242.4 - Unbound Subbase Material Properties**

**NOTES ON TABLE C242.4:**

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ♦ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested.

**C242.09 WITHDRAWN****C242.10 LIGHTLY BOUND BASE AND SUBBASE MATERIALS**

- |  |  |
|--|--|
| 1. Bound materials utilised in semi-rigid pavements as a base layer for Traffic Category A shall be supplied as a crushed rock product with stabilising agent incorporated in a stationary mixing plant (pugmill) at the supplier's quarry unless prior written approval is obtained from the Council.   | <b><i>Traffic Category A</i></b>                           |
| 2. Bound material to be used as subbase generally or base layer for Traffic Category B may be supplied as a crushed rock product with stabilising agent incorporated in a pugmill or may be produced by the in-situ stabilisation of natural or blended gravel, provided that the material to be bound is approved by Council prior to incorporation into the works. | <b><i>Traffic Category B</i></b>                           |
| 3. For Category A pavement, prior to stabilisation, the base pavement material shall meet the requirements of DGS20, except that the PI shall be a maximum of 9.   | <b><i>Material Requirements Prior to Stabilisation</i></b> |
| 4. Material requirements for the stabilising agent shall be in accordance with the Specification for STABILISATION.  | <b><i>Stabilising Agent</i></b>                            |
| 5. The stabilisation process shall meet the requirements of the Specification for STABILISATION.   | <b><i>In-situ Stabilisation</i></b>                        |
| 6. The unconfined compressive strength (UCS) of the material after seven days natural curing as determined by Test Method T131 shall be not less than 1MPa nor more than 1.5MPa. Sampling and test specimen compaction of the material shall be undertaken within one hour of the incorporation of the stabilising agent.  | <b><i>Unconfined Compressive Strength</i></b>              |

**DELIVERY, STOCKPILING AND PROCESSING OF PAVEMENT MATERIAL****C242.11 DELIVERY TO SITE**

- |   |                              |
|---|------------------------------|
| 1. Materials shall be supplied sufficiently damp to avoid segregation and loss of fines during transit. | <b><i>Damp Condition</i></b> |
|---|------------------------------|

**C242.12 STOCKPILING OF UNBOUND MATERIALS**

- |   |   |
|---|---|
| 1. Stockpile sites shall be located as shown on the Drawings or as approved by the Superintendent.  | <b><i>Stockpile Sites</i></b>             |
| 2. Stockpile sites, which shall be cleared of all vegetation and extraneous matter, shall be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by AS 1289.5.4.1 for standard compactive effort, of not less than 95 per cent. | <b><i>Compacted and Free Draining</i></b> |
| 3. Stockpiles and stockpile sites shall be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.   | <b><i>Stockpile Requirements</i></b>      |
| 4. The total height of any stockpile shall not exceed 4m.   | <b><i>Height</i></b>                      |
| 5. Stockpiles shall be of uniform shape with side slopes neither steeper than 1.5 to 1 nor flatter than 3 to 1.   | <b><i>Shape</i></b>                       |



6. The worked face of any stockpile shall be the full face of the stockpile. The stockpiled material shall be maintained at a moisture content sufficiently damp to avoid loss of fines.

***Maintained  
Damp***

7. At the completion of the works, all permanent stockpile sites shall be cleared of all surplus material and left in a clean and tidy condition. Temporary Stockpile sites shall be cleared and revegetated as directed by the Superintendent in accordance with Council requirements.

***Completion of  
Work***

#### **C242.13 DELIVERY OF MODIFIED OR LIGHTLY BOUND MATERIALS**

1. Modified or lightly bound materials shall be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport.

***Vehicle  
Deliveries***

2. For lightly bound materials, the time between mixing and conveyance by delivery trucks to the site, shall be such as to allow incorporation into the works including trimming and compaction within the nominated field working period.

***Time Limit***

3. Each truck load of bound material shall be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets shall be made available to the Superintendent at the point of delivery.

***Delivery  
Dockets***

4. Lightly bound materials shall comply with the requirements of the Specification for STABILISATION.

### **SPREADING OF PAVEMENT MATERIAL**

#### **C242.14 SPREADING PAVEMENT MATERIALS**

1. Unbound materials shall not be spread upon an underlying pavement layer which has a moisture content exceeding 90 per cent of the laboratory optimum moisture content as determined by AS 1289.5.2.1 or which has become rutted or mixed with foreign matter. The underlying layer shall be corrected to comply with this Specification before spreading of the next layer of pavement.

***Underlying  
Layer Quality***

2. The cost of correcting an underlying layer to comply with this Specification shall be borne by the Contractor.

***Contractor's  
Costs***

3. Each layer of material shall be deposited and spread in a concurrent operation and, after compaction, the finished surface levels on the base and subbase courses shall be within the permitted tolerances stated in Clause C242.22(c) without subsequent addition of material. The thickness of each compacted layer shall be neither less than 100mm nor more than 200mm for all pavement layer types, unless otherwise approved by the Superintendent.

***Tolerances***

4. At all work boundaries in bound materials the Contractor shall provide vertical faces to provide for transverse and longitudinal joints.

***Joints***

5. When spread for compaction processes the moisture content of the base or subbase materials shall be in the range of 60-90 per cent of laboratory optimum moisture content in accordance with AS 1289.5.2.1.

## TRIMMING AND COMPACTION

### C242.15 GENERAL REQUIREMENTS

- |  |   |
|--|---|
| 1. Each layer of the base and subbase courses shall be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in Clauses C242.19 and C242.20.   | <b><i>Uniform<br/>Compaction</i></b>              |
| 2. On sections of pavement with one-way crossfall, compaction shall begin at the low side of the pavement and progress to the high side. On crowned sections, compaction shall begin at the sides of the pavement and progress towards the crown. Each pass of the rollers shall be parallel with the centreline of the roadway and uniformly overlap each preceding pass. | <b><i>Compaction<br/>Procedure</i></b>            |
| 3. At locations where it would be impracticable to use self propelled compaction plant, the pavement material shall be compacted by alternative hand-operated plant approved by the Superintendent.  | <b><i>Hand Operated<br/>Plant</i></b>             |
| 4. Watering and compaction plant shall not be allowed to stand on the pavement being compacted.  | <b><i>Plant<br/>Movement<br/>Restrictions</i></b> |
| 5. The placement of subsequent layers shall not be allowed until the requisite testing has been completed and the test results for each layer have been accepted by the Superintendent.  | <b><i>Placing<br/>Subsequent<br/>Layers</i></b>   |
| 6. Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up shall be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.   | <b><i>Excessive<br/>Moisture<br/>Content</i></b>  |

### C242.16 WITHDRAWN

## ACCEPTANCE OF COMPACTED LAYERS

### C242.17 LOTS FOR ACCEPTANCE

- |  |                                    |
|--|------------------------------------|
| 1. Acceptance of work, as far as compaction is concerned, shall be based on density testing of the work in lots. A lot shall be nominated by the Contractor, but shall conform to the following: | <b><i>Lot<br/>Requirements</i></b> |
| (a) cover only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints;                         |                                    |
| (b) for unbound materials it may equal a day's output using the same material.   |                                    |

2. When directed by the Council, acceptance of lots shall be determined according to the elastic rebound deflection. The elastic rebound deflection shall be taken as the maximum deflection in accordance with Test Method T160 utilising the Benkelman Beam or equivalent. Refer to Table C242.5 for the average maximum deflection readings at the various layers of formation are :-

**Benkelman  
Beam Testing**

Construction Level	Maximum tolerable Deflection (mm)		Target Deflection (mm)
	Traffic Category A	Traffic Category B	
1m below finished surface	1.4	1.6	0.9
Top of subgrade	1.2	1.4	0.8
Top of select subgrade	1.0	1.2	0.5
Top of sub base	0.9	1.1	0.5
Top of Base	0.8	1.0	0.4
Top of Base (asphalt)	0.6	0.6	0.4

**Table C242.5**

(Before Testing with Benkelman Beam it is essential that the pavement has been standing for at least one hour without rolling, this allows dissipation of liquid and gaseous pore pressures.)

The co-efficient of variation (CV) in recorded deflections shall not exceed 30 per cent. Measurements shall be taken at maximum spacings of 30 metres in each lane, with a minimum of six measurements per lot.

The characteristic deflection of each segment of road will be calculated as follows:-

$$D = X + (1.65 \times S)$$

Where:-

D = Characteristic deflection (mm)

X = mean deflection (mm)

S = standard deviation of deflection (mm)

**C242.18 COMPACTION ASSESSMENT**

1. The Superintendent shall assess compaction for each lot based on random sampling of test locations for in-situ dry density testing.

**Density  
Testing**

2. The Contractor shall arrange for testing to assess compaction on the basis of ten tests per 5000 sq m with a minimum of six tests per lot, and present the results to the Superintendent for approval.

**Sampling**

3. The Contractor shall make available a self propelled pneumatic tyred roller and shall carry out proof loading by rolling that section of pavement as directed by the Superintendent or Council. The roller shall be a dual axle multi-wheel type. The load on each tyre shall be 1.5 tonne. The tyres are to be smooth and operate at a pressure of at least 600kpa.

**Proof testing**

**C242.19 RELATIVE COMPACTION**

1. The relative compaction of pavement material at each location tested for in-situ dry density shall be calculated in accordance with AS 1289.5.3.1 as follows:

**Calculation**

$$\text{Relative Compaction (per cent)} = \frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$$

2. In-situ dry density testing shall be carried out by the Contractor using AS 1289.5.3.1

**Dry Density Testing**

3. Each day that material is produced for placement in a layer or layers, a sample of the material shall be taken by the Contractor for maximum dry density testing to represent that day's production.

**Daily Samples**

4. For unbound layers, the sample shall be tested in accordance with AS 1289.5.1.1 to determine the maximum dry density (standard compactive effort) for the material.

**Maximum Dry Density**

5. For bound layers the sample shall be tested within two hours after the addition of stabilising agent to the mix in accordance with RTA Test Method T130 to determine the maximum dry density (standard compactive effort) for the material. This test method shall also be used to determine the optimum moisture content.

**Time for Testing**

6. The maximum dry density so determined shall be used as the comparative dry density in relative compaction calculations for all like material from that lot or day's production placed in a single layer of work whichever is the lesser.

**Comparative Dry Density****C242.20 COMPACTION REQUIREMENTS AND ACCEPTANCE**

1. A lot shall be accepted for compaction if:
- (a) The minimum value of all calculated relative compaction for modified compactive effort is not less than 100 per cent within the lot or the area of pavement being assessed.
  - (b) In the case of lightly bound layers an area of pavement presented for compaction assessment has within that area a zone or zones with relative compaction less than 102 per cent (standard compactive effort) but equal to or greater than 100 per cent may be accepted by the Superintendent provided such zone or zones shall not comprise more than 5 per cent of the area presented.
  - (c) moisture content shall be within +1%, -3% of optimum

2. Lots or areas of pavement not achieving these specified values shall be rejected. Unbound layers may be reworked as provided by Clause C242.21, but the bound materials in rejected layers/courses shall be removed and replaced with fresh materials in accordance with Clause C242.24.

**Rejection of Lots****C242.21 REWORKING OF REJECTED UNBOUND LAYERS**

1. Lots or areas of pavement that have been rejected in regard to compaction shall be reworked before resubmission for compaction assessment.

**Reworking**

2. Material that has become degraded, segregated or otherwise reduced in quality by reworking shall be rejected. The rejected material shall be removed, disposed of and replaced with fresh material complying with this Specification in accordance with Clause C242.24. When a lot or area of pavement is resubmitted for compaction assessment, testing shall be carried out in accordance with Clauses C242.18 and C242.19.

**Rejected Material**

**C242.22 TOLERANCES****a) General**

1. The tolerances stated are the acceptable limits of departure from the dimensions shown on the Drawings, which may occur during construction.

***Tolerances***

2. Areas for assessment of conformity with tolerance requirements shall be divided into lots and presented to the Superintendent together with survey reports covering line and level.

***Lots for Assessment of Conformity*****b) Width**

1. At any cross section without kerb and/or guttering, and for pavement layers extending under the kerb and/or guttering, the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface shall be neither less than 50mm less than the dimension nor more than 300 mm greater than the dimension shown on the Drawings.

***Horizontal Dimensions***

2. The average width of the layer determined from measurements at three sites selected at random by the Superintendent over any 200 metre road length, or part thereof, shall be not less than the specified width.

***Average Width*****c) Levels and Surface Trim*****Subbase Surface Level***

1. The levels of the finished surface of the top of the unbound subbase course shall not vary from the design levels by more than +0, -10 .

2. Level tolerances at the top of the unbound base course shall not vary from the design level by more than +10, -0. In addition, where kerb and gutter exists or is being constructed, the level of the top of the base course adjacent to the kerb and gutter shall not vary by more than +5, -0 from the lip level of the gutter.

***Base Surface Level***

3. The design level of the top of the subbase course shall be determined from the design level of the finished road surface less the thickness of the base course and the wearing course.

***Subbase Design Level***

4. The pavement surface after trimming and immediately prior to sealing shall be of a quality such that the deviation under a 3 metre straight edge placed in any direction does not exceed 6mm. Measurements with the 3 metre straight edge shall be taken at a minimum of 10 randomly selected stations so as to represent a 100 metre lane length or part thereof. Notwithstanding this requirement the surface shall not pond water.

***Straight Edge Deviation*****C242.23 ACTION ON REJECTION****(a) Unbound Materials**

A lot that has not complied with the requirements for width or level tolerance as set out in Clauses C242.22(b) and C242.22(c) respectively shall be tynd and reworked or trimmed to meet the required tolerances.

***Rejection Criteria*****(b) Lightly Bound Materials**

An area of bound material that has not complied with the requirements for width or level tolerance as set out in Clauses C242.22(b) and C242.22(c) respectively shall be rejected except as otherwise provided for in this Clause. Rejected areas shall be removed, disposed of and replaced with fresh material in accordance with Clause C242.24.

***Rejection Criteria***

2. Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

***Corrective Action Circumstances***

- (i) Where the cause for rejection is under Clause C242.22(c), the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.
- (ii) Where the cause for rejection is under Clause C242.22(c), the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20mm above the original design level. Approval by the Superintendent shall be subject to the following requirements:
- The rate of change of grade from the original finished design surface level shall be less than 3 mm per metre.
  - The regrading shall not interfere with the proper design functioning of the drainage system.
  - The regrading shall not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond Council's allowable design limits.
  - The regrading shall not interfere with clearances.
- (iii) Where the cause for rejection is under Clause C242.22(c), the course is a base course and rejection is due to departures from design level being too far above the design level and there is no kerb and gutter, the Contractor may propose a regrading of the design level of the base course. Approval by the Superintendent shall be subject to the requirements of this Clause in (ii) above.

#### **C242.24      REMOVAL AND REPLACEMENT OF REJECTED COURSES**

1. Sections of the work that have been rejected shall be removed from the work and replaced with fresh material. Rejected material shall be removed from site. ***Rejected Material***
2. In rejected sections the material shall be removed over the full length of the rejected lot, except that a minimum length of 50 m of pavement layer shall be removed and replaced. Any damage to underlying or abutting layers or structures shall be made good by the Contractor using methods approved by the Superintendent. ***Length to be Removed***
3. After removal of rejected base or subbase course material, the section shall be presented for inspection by the Superintendent before replacement work is commenced. ***Replacement***

#### **C242.25      MAINTENANCE BEFORE COMPLETION OF WEARING SURFACE**

1. Following the Superintendent's acceptance of any section of the work, the Contractor shall maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The base course of sections of the accepted work shall be covered with a primerseal over the full width of pavement in accordance with the Specification for SPRAYED BITUMINOUS SURFACING within seven days of the date of the acceptance of such sections, unless otherwise approved by the Superintendent. ***Primerseal***
2. Should the pavement condition deteriorate before the application of the primerseal and consent to proceed with the bitumen surfacing work is withdrawn by the Superintendent, the Contractor shall re-prepare the pavement and re-present the pavement for inspection by the Superintendent. ***Contractor's Responsibility***

## OPENING PAVEMENT TO TRAFFIC

### C242.26 GENERAL REQUIREMENTS

- |    |  |  |
|----|--|--|
| 1. | For unbound pavements, construction plant and vehicles not involved in the current construction or testing of the work shall not be permitted to use the pavement until the primerseal has been applied, unless otherwise approved by the Superintendent.      | <b><i>Restrictions<br/>on Movement</i></b>                                   |
| 2. | For bound pavements, construction plant and vehicles not involved in the current construction or testing of the work shall not be permitted to use the pavement until the primerseal has been applied and seven days have elapsed since placement of the base. | <b><i>Restrictions<br/>on Movement<br/>of Construc-<br/>tion Traffic</i></b> |
| 3. | Where there is no need for immediate traffic on bound pavements, traffic shall not be allowed to use the constructed pavement until a minimum of seven days after completion of the full pavement depth and the primerseal.                                    | <b><i>Open to Traffic<br/>Bound<br/>Pavement</i></b>                         |

## LIMITS AND TOLERANCES

### C242.27 SUMMARY OF LIMITS AND TOLERANCES

The tolerances applicable to the various clauses in this Specification are summarised in the Table below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Stockpile Sites</b>	(i) Relative Compaction >95% (ii) Stockpile height <4m (iii) Stockpile batter <1.5:1 and >3:1	C242.12 C242.12
2.	<b>Spreading Pavement Materials</b>		
	(i) Compacted Layer Thickness	≥100mm, ≤200mm	C242.14
3.	<b>Compaction Acceptance</b>		
	Minimum value of all calculated relative compaction results	≥100 per cent (standard compactive effort).	C242.20
4.	<b>Width of Pavement</b>		
	(i) Design centre-line to edge of constructed pavement	-50mm to +300mm of dimensions on Drawings	C242.22(b)
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, shall be not less than the specified width.	C242.22(b)
5.	<b>Surface Level</b>		
	(i) Subbase levels	+0,-10mm from design level	C242.22(c)
	(ii) Base levels	+10, -0mm from design level	C242.22(c)
	(iii) Base levels adjacent to Kerb and Gutter	+5, -0mm from the lip levels of adjacent gutter.	C242.22(c)
	(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing shall be less than 6mm	C242.22(c)

**Table C242.6- Summary of Limits and Tolerances**



**SPECIAL REQUIREMENTS**

**C242.28      RESERVED**

**C242.29      RESERVED**

**C242.30      RESERVED**

**C242.31      RESERVED**

**C242.32      RESERVED**

**C222.33      RESERVED**

DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C244

Revision 3

**SPRAYED  
BITUMINOUS SURFACING**



**SPECIFICATION C244 - SPRAYED BITUMINOUS SURFACING**

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## **SPRAYED BITUMINOUS SURFACING**

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## SPECIFICATION C244 SPRAYED BITUMINOUS SURFACING

### GENERAL

#### C244.01 SCOPE

1. The work to be executed under this Specification consists of the supply of all materials and the application of any or all of the following types of sprayed bituminous surfacing as required under the Contract:

(i) Prime

Consisting of the application of a primer of field or refinery cutback bitumen without aggregate to provide penetration of the surface (preferably from 5 to 10 mm) and waterproofing.

(ii) Primerseal

Consisting of the application of a primerbinder of field or refinery cutback bitumen to provide surface penetration (preferably from 2mm to 5mm), into which aggregate is incorporated to provide a temporary wearing surface prior to the application of the final wearing surface.

(iii) Seal or Reseal

Consisting of the application of a bitumen binder into which aggregate is incorporated to provide a durable wearing surface.

2. The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, shall be as shown on the Drawings and/or as detailed in Annexure C244.A.

3. For multiple application treatments, the binder and aggregate may be required to be laid in one or more separate applications.

#### C244.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

**(a) Council Specifications**

C201 - Control of Traffic

**(b) Australian Standards**

AS 2008	-	Residual bitumen for pavements.
AS 2157	-	Cutback bitumen.
AS 2341.9	-	Methods of testing bitumen and related road making products - Determination of water content (Dean & Stark)
AS 3568	-	Oils for Reducing the Viscosity of residual Bitumen for Pavements

### (c) RTA Specifications and Forms

MR466	-	Sprayed Bituminous Surfacing Cutback Chart
1151	-	Specification for supply and delivery of Cover Aggregate
3253	-	Bitumen for Pavements
3258	-	Aggregate Precoating Agents
3259	-	Bitumen Adhesion Agents
3261	-	Cutback Bitumen
RTA Form 23	-	Bituminous Surfacing Daily Record
3251	-	Cutter and heavy flux oils

### (d) Government Legislation

### (e) Other

AUSTROADS	-	Design of Sprayed Seals.
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## MATERIALS

### C244.03 BINDERS

#### (a) Bitumen

***Bitumen***

1. Bitumen shall be Class 170 conforming to AS2008.

#### (b) Refinery Cutback Bitumen

***Cutback  
Bitumen***

1. Refinery cutback bitumen shall conform to AS 2157.

### C244.04 ADDITIVES

#### (a) Cutter Oil

***Cutter  
Specification***

1. Cutter oil shall conform to the requirements of AS3568, displaying an Abel flash point of not less than 38°C and a viscosity at 40°C not greater than 2.0 millipascal seconds, with the following qualifications to the properties for its classification as set down in AS3568 Table 1:

- (i) Either "Aniline point" or "Aromatic content" is acceptable.
- (ii) There shall be no "Density" requirement.
- (iii) The presence of water, assessed visually as an immiscible phase in any sample of the material, shall be grounds for its rejection. AS2341.9 shall not be demanded as a referee test if more than 0.1% of liquid water is found in any delivery or batch.
- (iv) If the viscosity is calculated by the equation given in Table 1, Note 3 of AS3568, "f" shall be taken to be 0.0009 per °C.

2. Delivery and storage procedures for cutter oil delivered in drums shall ensure that all containers are clean and free from any deleterious material prior to filling with cutter oil, and all drums are stored so as to ensure that entry of water through seals or welds in the drums is prevented.

***Delivery &  
Storage***

**(b) Adhesion Agent**

***Adhesion Agent***

1. Bitumen adhesion agents shall conform to RTA Specification 3259.

**C244.05 AGGREGATE**

1. Aggregate shall conform to RTA Specification 1151

***Specification***

2. The Contractor shall obtain test results for each lot/stockpile of aggregate, and certification of compliance with RTA Spec 1151 from a suitably accredited NATA laboratory, before aggregate from the lot is incorporated in the Works.

***Test Results***

**C244.06 PRECOATING AGENT**

1. Aggregate precoat agent(s) shall conform to RTA Specification 3258.

***Precoat***

**C244.07 SAMPLING AND TESTING OF MATERIALS**

1. Sampling and testing of materials shall be arranged by the Contractor and carried out by a NATA registered laboratory in accordance with the relevant materials specifications cited in this Specification.

***Contractor's Responsibility***

2. All costs associated with sampling and testing shall be borne by the Contractor.

***Contractor's Costs***

## **DESIGN OF BITUMINOUS SURFACING**

**C244.08 GENERAL**

1. At least seven days before commencing sprayed bituminous surfacing work, the Contractor shall submit to the Superintendent for approval, details of the proposed bituminous surfacing design for the work together with a certification that the nominated materials for the work meet the requirements of the Specification.

***Proposed Design***

2. The Contractor shall carry out the design of bituminous surfacing in accordance with the procedure contained in AUSTROADS Design of Sprayed Seals and shall submit these design details to the Superintendent. Design application rates shall be known as "nominated application rates" and materials as "nominated materials".

***AUSTROADS Design Procedure***

3. The following additional details are required:

***Additional Information Sought***

- (i) Test results for all nominated materials.
- (ii) Aggregates - source, geological type, nominated grading, ALD.
- (iii) Precoat agent and bitumen adhesion agent - types and proportions.
- (iv) Bitumen - refinery source, certification of compliance with AS2008.
- (v) Cutback bitumen - refinery source of bitumen, source of cutter, certification of compliance with AS2157.

This information shall be submitted to the Superintendent for approval. The Contractor shall Not proceed with the work until approval of the Superintendent has been issued.



## **APPLICATION OF SPRAYED BITUMINOUS SURFACING**

### **C244.09 GENERAL**

1. The Contractor shall carry out sprayed bituminous surfacing so as to: **Work Quality**
- (i) provide a uniform application of binder with adequate adhesion to the underlying surface;
  - (ii) provide a complete cover of interlocking aggregate particles, and
  - (iii) achieve effective bond between binder and aggregate.
2. The Contractor shall give the Superintendent two days notice of intention to commence sprayed bituminous surfacing, confirming spray rates, nominal aggregate size and ALD, and shall obtain the Superintendent's approval to proceed.

### **C244.10 PRECOATING OF AGGREGATE**

1. The aggregate precoat agent shall be applied to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading. **Application**
2. Precoating of aggregate shall not be carried out when rain is imminent. If aggregate has been precoat and rain appears imminent, the aggregate shall be adequately covered to prevent the precoat material being washed from the aggregate particles. **Weather Conditions**
3. The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the precoat agent on the stockpiled aggregate. **Cover for Stockpiles**

### **C244.11 PLANT**

1. A mechanical sprayer shall be used to apply primer, primerbinder and binder. The sprayer shall have a current Sprayer Certificate (RTA Form 354) issued by the Roads and Traffic Authority of NSW. **Sprayer Certificate**
2. The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times. **Spray Nozzles**
3. Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform spreading rate. **Aggregate Spreader**
4. Rollers shall be in accordance with Clause C244.20. **Rollers**
5. The Contractor shall remove from the work any plant or equipment not fully operational or not in a satisfactory condition for carrying out work in accordance with this Specification. **Faulty Equipment**

### **C244.12 PREPARATION OF PAVEMENT SURFACE**

1. Before the application of primer, primerbinder or binder, the pavement surface shall be swept by the use of a mechanically-operated rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff bass or similar brooms. Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed. **Pavement Sweeping**

- |   |   |
|---|---|
| 2. Adherent patches of foreign material shall be removed from the surface of the pavement.                                    | <b><i>Foreign Matter on Pavement</i></b>  |
| 3. For the spraying of primer or primerbinder, the pavement surface shall be slightly damp.                                   | <b><i>Damp Pavement</i></b>               |
| 4. No spraying of bitumen shall be undertaken until the pavement has been prepared to the satisfaction of the Superintendent. | <b><i>Bitumen Spraying Hold Point</i></b> |

**C244.13 REVIEW OF NOMINATED APPLICATION RATES**

- |  |   |
|--|---|
| 1. The Contractor shall select the locations where each lot of aggregate is to be incorporated in the Works.   | <b><i>Aggregate Lots</i></b>              |
| 2. The Contractor shall review the bituminous surfacing design at each location based on the actual ALD test result for the lot of aggregate instead of the ALD value of the nominated aggregate, and using the AUSTROADS Design of Sprayed Seals. The revised application rates shall be known as “target application rates”. | <b><i>Target Application Rates</i></b>    |
| 3. The Contractor shall submit details of the aggregate lot and target application rates of each work location to the Superintendent for approval before commencing sprayed sealing at that location.  | <b><i>Contractor’s Responsibility</i></b> |

**C244.14 BINDER TEMPERATURE REQUIREMENTS**

- |   |  |
|---|--|
| 1. Bitumen and cutback bitumen shall be within the range shown in Table C244.1 when incorporated with cutter oil.   | <b><i>Mixing Temperature</i></b>         |
| 2. Temperature ranges for spraying of primers, primer binders and binders shall be within the ranges shown in Table C244.1.   | <b><i>Spraying Temperature</i></b>       |
| 3. The Contractor shall measure and record the temperature of the bituminous material, using a suitable means. The thermometer shall be verified as accurate to within 2.5 percent of the correct temperature.  | <b><i>Measurement of Temperature</i></b> |
| 4. If the temperature of the bituminous material is below the applicable lower limit from Table C244.1, the bituminous material may be heated providing safe heating practices are adopted. Burners shall not be used unless the level of the material in the heating tank is at least 250 mm above the tops of the heating tubes. The Contractor shall comply with the Bush Fires Act, 1949 and the Local Government Act 1993. Two or more suitable fully-charged pressurised chemical fire extinguishers shall be placed conveniently to the heaters at all times while heating is in progress. | <b><i>Safe Heating Practices</i></b>     |
| 5. During heating, the temperature of the bituminous material shall not exceed the applicable upper limit from Table C244.1. The temperature of the bituminous material just above the heating tubes shall be checked at regular intervals to ensure that there is no local overheating.  | <b><i>Heating Limits</i></b>             |
| 6. Bituminous materials shall not be held at temperatures within the ranges shown in Tables C244.1 for periods in excess of ten hours.  | <b><i>Max Period of Heating</i></b>      |
| 7. Any bituminous material which has been overheated shall not be used in the work. The Contractor shall record disposal of such material confirming its exclusion from use under this contract.  | <b><i>Overheated Bitumen</i></b>         |

**C244.15 PAVEMENT TEMPERATURE AND WEATHER CONDITIONS**

1. The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work. For this purpose, a spirit or mercury-in-glass thermometer or other suitable type of thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. When a spirit or mercury-in-glass thermometer is used to measure pavement temperature, the bulb of the thermometer shall be covered from direct sunlight with a small heap of grit or similar material.

**Measurement  
and Recording**

2. If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

**Sun and Shade  
Conditions**

3. Spraying primers, primerbinders and binders shall be undertaken only if the pavement temperature has been at or above the minimum temperature shown in Table C244.1 for at least one hour before commencement of spraying and does not fall below the specified minimum pavement temperature for spraying during the period of spraying.

**Minimum  
Pavement  
Temperature**

4. Spraying shall not be carried out on a wet pavement, while rain appears imminent or during high winds or dust storms.

**Spraying  
Conditions**

TYPE OF MATERIAL	CLASS OR GRADE	EQUIVALENT % CUTTER	MAX HEATING TEMP (°C)	MIN PAVEMENT TEMP (°C)	SPRAYING TEMP (°C)
Bitumen	170		190	10	160 - 190
Cutback Bitumen	AMC 00	56)	30	10	10 - 20
	AMC 0	44)	55	10	35 - 55
	AMC 1	34)	80	10	60 - 80
	AMC 2	27) Conven-	100	10	75 - 100
	AMC 3	21) tional	115	10	95 - 115
	AMC 4	16) Cutter	135	10	110 - 135
	AMC 5	11)	150	10	120 - 150
	AMC 6	7)	160	10	135 - 160
Cutback Bitumen	AMC 7	3)	175	10	150 - 175
	FC2	25)	95	5	70 - 75
	FC3	20) Fast	95	5	80 - 90
	FC4	15) Evapo-	110	5	95 - 110
	FC5	10) rating	140	10	120 - 140
	FC6	7) Cutter	150	10	130 - 150
	FC7	3)	160	10	140 - 160

**Table C244.1 - Temperature Limits**

**C244.16 INCORPORATION OF CUTTER OIL AND ADHESION AGENT**
**(a) Cutting Back Bitumen**

1. The Contractor shall determine and record the proportion of cutter oil required for each sprayer load, using MR Form 466 and based on the measured pavement temperatures.

**Contractor's  
Responsibility**

2. The cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of cutback bitumen shall be circulated at a rate of at least 700 litres per minute for twenty minutes to ensure that the mixture is homogeneous.

**Mixing Cutter  
Oil**

3. If a part sprayer load of field cutback bitumen is unused on the date of mixing, and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter shall be added to the returned cutback bitumen unless the tank is fitted with an effective mechanical mixing system. When the returned cutback bitumen is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned cutback bitumen.

**Unused  
Cutback  
Bitumen**

**(b) Bitumen Adhesion Agent**

1. Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres per minute for fifteen minutes before spraying.

**Mixing  
Adhesion  
Agent**

**C244.17 APPLICATION OF PRIMER, PRIMERBINDER AND BINDER**

**(a) General**

1. The area to be sprayed with primerbinder or binder shall be limited to the area which can be covered with aggregate at the target application rate within fifteen minutes of spraying bitumen or cutback bitumen and shall be sprayed past the lip of the gutter to a maximum of 10mm.

**Limit on Spray  
Area**

**(b) Primer and Primerbinder**

1. Nominated and target application rates and quantities of primer and primerbinder shall apply to the whole material, including cutter oil, measured at 15°C.

**Application  
Rates**

2. After application of a primer, a period of at least seven days, or such longer period as determined to be necessary for the primer to become completely dry, shall elapse before the binder for a seal is applied. All traffic shall be kept off the primed surface.

**Curing Time  
for Primer**

3. After application of a primerbinder, a period of at least fourteen days shall elapse before the binder for a seal is applied, unless otherwise determined by the Superintendent.

**Curing time for  
Primer Binder**

**(c) Binder**

**Nominated and  
Target Rates**

1. Nominated and target application rates and quantities of binder shall be based on the volumes of bitumen measured at a temperature of 15°C and shall not include any bitumen adhesion agent and/or cutter oil.

2. Where bitumen adhesion agent and/or cutter oil have been added to the binder, the application rate of the total binder at 15°C shall be adjusted to allow for the quantities of bitumen adhesion agent and/or cutter oil in the mixture.

**Adjustment of  
Application  
Rate**

3. The Contractor shall determine the hot application rate of total binder, including bitumen adhesion agent and/or cutter oil, using MR Form 466.

**Calculation of  
Hot Application**

4. Where refinery cutback bitumen is used as the binder, the target application rate of binder shall be increased by the Contractor to allow for the percentage cutter oil in the mixture as indicated in Table C244.1.

**Refinery  
Cutback  
Bitumen  
Variation**

**(d) Operation of the Sprayer**

1. The type of spray nozzles to be used on the spray bar of the sprayer shall be compatible with the nature of the binder to be sprayed and its application rate.

**Nozzle Type**

## SPRAYED BITUMINOUS SURFACING

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- |   |                                       |
|---|---------------------------------------|
| 2. Where the longitudinal edges of spray runs are not required to overlap, either special type end nozzles or intermediate nozzles set with a jig as end nozzles may be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs shall be 50 mm for special type end nozzles. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays the nozzles shall be set in the normal manner for intermediate nozzles and the overlap shall be 300 mm. | <b><i>Spray Overlap</i></b>           |
| 3. The spraying of primer, primerbinder or binder for each run of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120 grams per square metre laid across and held securely to the pavement surface beforehand. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application is attained at the commencement of spraying.  | <b><i>Protective Paper Strip</i></b>  |
| 4. The sprayer shall maintain a constant road speed throughout the length of each sprayer run.  | <b><i>Road Speed</i></b>              |
| 5. The spraying for each run shall terminate on a protective strip of paper laid across and held securely to the pavement surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate.  | <b><i>Terminating Paper Strip</i></b> |
| 6. Spraying shall cease immediately any defect develops in the spraying equipment and spraying shall not recommence until the fault has been rectified.   | <b><i>Equipment Defects</i></b>       |
| 7. Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. If the blockage is due to the condition of the binder being sprayed, that load together with any binder from the same bulk tanker or supply unit shall not be used.  | <b><i>Nozzle Blockage</i></b>         |
| 8. Where a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, such areas shall be sprayed by means of the hand spray equipment attached to the sprayer.  | <b><i>Hand Spraying</i></b>           |
| 9. After each sprayer run, the quantity of binder sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder after three runs differs by more than 5 per cent from the target application rate, the sprayer shall not be used until a new Sprayer Certificate has been obtained.   | <b><i>Application Rate Checks</i></b> |
| 10. Areas not within 5 percent of the target application rate of primer, primerbinder or binder shall constitute a 'Nonconformance' under the Contract.   | <b><i>Non-conformance</i></b>         |

### **C244.18 WORK RECORDS**

- |   |                                   |
|---|-----------------------------------|
| 1. Particulars of the work performed shall be recorded by the Contractor on RTA Form 23 - Bituminous Surfacing Daily Record. Details of primer, primerbinder, binder and aggregate applied shall be recorded immediately after every sprayer run. Each form shall be signed by the Contractor's representative as a true record of the work performed. The Contractor shall supply to the Superintendent a copy of each completed form. | <b><i>Sprayer Run Records</i></b> |
|---|-----------------------------------|

### **C244.19 CONTROL OF TRAFFIC**

- |  |   |
|--|---|
| 1. The Contractor shall provide for traffic in accordance with the requirements of the Specification for CONTROL OF TRAFFIC while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate. | <b><i>Contractor's Responsibility</i></b> |
|--|---|

2.	Where early use of the new seal is needed to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no displacement of aggregate occurs. Where necessary, the Contractor shall use patrol vehicles to ensure that traffic travels at an acceptable speed.	<b><i>Speed Control</i></b>
3.	The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.	<b><i>Minimise Traffic Delays</i></b>
4.	If facilities for the diversion of traffic are not available, the Contractor may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work shall cease. Traffic shall not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.	<b><i>Part Width Spraying</i></b>
<b>C244.20 APPLICATION AND INCORPORATION OF AGGREGATE</b>		
1.	The application of aggregate shall proceed after spraying is commenced and shall be completed within fifteen minutes of spraying bitumen or cutback bitumen.	<b><i>Time for Completion</i></b>
2.	Wet aggregate shall not be used.	<b><i>Wet Aggregate</i></b>
3.	The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. Sufficient loaded and measured trucks of dry aggregate shall be at the site to provide full cover for the area sprayed.	<b><i>Procedure</i></b>
4.	The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.	<b><i>Uniform Application</i></b>
5.	Any bare or insufficiently covered areas shall be re-run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Any aggregate spread in excess of the target aggregate application rate shall be removed before rolling is commenced.	<b><i>Deficient or Excess Aggregate</i></b>
6.	After the aggregate has been applied to each section of the work, initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheel rollers of minimum load of one tonne per tyre and minimum tyre pressure of 550 kPa. Initial rolling shall continue until the aggregate is firmly embedded in the primerbinder or binder.	<b><i>Initial Rolling</i></b>
7.	If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom or by light hand brooming after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primerbinder or binder, the Contractor shall defer or eliminate the drag brooming.	<b><i>Brooming of Surface</i></b>
8.	Backrolling shall then be carried out for a minimum period of one hour per roller per 1000 square metres sprayed.	<b><i>Backrolling</i></b>
9.	Where a bituminous surfacing is specified with separate applications of coarse and fine aggregate on a single application of binder, the coarse aggregate shall be applied first, rolled and any necessary brooming carried out as described above, before application of the fine aggregate and its subsequent rolling and brooming. In this case, the time limits for incorporation of aggregate (paragraph 1 above) shall apply only to the application of the coarse aggregate. The application of fine aggregate will proceed in any case as soon as possible after satisfactory application and embedment of the coarse aggregate.	<b><i>Two Aggregate Application</i></b>
10.	When the aggregate has been evenly spread and embedded in the binder, any remaining loose particles of aggregate shall be removed from the pavement.	<b><i>Removal of Loose Particles</i></b>

### C244.21 PROTECTION OF SERVICES AND ROAD FIXTURES

1. The Contractor shall take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, kerb and gutter, bridge or culvert decks and other road fixtures.

***Contractor's  
Responsibility***

2. Immediately after aggregate has been spread over the binder, the Contractor shall clean off or remove any sprayed surfacing material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

***Services and  
Road Fixtures***

## NONCONFORMANCE OF MATERIALS AND WORK

### C244.22 GENERAL

1. If any materials supplied fail to conform to the requirements in this Specification or if any section of sprayed bituminous surfacing work fails to conform to the requirements of this Specification - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures shall constitute a 'Nonconformance' under the Contract.

***Noncon-  
formance  
Conditions***

2. If the nonconformance is not acceptable in accordance with Clause C244.09, the nonconforming material shall be replaced or the nonconforming section of sprayed bituminous surfacing work shall be either replaced or corrected.

***Replace or  
Correct Non-  
conformance***

3. The cost of rectifying nonconformances, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, shall be borne by the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this Specification.

***Cost of  
Rectification***

## SPECIAL REQUIREMENTS

### C244.23 INDEMNITY AGAINST CLAIMS FOR THE PROTECTION OF COUNCIL

The Contractor to indemnify Council against all claims that arise out of or in relation to the work under the contract.

### C244.24 LETTERBOX DROP

The Contractor must provide a sample of information to residents prior to sealing and should include:

***Letterbox Drop***

- 1 Date of sealing
- 2 Contact telephone number (1800 number) and name in case of emergencies.
- 3 Benefits of resealing
- 4 Information about tar removal from tyres and driveways etc.
- 5 Conditions associated with the sealing process eg. Loose stones.

**C244.25    RESERVED**

**C244.26    RESERVED**

**C244.27    RESERVED**

**C244.28    RESERVED**



## LIMITS AND TOLERANCES

### C244.29 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C244.2 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	Design of Bituminous Surfacing	Contractor to provide details of design to Superintendent at least seven days before proposed commencement of work	C244.08
2.	Sweeping of Pavement Surface	Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed	C244.12
3.	<b>Bitumen Heating</b>		
	(a) Bitumen Temperature	When incorporated with cutter oil, bitumen shall be in temperature ranges as per Table C244.1.	C244.14
	(b) Refinery Cutback Bitumen Temperature	At the time of spraying shall be in temperature range as per Table C244.1.	C244.14
	(c) Overheating of Bitumen	Bituminous material shall not be heated above the upper temperature limits of Table C244.1. Overheated material shall be rejected.	C244.14
	(d) Retention of Temperature	Bituminous materials shall not be held at temperatures within the ranges of Table C244.1 for periods in excess of 10 hours.	C244.14
4.	<b>Spraying Temperature</b>		
	(a) Pavement Temperature	Bituminous surfacing shall not be undertaken if the pavement temperature has not been at or above temperatures given in Table C244.1 for at least one hour before commencement of spraying.	C244.15
5.	Cutting Back Bitumen	Circulation of hot bitumen and cutter oil mixture in the sprayer shall be at the rate of 700 litres per minute for 20 minutes.	C244.16
6.	Bituminous Adhesion Agent	Circulation of bituminous adhesion agent with hot bitumen shall be at the rate of 700 litres per minute for 15 minutes.	C244.16

Item	Activity	Limits/Tolerances	Spec Clause
7.	<b>Application of Bituminous Material</b>		
	(a) Spray Area	Area to be sprayed shall be limited to area which can be covered by aggregate at target application rate within 15 minutes of spraying.	C244.17
	(b) Application Rates	Application rates and quantities shall apply to a temperature of 15°C.	C244.17
	(c) Primer	At least a 7 day period shall elapse after spraying of primer before binder for a seal is applied.	C244.17
	(d) Primerbinder	At least a 14 day period shall elapse after spraying of primerbinder before application of binder.	C244.17
	(e) Nonconformance	Areas not within 5 percent of the target application rate of primer, primerbinder or binder shall constitute 'nonconformance' under the Contract.	C244.17
8.	<b>Application of Aggregate</b>		
	(a) Spreading Time	Application of aggregate shall be completed within 15 minutes of spraying bitumen or cutback bitumen on each section.	C244.20
9.	<b>Rolling</b>		
	(a) Roller Numbers and Type	Initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheeled rollers. Minimum load of one tonne per tyre and minimum tyre pressure 550KPa.	C244.20
	(b) Backrolling	Backrolling shall be undertaken for minimum of one hour per roller per 1000 square metres sprayed.	C244.20

**Table C244.2 - Summary of Limits and Tolerances**

**ANNEXURE C244A      DETAILS OF WORK**

Section		Prime	Primer Seal		Seal or Reseal	
From	To		Binder	Aggregate	Binder	Aggregate

DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C245

Revision 3

**ASPHALTIC CONCRETE**



**SPECIFICATION C245  
ASPHALTIC CONCRETE**

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## SPECIFICATION C245 ASPHALTIC CONCRETE

### GENERAL

#### C245.01 SCOPE

1. The work to be executed under this Specification consists of the design, production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt in accordance with the provisions of the Contract. The extent of the Contractor's work shall include:

#### *Extent of Work*

- (a) Sampling and testing of materials and the design of asphalt mixes required by the Contract.
- (b) Manufacture of the production mix.
- (c) Provision of a testing laboratory.
- (d) Preparation of the surface on which asphalt is to be placed.
- (e) Transport of asphalt.
- (f) Laying and compaction of asphalt.
- (g) Sampling and testing.

The asphalt mixes shall be dense graded.

#### C245.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

#### *Documents Standards Test Methods*

##### (a) Council Specifications

C201 - Control of Traffic

##### (b) Australian Standards

- AS 1141.11 - Method of sampling and testing aggregates - Particle size distribution by dry sieving.
- AS 1141.14 - Method of sampling and testing aggregates - Particle shape, by proportional calliper.
- AS 1141.18 - Method of sampling and testing aggregates - Crushed particles in coarse aggregate derived from gravel.
- AS 1141.22 - Method of sampling and testing aggregates - Wet/dry strength variation.
- AS 1141.41 - Method of sampling and testing aggregates - polished aggregate friction value - horizontal bed machines.
- AS 1141.50 - Method of sampling and testing aggregates - Resistance to stripping of cover aggregates from binders.
- AS 1160 - Bitumen emulsions for the construction and maintenance of pavements.



## ASPHALTIC CONCRETE

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AS 1507	-	Road tars for pavements.
AS 2008	-	Residual bitumen for pavements.
AS 2150	-	Hot mix asphalt.
AS 2341.2	-	Method of testing bitumen and related road making products - Determination of dynamic (coefficient of shear) viscosity by flow through a capillary tube.
AS 2341.5	-	Method of testing bitumen and related road making products - Determination of apparent viscosity by 'Shell' sliding plate micro-viscometer.
AS 2341.7	-	Method of testing bitumen and related road making products - Determination of density using a density bottle.
AS 2341.8	-	Method of testing bitumen and related road making products - Determination of matter insoluble in toluene.
AS 2341.11	-	Method of testing bitumen and related road making products - Determination of ductility.
AS 2341.12	-	Method of testing bitumen and related road making products - Determination of penetration.
AS 2341.14	-	Method of testing bitumen and related road making products - Determination of flashpoint of residual bitumen.
AS 2341.18	-	Method of testing bitumen and related road making products - Determination of softening point (ring and ball method).
AS 2357	-	Mineral fillers for asphalt.
AS 2758.5	-	Aggregates and rock for engineering purposes - Asphalt aggregates.

### (c) RTA Standard Test Methods

T103	-	Pretreatment of Road Materials by Artificial Weathering.
T230	-	Resistance of Stripping of Cover Aggregates and Binders.
T239	-	Fractured Faces of Coarse Aggregate.
T501	-	Freedom from Foaming of Bituminous Materials
T600	-	Methods of Sampling Materials used in Bituminous Sealing Works
T601	-	Compaction of Test Specimens of Dense Graded Bituminous Mixtures - Modified Hubbard-Field Procedure.
T603	-	Stability of Dense Graded Bituminous Mixtures - Modified Hubbard-Field Procedure
T606	-	Bulk Density of Compacted Dense Graded Bituminous Mixtures
T607	-	Bitumen Content and Aggregate Grading of Bituminous Mixtures - Reflux Method.
T731	-	Moisture Content of Scrap Rubber
T732	-	Metallic Iron Content of Scrap Rubber
T733	-	Bulk Density of Scrap Rubber
T734	-	Foaming Caused by Scrap Rubber Addition to Bitumen
T735	-	Laboratory Preparation of Rubber Bitumen Mixes.
T736	-	Flow Test for Rubber Bitumen Mixes
T739	-	Torsional Recovery of Polymer Modified Bitumen
T741	-	Elastic Recovery of Polymer Modified Bitumens (ARRB Elastometer)
T1180	-	Resilience Test for Hot Poured Elastomeric Joint Sealants.

### (d) ASTM Test Methods

D5	-	Penetration of bituminous materials.
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## C245.03 PLANT

1. The Contractor shall provide all the plant and equipment necessary for carrying out the work in accordance with this Specification.

**Contractor's  
Responsibility**

- |  |   |
|--|---|
| <p>2. All plant and equipment used on the work shall be kept in good operating condition. The Contractor shall remove from the work any plant or equipment which the Superintendent considers to be unsuitable, not fully operational, or not in a satisfactory condition for carrying out work in accordance with this Specification.</p> | <p><b><i>Plant to be Suitable</i></b></p> |
|--|---|

#### **C245.04 PROTECTION OF SERVICES AND ROAD FIXTURES**

- |   |  |
|---|--|
| <p>1. The Contractor shall take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor shall clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.</p> | <p><b><i>Contractor's Responsibility</i></b></p> |
|---|--|

#### **C245.05 PROTECTION OF WORK**

- |  |  |
|--|--|
| <p>1. The Contractor shall provide for traffic in accordance with the requirements of the Specification for CONTROL OF TRAFFIC while undertaking the work.</p> | <p><b><i>Provision for Traffic</i></b></p> |
| <p>2. The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work.</p>             | <p><b><i>Delays</i></b></p>                |

#### **C245.06 WORK RECORDS**

- |   |  |
|---|--|
| <p>1. Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Annexure C245A. The Contractor shall complete the Asphalt Work Record, which shall be countersigned by the Superintendent each day as a true record of the work performed. A copy shall be supplied to the Superintendent.</p> | <p><b><i>Asphalt Work Record</i></b></p> |
| <p>2. Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.</p>   | <p><b><i>Delivery Dockets</i></b></p>    |

### **MATERIALS**

#### **C245.07 GENERAL**

- |  |                               |
|--|-------------------------------|
| <p>1. Unless otherwise directed by the Superintendent or separately stated in this Specification, materials or mix ingredients shall be sampled in accordance with Test Method T600.</p> | <p><b><i>Sampling</i></b></p> |
|--|-------------------------------|

#### **C245.08 AGGREGATES**

- |  |                                 |
|--|---------------------------------|
| <p>1. Aggregates shall be of uniform quality and grading. Aggregates complying with the requirements of this Clause when combined with the mineral filler shall be capable of achieving the asphalt properties required by this Specification.</p> | <p><b><i>Uniformity</i></b></p> |
|--|---------------------------------|

##### **(a) Coarse Aggregate**

- |   |                              |
|---|------------------------------|
| <p>1. Coarse aggregate shall comply with AS 2758.5 and comprises all mineral matter having a nominal size of not less than 5mm. Coarse aggregate shall consist of clean, dry, hard, tough and sound crushed rock, metallurgical slag or gravel, be of uniform quality and be free from dust, clay, dirt or other matter deleterious to asphalt.</p> | <p><b><i>Quality</i></b></p> |
| <p>2. The grading of the coarse aggregate used in the work shall be determined in accordance with AS 1141.11.</p>   | <p><b><i>Grading</i></b></p> |

3. When submitting details of the nominated mix the Contractor shall submit to the Superintendent NATA Certified Laboratory Test Reports on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

**NATA Reports**

4. If the Contractor proposes to blend two or more coarse aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the following requirements:

**Test Requirements**

(i) Wet Strength - AS 1141.22.

Shall be not less than 100 kN for any fraction.

(ii) Wet/Dry Strength Variation - AS 1141.22

Shall not exceed 35 per cent for any fraction or constituent.

(iii) Particle Shape - AS 1141.14

The proportion of misshapen particles in the fraction retained on the 9.50 mm AS sieve shall not exceed 35 per cent using a caliper ratio of 2:1 and shall not exceed 10 per cent using a caliper ratio of 3:1.

(iv) Fractured (Crushed) Faces of Coarse Aggregate - AS 1141.18

Aggregate which is retained on a 6.70 mm AS sieve shall consist of at least 75 per cent by mass of particles with at least two fractured faces and when used in the wearing course shall have at least 90 per cent by mass of particles with at least one fractured face. The area of each fractured face shall be a significant proportion of the total surface area of the particle.

(v) Resistance to Stripping - AS 1141.50

Stripping of aggregates treated by the addition of a suitable adhesion agent to the binder shall not exceed 10 per cent.

5. When tested in accordance with AS 1141.11 aggregate shall be rejected if the Polishing Aggregate Friction Value (PAFV) for the aggregate is less than 50. Use of the aggregate with a lesser value shall be subject to the Superintendent's approval.

**Polishing Value**

6. Test samples may be pretreated by procedures described in Test Method T103 before commencement of the tests referred to in Clause C245.08(a).

**Pretreatment of Samples**

**(b) Fine Aggregate**

1. Fine aggregate comprises all mineral matter (other than filler) passing the 4.75 mm AS sieve. It shall consist of clean, hard, tough and sound grains, free of coatings or loose particles of clay, silt or other matter deleterious to asphalt. The fine aggregate shall consist of natural sand or a mixture of natural sand and material derived from the crushing of sound stone or gravel.

**Soundness**

2. When submitting details of the nominated mix the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

**NATA Reports**

3. If the Contractor proposes to blend two or more fine aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and

**Test Requirements**

constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of Clause C245.08(a).

**(c) Special Aggregates**

1. Where special aggregates are required in an asphalt, the aggregates shall be from a source approved by the Superintendent. **Approved Source**

**C245.09 MINERAL FILLER**

1. Mineral filler shall consist of hydrated lime, fly ash, portland cement, flue dust from the manufacture of portland cement or other material approved by the Superintendent. **Constituents**
2. The mineral filler shall comply in all other respects with the requirements of AS 2357. The voids in the dry compacted filler shall be not less than 40 per cent. **Voids**

**C245.10 BINDER**

1. Unless otherwise directed by the Superintendent, the binder supplied and used in the works shall be bitumen complying with Clause C245.10(a). **Bitumen Quality**
2. Where other binders are required they shall comply with the requirements of Clause C245.10(b).

**(a) Bitumen** **Qualities**

1. The bitumen shall be obtained from processing the residual from the refining of naturally occurring crude petroleum. The residual bitumen shall be homogeneous, contain no inorganic mineral matter other than that naturally occurring and shall be tested and comply with the requirements as shown in Table C245.1.

2. The bitumen used in the works shall be as specified in Annexure C245B. **Specification**

Requirements					
Property	Class 170		Class 320		Test Method
	Min	Max	Min	Max	
Viscosity at 60° (Pa.s)	140	200	260	380	AS 2341.2
Viscosity at 135° (Pa.s)	0.25	0.45	0.40	0.65	AS 2008
Penetration at 15°C (mm) (200g, 60s)	8	-	6	-	AS 2341.12
Flashpoint (°C)	250	-	250	-	AS 2341.14
Matter insoluble in Toluene (% by mass)	-	1.0	-	1.0	AS 2341.8
Effect of heat and air (Rolling thin film oven test)					AS 2008
(a) Ductility of residue at 15°C (mm)	200	-	-	-	AS 2341.11
(b) Viscosity of residue at 60°C as percentage of original	-	300	-	300	AS 2341.2
(c) Apparent viscosity of residue at 25°C and a shear strain rate of $1 \times 10^{-2}/s$ as percentage of original (alternative to (b) above)	-	300	-	-	AS 2008 AS 2341.5
The film oven test (1.6mm)					AS 2008
(a) Ductility of residue at 25°C (mm)	600	-	-	-	AS 2341.11

## ASPHALTIC CONCRETE

Density at 15°C (kg/L)	1.00	-	1.01	-	AS 2341.7
Water Content and Foaming at 175°C		Nil		Nil	T501

### (b) Other Binders

1. These binders shall be incorporated in the works in accordance with the requirements of this Specification unless otherwise directed by the Superintendent.

***Incorporated in Works***

2. Where other binders are produced by the inclusion of an additive at the time of manufacture of the asphalt, the mixing time required by Clause C245.18(c) shall be increased by 25 per cent unless otherwise approved by the Superintendent.

***Mixing Tim***

#### (i) Scrap Rubber Bitumen

1. Scrap Rubber Bitumen shall comprise Class 170 bitumen with scrap rubber either added at the time of mixing or preblended in the proportions as directed by the Superintendent.

***Scrap Rubber***

2. When Scrap Rubber Bitumen is preblended, the bitumen shall be heated to between 190°C and 200°C and the scrap rubber added in the required proportion. The mixture shall be maintained at between 190°C and 200°C and mixed continuously for one hour to allow for digestion of the scrap rubber in the bitumen.

***Heating Temperature***

3. A 20 per cent scrap rubber bitumen mixture prepared in accordance with Test Method T735 shall have a minimum recovery of 20 per cent when tested in accordance with Test Method T1180.

***Recovery Test***

4. Scrap rubber bitumen which has either separated or increased in viscosity to the extent that it is difficult to pump shall be rejected. Scrap rubber shall comply with the requirements of Clause C245.13.

***Viscosity***

#### (ii) Modified Bitumens

1. Polymer modified bitumens containing Styrene Butadiene Styrene (SBS) and Ethylene Vinyl Acetate (EVA) modifiers shall comply with the limits shown in Tables C245.2 and C245.3 as appropriate and the requirements set out below. The polymer modified bitumens shall be supplied in the grades shown in Annexure C245.B.

***Polymer Modified***

2. The binder shall be pumped and stored at the manufacturer's recommended temperatures unless temperatures are otherwise specified by the Superintendent.

***Storage Temperature***

3. For polymer modified bitumens all blending of materials (with the exception of bitumen adhesion agent) shall be carried out in the manufacturer's premises before dispatch. Materials shall not be blended in a road tanker or sprayer. The polymer modifiers shall be compatible with bitumen complying with AS 2008.

***Blending***

4. Polymer modifiers may be supplied as powder, pellets or prills provided that, when mixed with bitumen, the resultant modified bitumen complies with Grades 60 or DX of this Specification. For both testing compliance and field use, the required amount of modifier shall be advised by the Contractor.

***Form***

***Contractor's Responsibility***

Test	Grade 4*	Grade 5*	Grade 6*	Grade 60	Test Method
Elastic Recovery at 60°C (%)	-	-	85 min	90 min	T741
Viscosity on ER at 60°C (Pa.s)	-	-	5000 min	6000 min	T741
Torsional Recovery at 25°C (%)	-	-	60 min	60 min	T739
Flow at 60°C (mm)	-	-	10 max	1 max	T736
Viscosity at 135°C (Pa.s)	-	-	3 max	5 max	AS 2008
Flash Point (°C)	-	-	250 min	250 min	As 2341.14
Softening Point (°C)	-	-	75 min	85 min	AS 2341.18
Penetration at 25°C (mm/10) (100g. 5 s)	-	-	75 min	50 min	ASTM D5
Other polymers and Mineral Matter	-	-	0.5 max unless disclosed	0.5 max unless disclosed	

**Table C245.2 - Specified Properties for SBS Modified Bitumens**

\* Not applicable to this Specification

NOTE Table C245.2: For the purpose of assessing compliance with this Table samples shall be heated to 135°C without high shear mixing and immediately cast into test moulds.

Test	Grade A	Grade B	Grade BX	Grade C	Grade DX	Test Method
Elastic Recovery at 45°C (%) on heat up	80 min	85 min	40 min	75 min	35 min	T741
Viscosity by Elastomer at 60°C (Pa.s)	2500 min	600 min	2500 min	600 min	600 min	T741
Torsional Recovery at 25°C (%)	40 min	45 min	16 min	25 min	15 min	T739
Softening Point (°C)	62 min	59 min	64 min	57 min	54 min	AS 2341.18
Viscosity at 135°C (Pa.s)	11 max	5.5 max	7 max	2.5 max 0.625 min	1.25 max	AS 2008
Penetration at 25°C (mm/10) (100g. 5 s) after overnight cure	30 min	40 min	45 min	40 min	45 min	ASTM D5
Other polymers and Mineral Matter (%)	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	0.5 max unless disclosed	

**Table C245.3 - Specified Properties for EVA Modified Bitumens**

**C245.11 BITUMEN ADHESION AGENT**

1. A bitumen adhesion agent shall be added to the binder. Details of the proposed bitumen adhesion agent shall be submitted for the Superintendent's approval in accordance with Clause C245.15. The bitumen adhesion agent shall be used in a manner compatible with the manufacturer's recommendations. When tested in accordance with Test Method T230, the bitumen adhesion agent shall comply with the requirement in Clause C245.08(a) at a concentration within the range 0.5 per cent to 1.0 per cent by mass of the binder.

***Use and Test Requirements*****C245.12 BITUMEN EMULSION**

1. The bitumen emulsion shall be cationic rapid setting C170 bitumen emulsion complying with the requirements of AS 1160.

***Type*****C245.13 SCRAP RUBBER**

1. Scrap rubber may consist of either natural or synthetic rubber or a mixture of both. The scrap rubber shall be milled to comply with the grading limits shown in Table C245.4.

***Composition***

Sieve Size (mm)	Per Cent Passing by Mass
1.18	100
0.600	60 min.
0.300	20 max.

**Table C245.4 - Required Grading for Scrap Rubber**

2. Scrap rubber particles shall be granular in shape with no more than 10 per cent of the particles having a length greater than 7.5 mm and shall comply with the limits shown in Table C245.5.

***Particle Shape***

Property	Requirements	Test Method
Foaming (%)	50 max.	T734
Moisture Content (%)	1.0 max.	T731
Iron Content (%)	Nil	T732
Bulk Density (kg/m <sup>3</sup> )	400 max.	T733

**Table C245.5 - Required Properties for Scrap Rubber**

3. Scrap rubber shall not contain any metal fragments or other foreign material.

***Foreign Matter***

4. Cryogenically produced scrap rubber shall not be acceptable unless the cryogenic size reduction is followed by grinding.

**C245.14 GEOTEXTILE**

1. Geotextile may be required as an underlay for the drainage layer of asphalt or for other applications as an underlay for wearing or intermediate courses.

***Underlay***

- |   |                           |
|---|---------------------------|
| <p>2. The geotextile used as an underlay for drainage shall be a needle punched polyester felt with a mass per square metre of at least 340 grams.</p>  | <b>Mass</b>               |
| <p>3. For other applications, geotextile proposed by the Contractor may be approved provided the geotextile is considered by the Superintendent appropriate to the application and is used in accordance with the manufacturer's specification.</p> | <b>Other Applications</b> |
| <p>4. The geotextile must be able to withstand a temperature of 50 C higher than the temperature of the asphalt.</p>  |                           |

## **ASPHALT MIX DESIGN**

### **C245.15 NOMINATED MIX**

- |  |                                      |
|--|--------------------------------------|
| <p>1. The Contractor shall design each asphalt mix, henceforth called the 'nominated mix', within the limits shown in Table C245.6 unless otherwise approved by the Superintendent.</p>  | <b>Design</b>                        |
| <p>2. Each asphalt mix shall include a bitumen adhesion agent in the binder in accordance with Clause C245.11.</p>   | <b>Adhesion Agent</b>                |
| <p>3. When asphalt containing special aggregate is specified, the special aggregate shall comprise all coarse and fine aggregates of 5 mm nominal size and greater.</p>  | <b>Special Aggregate</b>             |
| <p>4. The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The Certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.</p> | <b>NATA Laboratory Tests</b>         |
| <p>5. Details of the nominated mix shall be <b>submitted to the Superintendent</b> at least seven (7) days before the placing of asphalt. The nominated mix information shall include combined aggregate grading and binder content, proportions of constituent materials used (including adhesion agent), gradings of aggregate and filler, and type and sources of aggregates, filler, binder and adhesion agent.</p>  | <b>Hold Point Submit Details</b>     |
| <p>6. If any revision is necessary, then the costs associated with revision of the nominated mix and testing of the revised nominated mix in accordance with Clause C245.16 shall be borne by the Contractor.</p>  | <b>Revised Mix Contractor's Cost</b> |



## ASPHALTIC CONCRETE

Property  Aggregate passing AS Sieve  (% by mass)	Requirements					
	Nominal Size of Asphalt					
	5mm (AC5)	10mm (AC10)	14mm (AC14)	20mm (AC20)	28mm (AC28)	40mm (AC40)
53.0mm						100
37.5mm					100	85-98
26.5mm				100	85-98	
19.0mm			100	90-98		
13.2mm		100	85-98	70-90	57-75	55-75
9.50mm		90-98				
6.70mm	100	70-90	60-75	40-70	45-60	40-55
4.75mm	85-98					
2.36mm	55-75	40-60	35-47	25-55	25-37	25-40
1.18mm						
0.600mm	26-43	23-38	15-30	15-27	15-27	14-24
0.300mm						
0.150mm						
0.075mm	4.5-11	4.5-10	3-7	3-7	3-6	3-6
Binder content (% by mass of total asphalt mix)*	5.6-6.8	5.1-6.4	4.8-6.2	4.6-6.1	4.2-5.8	3.5-5.5
Stability of the compacted asphalt mix (kN)						
Test Methods T601 and T603 (Modified Hubbard Field Procedure)	22-34	22-34	22-34	22-34	22-34	22-34
Min as per Marshall Method (at 35 blows)						
Voids in compacted asphalt mix (% of voids in volume of mix)						
Test Methods T601, AS1507 and T606 (modified Hubbard Field Procedures)	4-7	4-7	4-7	4-7	4-7	4-7
As per Marshall Method (at 35 blows)						
Voids filled by binder (% voids in the total mineral aggregate to be filled by binder) Test Method T606	65-80	65-80	65-80	65-80	65-80	65-80
Flow (mm) of compacted mix (35 blow Marshall)						
<b>NOTE:</b> * Some increase beyond these ranges of binder content may be permitted for aggregates having unusually high absorption characteristics.						

**Table C245.6**

### Limits for Design of Nominated Mix - Dense Graded Asphalt (AC)

## **C245.16    APPROVED MIX**

1. When a nominated mix has been **approved by the Superintendent** it shall be known as the 'approved mix'. Work shall not commence until an asphalt mix has been approved.

***Approval  
Hold Point***

2. The Contractor shall not make any changes to the approved mix, its method of production or constituent materials without the prior written approval of the Superintendent. If any such change is proposed, then the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C245.15.

***Changes to  
Approved Mix***

3. If the Contractor's nominated mix has received prior approval under a separate contract with the Principal within twelve months before the proposed date of initial delivery under this contract, then provided that:

***Prior Approval***

- (a) the Contractor produces documentary evidence and full details of the previously approved mix supplied under a specification which required the same standard of materials and product as this Specification;
- (b) the constituent materials and their quality remain unchanged from that previously approved; and
- (c) the in-service performance of the asphalt incorporating the nominated mix has proved acceptable to the Principal;

the Superintendent may approve the nominated mix without requiring the prior-testing of samples by the Contractor at a NATA registered laboratory, but may require samples to be tested in accordance with Clause 241.15 at any time during the course of the contract.

4. Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor shall be responsible for producing asphalt which satisfies all requirements of the Specification.

***Contractor's  
Responsibility***

## **C245.17    REQUIREMENTS OF PRODUCTION MIX**

1. Asphalt produced in the plant and delivered to the site shall be known as the 'production mix'.

### **(a)    Dense Graded Asphalt**

Dense graded asphalt shall comply with the requirements shown in Table C245.7 unless otherwise approved by the Superintendent.

<b>Production Mix Properties</b>	<b>Allowable Variations from Approved Mix *</b>
Nominated Mix Type (see Table C245.6)	AC5, AC10, AC14, AC20, AC28, AC40
Grading - Test Method T607	
Passing 4.75mm AS sieve and larger	±7%
Passing 2.36mm and 1.18mm	±5%
Passing 0.600mm and 0.300mm	±4%
Passing 0.150mm	±2.5%
Passing 0.075mm	±1.5%
Binder Content - Test Method T607	±0.3%
Voids in compacted mix - Test Methods T601, AS1507 and T606	4 - 7%
Voids in compacted mix - Marshall method (at 35 blows)	-
Voids filled by binder - Test Method T606	65 - 80%
Flow of compacted mix - (35 blow Marshall)	-

\* Notwithstanding, these allowable variations shall not fall outside the limits for design of nominal mix as shown in Table C245.6.

**Table C245.7**  
**Dense Graded Asphalt - Requirements for Production Mix**

## PRODUCTION

### **C245.18 MIXING PROCEDURE**

#### **(a) Plant**

1. Mixing shall be undertaken in an approved batch pugmill, continuous pugmill or drum mixing plant, capable of uniformly mixing coarse and fine aggregate, filler, and binder to meet the requirements specified in this Specification at all times.

**Characteristics**

#### **(b) Temperature**

1. Plant temperatures shall be maintained in a range sufficient to ensure a homogeneous asphalt without causing deleterious effects to the binder through overheating. Temperatures shall be in the ranges shown in Table C245.8. For asphalt made with other binders complying with Clause C245.10(b), the temperatures shall be in accordance with manufacturer's recommendation.

**Temperatures**

2. In special cases, the Superintendent may permit a lower temperature for manufacture, but in no circumstances shall the temperature of the asphalt at the time of laying be less than the minimum value specified in Clause C245.26(c) for the appropriate road surface temperature and layer thickness.

**Limits**

3. The asphalt temperature shall be measured as the asphalt leaves the pugmill, drum and/or the hot storage bin(s). **Measurement**
4. The asphalt shall have a moisture content not greater than 0.5 per cent by mass when tested in accordance with AS 2150. **Moisture Content**

DENSE GRADED ASPHALT			
Type of Binder	Class 170	Class 320	SBS Modified Class 170
Min Binder Temp	140°C	140°C	180°C
Max Binder Temp	165°C	170°C	190°C
Min Asphalt Temp	140°C	140°C	180°C
Max Asphalt Temp	165°C	170°C	190°C

**Table C245.8**  
**Temperatures for Manufacture of the Asphalt**

- (c) **Mixing Time** **Uniform Coating**
1. Mixing time shall be such that all particles of aggregate are uniformly coated with binder.
- (d) **Storage of Asphalt** **Limitations**
1. Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt which has been stored for more than twenty four hours or is below the minimum temperature specified in Clause C245.26(c) shall not be used.
- (e) **Contractor's Laboratory** **Quality Control**
1. The Contractor shall maintain and operate a testing laboratory at or near the mixing plant to control the quality of the asphalt produced.

#### **C245.19 SAMPLING AND TESTING OF PRODUCTION MIX**

- (a) **Responsibility for Sampling** **Contractor's Responsibility and Costs**
1. The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose. The samples shall be taken by the Contractor. The costs associated with taking samples of production mix shall be borne by the Contractor.
- (b) **Frequency of Sampling** **Sampling Rate**
1. For the purpose of testing production mix, samples shall be taken at the rate of one sample for each 50 tonnes of asphalt or part thereof. Unless otherwise directed by the Superintendent the sample shall be taken at the point of delivery from trucks spaced to represent each 50 tonnes of asphalt or part thereof.

**(c) Method of Sampling**

1. Each sample shall comprise two increments taken from separate sites distributed over the area of the truck load. Each increment shall represent half the truck load. The sampling point shall be at least 500 mm from any side of the truck body. Surface material shall be removed for a depth of approximately 100 mm and the sample taken from the exposed surface by a deep-sided sampling scoop of such a shape as to prevent the inclusion of material falling in from the sides.

**Sampling Points**

2. A sample of at least 5 kilograms shall be taken.

**Size of Sample****(d) Containers**

1. Each sample or sample portion as appropriate shall be placed in an airtight metal container, suitably labelled for identification and delivered to the Contractor's nominated NATA registered Laboratory. The label shall be affixed to the body and the lid of the metal container. A suitable label is as follows:

Date

Contract No

Type of Material

Quantity delivered

Sample No.

Supplier

Delivery Docket No.

Delivery Vehicle Regd. No.

Location and Lot Number

**(e) Testing**

1. Testing required by this Clause shall be arranged by the Contractor at a NATA registered laboratory.

**Registered Laboratory**

2. The cost of such testing shall be borne by the Contractor.

**Contractor's Costs****(f) Inspection of Mixing Plant**

1. The Superintendent shall have access at all times to all parts of the mixing plant for checking masses or proportions, the nature of materials, temperature measurements or the general operation of the plant and may direct action to be taken to correct any deficiencies. The Superintendent shall advise the asphalt supplier or the supplier's representative of the inspection on or before arrival at the plant.

**Access**

## **TRANSPORT**

**C245.20 GENERAL**

1. The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

**Release Agent**

2. During transport asphalt shall be covered with a canvas or other suitable cover which is held down securely.

**Cover of Load**

3. When mix is to be transported over long distances, or in cold conditions, the mix shall be covered with a heavy duty canvas or similar waterproof cover which shall overlap the sides of the truck body by at least 250 mm and shall be tied down securely. The bodies of all trucks shall be suitably insulated.

**Long Distance**

- |    |  |                             |
|----|--|-----------------------------|
| 4. | Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment.  | <b><i>Delivery Rate</i></b> |
| 5. | Unless other means of measurement are approved by the Superintendent, the mass of all truck-loads of asphalt shall be measured on an accredited weighbridge. | <b><i>Weighbridge</i></b>   |

## **PLACING**

### **C245.21 GENERAL**

- |    |   |                                  |
|----|---|----------------------------------|
| 1. | The type and size of asphalt and the surface levels and thickness for each layer of asphalt shall be as shown in the Drawings, or as specified by the Superintendent.   | <b><i>Layers</i></b>             |
| 2. | Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of the Superintendent, spreading and compaction will be adversely affected. | <b><i>Weather Conditions</i></b> |

### **C245.22 PREPARATION OF PAVEMENT**

#### **(a) Cleaning of Surface**

- |    |   |                           |
|----|---|---------------------------|
| 1. | The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300 mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent. | <b><i>Requirement</i></b> |
|----|---|---------------------------|

#### **(b) Rectification of Pavement Surface**

- |    |   |  |
|----|---|--|
| 1. | The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's cleaning activities. Affected areas designated by the Superintendent shall be removed and reinstated with fresh asphalt compacted to the degree specified in Clause C245.31 and the cost of repairing such damage shall be borne by the Contractor.  | <b><i>Contractor's Responsibility</i></b><br><br><b><i>Contractor's Cost</i></b> |
| 2. | The Superintendent may direct that specific surface depressions of greater depth than twice the permissible tolerance (specified in Clause C245.32(d)) of the layer to be placed be tack coated and squared where necessary, filled with fresh asphalt of appropriate nominal size in accordance with Table C245.12 and compacted before the main course is placed. The asphalt in these patches shall be compacted in accordance with Clause C245.31 to the general level of the existing surface. | <b><i>Correction Courses</i></b>   |
| 3. | No placing of asphalt shall be undertaken until the pavement has been prepared to the <b>satisfaction of the Superintendent and has been inspected by Council.</b>  | <b><i>Asphalt Placement Hold Point</i></b>                                       |

### **C245.23 LAYING OF GEOTEXTILES**

#### **(a) Geotextile for Drainage Layer**

- |    |  |                                   |
|----|--|-----------------------------------|
| 1. | Where a geotextile as specified in Clause C245.14 is to be applied, the surface shall be prepared in accordance with Clause C245.22.   | <b><i>Surface Preparation</i></b> |
| 2. | The geotextile shall be neatly cut to fit and at all joins of the geotextile it shall be lapped a minimum of 300 mm with the overlap in the direction of paving. Joins shall be kept to a minimum. | <b><i>Cutting and Joining</i></b> |

3. The geotextile shall be pinned by means of 'U' shaped wire staples of suitable leg length and a wire diameter of 3mm minimum or other rapid fastening system approved by the Superintendent.

***Staples***

4. The geotextile shall be pinned through each join and the centre of any length at intervals not exceeding 2 m and at all ends and edges. The pinning shall prevent movement of the geotextile before and during the paving operation.

***Pinning***

***Locations***

#### **C245.24 PAVEMENT DRAIN**

1. Where a pavement drain or an edge drain is specified or shown on the Drawings, the sequence of operations will be directed by the Superintendent.

#### **C245.25 SEAL**

A 7mm prime seal shall be laid in accordance with Specification C244 Sprayed Bituminous Surfacing Clause C244.17.

#### **C245.26 TACK COAT**

1. Unless otherwise directed by the Superintendent, the whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion which shall meet the requirements of Clause C245.12. Where multiple courses are to be applied a tack coat shall be used between each course unless directed otherwise by the Superintendent.

2. The application rate of undiluted bitumen emulsion shall be neither less than 0.15 litres per square metre nor more than 0.50 litres per square metre.

***Application Rate***

3. Where a geotextile is used as specified in Clause C245.23(a) no tack coat shall be applied.

***Excluded with Geotextile***

4. The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.

***Mechanical Sprayer***

5. The bitumen emulsion may be warmed or diluted with water to facilitate spraying of a light uniform application. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Overapplication of tack coat, due to surface depressions, shall be removed or dispersed by brushing.

***Application***

6. All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.

***Contact Surfaces***

7. Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat any services or exposed fixtures including concrete kerbs, guardrail or bridge handrails. Any such spray or coating shall be removed in accordance with Clause C245.04.

***Surface Protection***

8. When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the Superintendent may require that the finished surfaces be blinded with limestone dust or similar material to protect them from carryover of bituminous material.

***Truck Movements***

9. Proprietary tack coats may be approved by the Superintendent in special circumstances.

***Proprietary Tack Coats***

**C245.27 LAYING**
**(a) Paver**

1. The paver(s) shall have a minimum spreading capacity of 50 tonnes of asphalt per hour and capable of spreading a width of at least 3.7m to the requirements of this Specification. It shall have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam and an automatic crossfall control.

**(b) Laying Operations**

1. The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum. Seven days before commencing to lay asphalt the Contractor shall submit to the Superintendent for approval details of proposed laying widths and joint locations for each layer.

***Hold Point  
Submit Joint  
Layout***

2. The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

***Continuous  
Laying***

3. When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80°C by the time the following paver matches the longitudinal joint.

***Laying in  
Echelon***

4. In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

***Irregularities in  
Laying***

5. Unless otherwise approved by the Superintendent, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

***Worker Control***

6. The Superintendent may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers. Asphalt so placed, shall be spread so as to produce a smooth even surface with uniform density to the correct level.

***Hand  
Spreading***

**(c) Laying Temperature**

1. For asphalts made with Class 170 or 320 bitumen the minimum asphalt temperatures at the time of discharge into the paver shall be as shown in Table C245.9.

***Limits***

2. For asphalt made with other binders complying with Clause C245.10(b), the minimum asphalt temperature for laying shall be as directed by the Superintendent.

***Other Binders***

3. The Superintendent may allow asphalt to be laid outside the specified limits for wind velocities if the Contractor supplies at least an additional roller above the minimum number of rollers specified in Clause C245.28 and can demonstrate that the level of compaction specified in Clause C245.31 can be achieved.

***Outside  
Specified Wind  
Velocities***

4. The Superintendent may reject that part of any truck load which contains lumps of cooled asphalt which are liable to affect the quality of the finished surface.

***Cooled Asphalt  
in Truck***

5. The laying temperature shall be measured in the truck just prior to discharging into the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2°C with a range from at least 0°C to 200°C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200 mm at a location at least 300 mm from the side of the truck body. The average of two readings shall be adopted as the temperature of the mix. Any necessary measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause shall be made by the Contractor in the presence of the Superintendent.

***Temperature  
Determination***



## ASPHALTIC CONCRETE

Binder Type	Road Surface Temperature in Shade (°C)	Asphalt Temperatures (°C)			
		Layer Thickness Less than 30mm	Layer Thickness 30mm to 45mm	Layer Thickness 45mm to 100mm	Layer Thickness over 100mm
Class 170	5-10	*	*	145	130-155
& Class 320 Bitumen	10-15	150#	145#	140	125-150
	15-25	145#	140#	135	120-145
	over 25	140	135	130	115-140
SBS polymer modified bitumen **	15-25		160	155	
	over 25		150	150	
<p align="center"><b>Table C245.9</b> <b>Minimum Asphalt Temperatures for Laying</b></p> <p><b>NOTE for Table C245.9:</b>      *Layers thinner than 45mm shall not be placed when the pavement temperature is below 10°C for dense graded asphalt</p> <p>   **                      For other polymers the minimum temperatures as directed by the Superintendent.</p>					

### (d) Level Control

1. The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties. **Minimum**
2. Corrective courses shall be automatically controlled from fixed wire or stringline level controls and, as required by the Superintendent, a joint matching device. Where the correction is only minor, the Superintendent may allow the use of levelling beams at least 10m long. **Corrective Course**
3. Intermediate courses shall be automatically controlled from fixed wire or stringline level controls and, as required by the Superintendent, a joint matching device. **Intermediate Course**
4. The wearing course shall be controlled by levelling beams at least 10 m long and, as required by the Superintendent, a joint matching device. **Wearing Course**

### (e) Layer Thickness

1. The compacted thickness of each course shall be as shown on the Drawings, or as directed by the Superintendent at any location. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance with Table C245.10. **Nominated Layer Thickness**

Nominal Size of Asphalt (mm)	Compacted Layer Thickness (mm)	Type of Work
5*	15 to 25	Wearing course
10	25 to 40	Wearing course
14	35 to 50	Wearing course
10	25 to 40	Intermediate course
14	35 to 50	Intermediate course
20	40 to 80	Intermediate course
28	75 to 120	Intermediate course
40	100 to 160	Intermediate course

**Table C245.10**

**Course and Layer Thickness**

**NOTE Table C245.10:** \*Special purpose asphalt

**C245.28 JOINTS**

**(a) General**

1. The location of longitudinal and transverse joints shall be approved by the Superintendent in accordance with Clause C245.26(b) before work commences. The density of the asphalt and surface finish at joints shall be similar to those of the remainder of the layer.

**Location  
Hold Point**

**(b) Longitudinal Joints**

1. Unless otherwise directed by the Superintendent, an automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Unless otherwise directed by the Superintendent, longitudinal joints shall be:

**Joint Matching  
Device**

- continuous and parallel
- coincident with 150mm of line of change in crossfall
- offset by at least 150mm from joints in underlying layers
- located away from traffic wheel paths
- located beneath proposed traffic linemarkings in the case of a wearing course.

2. Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

**Overnight  
Exposure**

3. When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150 mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

**Paving in  
Echelon**

4. In the case of cold longitudinal joints, the edge or edges of the first paver run shall be butted and slightly elevated while hot using hand lutes.

**Cold**

5. If the edge of joints are left exposed overnight or longer, the edge shall be trimmed to a straight vertical face by cutting disc, rotary saw or pneumatic spade and lightly coated with tack coat material by brushing. The adjoining run shall be placed against the prepared edge with an overlap of 25 mm to 50 mm. The overlap shall be pushed back using lutes, immediately after placing, to form a slight ridge along the joint which the roller shall compress adjacent to the edge of the previously placed run. Any excess, overlapping or segregated material shall be discarded and not incorporated in the mat.

***Treatment of Exposed Joints***

6. The compaction of asphalt at a longitudinal joint shall be carried out immediately behind the paver using either a static steel wheeled roller or a vibratory steel wheeled roller operated in a static mode. Compaction shall commence with the roller travelling on the cold lane with a 150 mm overlap on the hot lane for the first forward and reverse pass. The second pass shall be made on the hot lane with 150 mm overlap on the cold lane.

***Compaction***

7. When thin layers are to be compacted, the Superintendent may allow the use of a vibratory steel wheeled roller operated in the vibratory mode. In this instance, the first forward and reverse pass shall be made with the roller travelling on the hot lane and with a 150 mm overlap on the cold lane.

***Thin Layers***

8. Rolling shall continue until the joint is smooth and dense.

***Rolling***

**(c) Transverse Joints**

1. When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

***Location***

2. Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1 m between successive layers and between adjacent runs.

3. Runs shall end either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds.

***Feathered Edge***

4. At the start of the run, care shall be taken to set the screed level with sufficient allowance for compaction so that just the correct thickness of asphalt is placed. The screed shall be heated to the asphalt temperature.

***Setting of Screed***

5. When the paver has moved a sufficient distance from the joint, a steel roller shall compact the joint in several transverse passes. The roller shall project about 150 mm further onto the fresh asphalt in each pass. If a vibratory roller is used, it shall be operated in the static mode. At locations where it is difficult to roll the joint transversely, the Superintendent may approve an alternative procedure.

***Rolling***

6. Boards shall be used for off pavement movement of the roller to prevent rounding the edge of the mat.

***Off Pavement Movement***

7. The joint shall then be rolled longitudinally.

8. When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses as set out in Table C245.10.

***Matching Existing Surface***

## COMPACTION

### C245.29 PLANT AND EQUIPMENT

1. The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish. **Compaction Fleet**
2. The minimum number of rollers used for compaction of asphalt laid at various rates shall be as shown in Table C245.11. **Minimum Plant**
3. For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used. **Confined Areas**
4. Rollers shall travel at a uniform speed not exceeding 5 kilometres per hour for steel rollers and 10 kilometres per hour for both vibratory steel and pneumatic tyred rollers. **Roller Speed**
5. Lateral changes in the direction of rolling shall be made on previously compacted asphalt. Sharp turns shall be avoided and any changes from forward to reverse shall be made smoothly. Vibrating rollers shall not be stopped or reversed while in the vibrating mode. **Direction Change**

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
Tonnes per hour per paver	Dense Graded Asphalt		
	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		

**Table C245.11**

**Minimum Roller Combinations for Compaction**

**NOTES Table C245.11:**

1.

At the discretion of the Superintendent, the minimum number of rollers may be decreased for layer thicknesses in excess of 60mm.

2.

Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.

**C245.30 DENSE GRADED ASPHALT****(a) Initial Rolling**

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift asphalt, pneumatic tyred rollers may be used.

***Roller Type***

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

***Commencing Time***

The transverse and longitudinal joints and edges shall be compacted first as specified in Clause C245.27.

***Priority***

Initial rolling shall be completed before the bitumen asphalt temperature falls below 105°C, or 120°C for polymer modified asphalt.

***Temperature Level*****(b) Secondary Rolling**

Secondary rolling shall immediately follow initial rolling. Either vibratory steel rollers, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers shall be between 600 kilopascals and 700 kilopascals. Rolling shall commence at the longitudinal joint side of the run.

***Roller Types and Tyre Pressures***

Secondary rolling shall be completed before the mix temperature falls below 80°C.

***Temperature Level*****(c) Final Rolling**

Final rolling shall be carried out by a pneumatic tyred roller with tyre pressures between 600 kilopascals and 700 kilopascals to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

***Tyre Pressures***

Final rolling shall be completed before the asphalt temperature falls below 60°C.

**C245.31 WITHDRAWN****C245.32 ACCEPTANCE CRITERIA FOR COMPACTION**

1. The acceptance for compaction shall be on a lot by lot basis where each day's work is generally one lot. Any defective areas which show cracking, or bony or fatty material shall be excluded from the lot and shall be rectified by the Contractor before being tested.

***Statistical Basis***

2. The Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

***Relative Compaction*****Cores**

The cores shall be taken on a random basis and have density tests performed on the cores in accordance with Test Method T606. The layer thickness shall be deemed to be the mean thickness of the cores. The testing shall be undertaken at a NATA registered laboratory.

### Nuclear Density Meter

The type of nuclear density meter shall be appropriate to the depth of the layer being measured and shall be calibrated for each type of asphalt.

The Contractor shall arrange for a nuclear density meter (backscatter mode) to measure density in situ and shall determine the acceptable compaction level, in terms of the nuclear density meter, from compaction trials or by correlation with cores taken from a compacted layer. The layer thickness shall be deemed to be the nominal layer thickness. The proposed correlation shall be submitted to the Superintendent for approval.

**Hold Point**

3. Relative compaction of the core is the ratio of the field bulk density of the core and the mean laboratory density of the lot, determined by Test Methods T601 and T606, and reported as a percentage of the mean laboratory density.

**Relative Compaction**

4. No cores or nuclear density measurements shall be taken within 150 mm of a joint or free edge. Unless directed by the Superintendent, layers less than 30 mm in thickness shall not be cored.

**Coring Limitations**

5. The minimum Relative Compaction of all values within a lot shall be 95 per cent for a layer of thickness less than 50 mm or 96 per cent for a layer of thickness of 50 mm or greater.

**Minimum Relative Compaction**

### C245.33 FINISHED PAVEMENT PROPERTIES

#### (a) General

1. Each course of asphalt shall be finished parallel to the finished surface of the wearing course.

**Parallel to Finished Course**

#### (b) Thickness

1. The thickness of asphalt shall be specified and/or measured in one of the following ways:

**Measurement**

##### (i) No Finished Surface Levels Specified

##### No corrective course required

When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in Table C245.12.

**Calculated Average Compacted Thickness**

Nominal Size of Asphalt (mm)	Tolerance (mm)
5	+5 -0
10	+5 -5
14	+5 -5
20	+10 -10
28	+10 -10
40	+10 -10

Table C245.12

**Tolerance for Course Thickness**

**(ii) Finished Surface Levels Specified**

When asphalt is placed in more than one course (excluding a corrective course) to specified levels over a pavement built by others, each course shall be placed in accordance with this clause provided that the thickness of the wearing course shall be not less than 90 per cent of that specified and the level of the wearing course shall comply with the limits shown in Table C245.13.

When the Contractor also constructs the underlying pavement, the level and thickness of the asphalt shall comply with the requirements of Clauses C245.26(d) and C245.32(c).

**(c) Level**

1. The top surface of any course after final compaction shall be parallel with the final wearing surface and the levels of the surface of the nominated course shall not vary from the levels determined from the Drawings or as determined by the Superintendent by more than the limits shown in Table C245.13.

<b>Nominated Course</b>	<b>Below Nominated Course Level (mm)</b>	<b>Above Nominated Course Level (mm)</b>
Wearing Course	0	10
Top of Intermediate Course	5	10
Other Intermediate Course	10	10
Corrective Course	15	10

**Table C245.13 - Tolerance for Course Levels**

2. Surface irregularities exceeding the tolerances given in this Clause shall be corrected to the satisfaction of the Superintendent before a subsequent course is placed.

**Surface Irregularities**

**(d) Shape**

1. The surface shall not deviate from the bottom of a 3 m long straightedge laid in any direction by more than the tolerances shown in Table C245.14.

**Tolerances**

<b>Course</b>	<b>Deviation (mm)</b>
Corrective Course	15
Intermediate Course	10
Wearing Course	5

**Table C245.14 - Deviation from 3m Straightedge**

2. Surface irregularities exceeding the tolerances given in Table C245.14 for a particular course shall be corrected to the satisfaction of the Superintendent before a subsequent course is placed. When the Contractor is required to provide a new wearing course in a single layer operation over a pavement built by others, the tolerance for the wearing course shown in Table C245.12 shall apply provided the deviations of the existing surface from a 3 m straightedge do not exceed the tolerance specified in Table C245.14 for an intermediate course.

***Surface  
Irregularities***

**(e) Riding Quality**

1. The finished surface shall have a smooth longitudinal profile. The riding quality of the finished surface shall be measured with a Prolimeter (RTA T187) or a calibrated NAASRA (AUSTRALODS) roughness meter vehicle (RTA T182) and the roughness count shall not exceed a value of 40 counts per kilometre where construction of the underlying pavement forms part of the contract.
2. Where the wearing course does not form part of the works under the Contract, the measurements shall be taken on the surface of the intermediate course.
3. The roughness count shall be determined from the average of three replicate runs. Each lane shall be divided into sections 100m long. The average roughness count of each section shall not exceed the relevant count specified above. Any length less than 100m shall be included with the section immediately preceding it and an average roughness determined for the section. Start and finish joints of the entire work shall not be included in any section.

**(f) Voids**

For asphalt mixes having voids outside the limits specified in Table C245.7, the asphalt may be accepted at the absolute discretion of the Superintendent if all other requirements of this Specification are met and provided the void contents fall within the range 3-8% for Classified Road mixes and 2-6% for the Unclassified Road mixes

***Limits on  
Voids***



## LIMITS AND TOLERANCES

### C245.34 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses of this Specification are summarised in Table C245.17 below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Coarse Aggregate</b>		
	(a) Wet Strength	>100kN for any fraction other than the 40mm open graded asphalt where wet strength is to be >150kN (Test Method T215)	C245.08
	(b) Wet/Dry Strength Variation	<35% (Test Method T215)	C245.08
	(c) Particle Shape	Fraction retained on 9.50mm AS sieve: <35% for caliper ratio 2:1 <10% for caliper ratio 3:1 (Test Method T213)	C245.08
	(d) Fractured Faces	Fraction retained on 6.70mm AS sieve: >75% of mass with at least two fractured faces. When used as a wearing course shall have at least 90% by mass with at least one fractured face. (Test Method T239)	C245.08
	(f) Polished Aggregate Friction Value (PAFV)	> minimum value specified in Annexure C245. (Test Method T233)	C245.08
2.	<b>Fine Aggregate</b>	Shall meet the requirements as specified for Coarse Aggregate (Item 1) above.	C245.08
3.	<b>Mineral Filler</b>		
	(a) Voids	Dry compacted filler voids > 40%	C245.09
4.	<b>Bitumen</b>		
	(a) Property Requirements	As Table C245.1	C245.10

Item	Activity	Tolerance	Spec Clause
5.	<b>Scrap Rubber Bitumen</b>	A 20% scrap rubber bitumen mixture prepared as for Test Method T735 shall have a minimum recovery of 20% when tested in accordance with Test Method T1180	C245.10
6.	<b>Scrap Rubber</b>		
	(a) Grading	As Table C245.4	C245.13
	(b) Length	< 10% of particles having a length greater than 7.50mm	C245.13
7.	<b>SBS Modified Bitumens</b>		
	(a) Specified Properties	As per Table C245.2	C245.10
8.	<b>EVA Modified Bitumens</b>		
	(a) Specified Properties	As per Table C245.3	C245.10
9.	<b>Design of Nominated Mix</b>		
	(a) Dense Graded Limits	As per Table C245.6	C245.15
10.	<b>Production Mix Variation</b>		
	(a) Dense Graded Asphalt	As per Table C245.7	C245.17
11.	<b>Temperatures for Manufacture of Asphalt</b>		
	(a) Binder Temperature	As per Table C245.8	C245.18
	(b) Asphalt Temperature	As per Table C245.8	C245.18
12.	<b>Asphalt</b>		
	(a) Moisture Content	< 0.5% by mass	C245.18
13.	<b>Laying of Geotextiles</b>		
	(a) Lapping at joins	Lap to be > 300mm	C245.23
	(b) Wire Staples	Wire diameter > 3mm	C245.23
	(c) Pinning	Intervals < 2m	C245.23
14.	<b>Tack Coat</b>		
	(a) Bitumen Emulsion	Application Rate > 0.15 and < 0.50 litres per square metre	C245.26

**ASPHALTIC CONCRETE**

<b>Item</b>	<b>Activity</b>	<b>Tolerance</b>	<b>Spec Clause</b>
15.	<b>Laying</b>		
	(a) Paver Capacity	>50 tonnes asphalt per hour	C245.27
	(b) Laying Depth	Adjustment between 10mm and 150mm	C245.27
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80°C when following paver matches the longitudinal joint.	C245.27
	(d) Faulty Operation of Paver	Thin layer spread by hand to correct irregularity if surface temperature >115°C for dense graded.	C245.27
	(e) Laying Temperature	As per Table C245.9.	C245.27
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per Table C245.10.	C245.27
16.	<b>Level Control</b>		
	(a) Levelling Beam for Corrective Course	>10m length	C245.27
	(b) Levelling Beam for Wearing Course	>10m length	C245.27
17.	<b>Longitudinal Jointing</b>		
	(a) Change in Crossfall	Within 150mm of line of change.	C245.28
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	C245.28
18.	<b>Transverse Jointing</b>		
	(a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	C245.28
19.	<b>Compaction</b>		
	(a) Dense Graded Asphalt		
	(i) Roller Speed	Steel Rollers <5km per hr Vibratory Pneumatic <10km per hr.	C245.29 C245.29
19.	<b>Compaction (Cont'd)</b>		
	(a) Dense Graded Asphalt		
	(ii) Rolling	Initial Rolling: To be completed before asphalt temperature falls below 105°C	C245.30
		Secondary Rolling: Tyre pressures on pneumatic rollers to be 600kPa to 700kPa. Rolling to be completed before the asphalt temperature falls below 80°C.	C245.30
		Final Rolling:	C245.30

Item	Activity	Tolerance	Spec Clause
		Tyre pressures on pneumatic rollers to be between 600kP and 700kP. Rolling to be completed before asphalt temperature falls below 60°C.	
	(b) Acceptance Criteria for Compaction	Minimum Relative Compaction of all values within a lot >95% for layer of thickness <50mm and >96% for layer thickness >50mm.	C245.32
20.	<b>Finished Pavement</b>		
	(a) Thickness	Max. compacted thickness as for Table C245.12 Where finished surface levels are specified, thickness shall be >90% of specified and level shall comply with requirements of Table C245.13	C245.33
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than tolerance in Table C245.14	C245.33

**Table C245.15 - Summary of Limits & Tolerances**

**SPECIAL REQUIREMENTS**

**C245.35    RESERVED**

**C245.36    RESERVED**

**C245.37    RESERVED**

**C245.38    RESERVED**

**C245.39    RESERVED**

**C245.40    RESERVED**

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**C245A    ASPHALT WORK RECORD**

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**C245B    SCHEDULE OF DETAILS**

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**ANNEXURE C245A**

Work Location: \_\_\_\_\_ km to \_\_\_\_\_ km

From \_\_\_\_\_ towards \_\_\_\_\_

Road Loc: [ / / ] to [ / / ]

New Surfacing ☐      Resurfacing ☐      Existing Surface Type \_\_\_\_\_

[illegible]

Contractor's  
Representative: \_\_\_\_\_  
(Signature)

**ASPHALTIC CONCRETE**

**ANNEXURE C245B  
SCHEDULE OF DETAILS**

Pavement Type \_\_\_\_\_  
Location \_\_\_\_\_

Sheet No. \_\_\_\_\_  
of \_\_\_\_\_ Sheets

Course	Type and Nom Size of Asphalt	Type of Binder	Grade of Binder and/or % by Wt of Additive	Compacted thickness of course (mm)	Minimum Delivery Rate (per hr)	Delivery Trucks to be Insulated*	Pavers in Echelon	Fixed Wire String Line with Support Intervals (m)	Level Control Device			Clause C245.39 Voids Deduction Requirement**
									Levelling Beam	Joint Matching Shoe	Automatic Crossfall Control	
Wearing												
Intermediate 1												
Intermediate 2												
Intermediate 3												
Intermediate 4												
Correction 1												
Correction 2												
Drainage Layer												

NAASRA Roughness Count of Existing Surface (Clause C245.33(e))

Section \_\_\_\_\_ Counts/km \_\_\_\_\_

Section \_\_\_\_\_ Counts/km \_\_\_\_\_

\* Delivery Trucks to be insulated unless otherwise shown (Clause C245.20)

Section \_\_\_\_\_ Counts/km \_\_\_\_\_

\*\* Requirement A to apply unless otherwise shown

PAFV of Aggregate 50 minimum. (Test Method T233)

(TO BE ISSUED BY SUPERINTENDENT FOR EACH SEPARABLE PART)

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C247

Revision 3

## **MASS CONCRETE SUBBASE**





**SPECIFICATION C247  
MASS CONCRETE SUBBASE**

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**SPECIFICATION C247****GENERAL****SCOPE**

The work to be executed under this Specification consists of the construction, by subbase including trial sections and with the provisions of the Contract.

**THICKNESS AND LEVELS OF SUBBASE**

The

***Levels***

**PROVISION FOR BASE SLAB ANCHORS**

During construction of the Contractor shall make provision to permit construction of base slab anchors at the locations trenches, compacting of the bottom of the trench, disposal of surplus material and Specification for PLAIN OR REINFORCED CONCRETE BASE as part of the concrete base

***Base Slab***

**C247.04**

1.  
in the text in the abbreviated form or code indicated.

***Standards Test***

(a)

**ons**

C271

-

Concrete Works

**Australian Standards**

AS 1012.3.1

-

Methods of sampling concrete - Determination of properties  
consistence of concrete – slump test  
Methods of sampling concrete - Determination of properties  
consistence of concrete – compacting factor test  
Methods of sampling concrete - Determination of properties  
consistence of concrete -

AS1012.3.4

-

related to the compactability index

-

concrete.

-

tensile and flexure test specimens, in the laboratory or in the

AS 1012.9

Method for the determination of the compressive strength of

AS 1012.

-

for compressive strength.

- AS 1141.11 - Method of sampling and testing aggregates - Particle size distribution by sieving.
- AS 1141.14 - Method of sampling and testing aggregates - Particle shape, by proportional calliper.
- AS 1141.22 - Method of sampling and testing aggregates - Wet/dry strength variation.
- AS 1160 - Bituminous emulsions for construction and maintenance of pavements.
- AS 1379 - Specification and supply of concrete.
- AS 1478 - Chemical admixtures in concrete.
- AS 2758.1 - Aggregate and rock for engineering purposes - Concrete aggregates.
- AS 3582.1 - Supplementary cementitious materials for use with portland and blended cement - Flyash.
- AS 3799 - Liquid membrane - forming curing compounds for concrete.
- AS 3972 - Portland and blended cements.

**(c) RTA Test Methods**

- T 321 - Dry Shrinkage of 100 x 100 x 280mm Concrete Prisms.

**(d) Roads Act**

## **MATERIALS FOR CONCRETE**

### **C247.05 CEMENT**

- |   |   |
|---|---|
| <p>1. Cement shall be Type GP Portland cement or Type GB blended cement complying with AS 3972. Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.</p>   | <b>Quality</b>                                      |
| <p>2. When submitting details of the nominated mix in accordance with Clause C247.15 the Contractor shall nominate the brand and source (including works) of the cement. On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work.</p>                                      | <b>Nominated Brand and Source</b>                   |
| <p>3. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.</p>  | <b>Proof of Quality</b>                             |
| <p>4. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent may require a retest to ensure the cement complies with AS 3972, before the cement is used in the work. The cost of retesting cement shall be borne by the Contractor.</p> | <b>Storage Time</b><br><br><b>Contractor's Cost</b> |
| <p>5. Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.</p>  | <b>Transport and Storage</b>                        |

### **C247.06 FLYASH**

- |  |                |
|--|----------------|
| <p>1. Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and the quality of flyash shall comply with AS 3582.1.</p>   | <b>Quality</b> |
| <p>2. When submitting details of the nominated mix in accordance with Clause C247.15, the Contractor shall nominate the powerstation source of the flyash. On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.</p> | <b>Source</b>  |

3. flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. **Evidence**

**C247.07**

1. Water used in the production of concrete shall be town supply water, meeting NH& **Quality**

**C247.08**

1. Chemical admixtures and their uses shall not contain calcium chloride, calcium formate, or 1478. Admixtures shall **Quality**  
Admixtures or combinations of admixtures other than specified below, shall not be used. An  
air included in the mix. If an air-  
the fresh concrete shall comply with Clause C247.14.

Fresh concrete with an air content not complying with Clause C247.14 shall be **Excess Air Content**

During the warm season (October to March inclusive), a lignin or lignin ('ligpol') set WR Re) approved by the Superintendent, **Retarder for**  
shall be used to control slump within the limits stated in Clause C247.13. The dosage shall  
manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance  
with AS  
together with the proposed 'dosage chart' in accordance with Clause C247.15.

4. During the cool season (April to September inclusive), only a lignin or lignin-based **Retarder for**  
complying with AS 1478) may be used in the mix or, alternatively, omitted altogether. If the  
Contractor proposes to vary the admixture between the warm and cool seasons such  
C247.16.

5. When submitting details of the nominated mix in accordance with Clause C247.15, **Type**  
be used. Documentary evidence of the quality shall be furnished by the Contractor to the  
Superintendent upon request at any stage of the work.

**C247.09****(a) General**

When submitting details of the nominated mix in accordance with Clause C247.15, **Source and Type**  
the Contractor shall nominate the sources of aggregate to be used and shall submit details

Aggregates shall all pass the 37.5 mm AS sieve and shall comply with AS 2758.1 in **Quality**  
75 micrometres, impurities and reactive materials. The proportion of misshapen particles  
1141.14 shall not exceed 35 per cent.

When submitting details of the nominated mix, the Contractor shall submit to the **Proposed**  
aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

4. If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

***Blending of Aggregates*****(b) Grading**

1. The grading of the combined aggregate used in the work, determined by AS 1141.11, shall not deviate from that of the Proposed Grading by more than the amounts shown in Table C247.1.

<b>Australian Standard Sieve</b>	<b>Maximum Deviation Per Cent Passing by Mass of Total Sample</b>
37.5 mm	-5
19.0 mm	+ or -10
4.75 mm	+ or -10
1.18 mm	+ or -5
600 µm	+ or -5
150 µm	+ or -2

**Table C247.1 - Aggregate Grading Deviation Limits**

**(c) Durability**

1. Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:-

***Tolerances***

- (i) Wet Strength - AS 1141.22 - Shall not be less than 50 kN.
- (ii) 10 per cent Fines Wet/Dry Variation - AS 1141.22 - Shall not exceed 35 per cent.

**(d) Storage**

1. Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

***Facilities Required***

2. The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

***Introduction of Foreign Matter***

## **QUALITY REQUIREMENTS OF CONCRETE**

**C247.10 CEMENT AND FLYASH CONTENT**

1. When a cement and flyash blend is nominated the minimum Portland cement content shall be 90 kilograms per yielded cubic metre of concrete and the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete.

***Minimum Content*****C247.11 COMPRESSIVE STRENGTH**

1. The compressive strength of concrete shall be determined in accordance with

***Compressive***



AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted.

**Strength****C247.12 SHRINKAGE**

1. The drying shrinkage of the nominated mix, determined by Test Method T321 shall not exceed 450 microstrain after three weeks air drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with Test Method T321.

**Shrinkage  
Limit****C247.13 CONSISTENCY**

1. The Contractor's nominated slump, determined in accordance with AS 1012.3, Method 1, shall be neither less than 25 mm nor more than 50 mm for mechanically placed concrete and shall be neither less than 70 mm nor more than 90 mm for hand placed concrete.

**Slump  
Tolerances****C247.14 AIR CONTENT**

1. If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS 1012.4, Method 2, shall be neither less than 3 per cent nor more than 7 per cent when discharged from the transport vehicle ready for placement.

**Air Content  
Tolerances****DESIGN AND CONTROL OF CONCRETE MIXES****C247.15 GENERAL**

1. The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a 'nominated mix'.

**Nominated Mix**

2. Also, the Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

**Certificate of  
Compliance  
with  
Specification**

3. In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1.0 MPa of the median.

**Compressive  
Strength  
Determination**

4. These details shall be submitted at least 21 days before using the nominated mix in the work.

**Submission of  
Details****C247.16 VARIATIONS TO APPROVED MIXES**

1. The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the

**Approval  
required to**

Superintendent.

*vary mix*

2. Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C247.15. If the variations to the quantities of the constituents in the approved mix are less than 10 kilograms for Portland cement, 20 kilograms for other cementitious material and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the Superintendent may approve the changes without new trials being carried out.

**Contractor's  
Responsibility**

3. Notwithstanding these tolerances, the minimum cement content shall be 90 kilograms per yielded cubic metre of concrete, the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete.

**Minimum  
Constituent  
Quantities**

## CONFORMANCE FOR CONCRETE STRENGTH AND THICKNESS

### C247.17 CONCRETE CYLINDERS

#### (a) Test Specimens

1. Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this Clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.

**Contractor's  
Responsibility**

2. Samples of concrete for testing shall be taken in accordance with AS 1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

**Sampling**

3. The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.

4. The Contractor shall mark the specimens for identification purposes.

**Marking**

5. The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.

**Contractor's  
Costs**

#### (b) Frequency of Moulding of Test Specimens

1. Test specimens shall be moulded as follows:-

**Moulding of  
Cylinders**

(i) For the determination of the compressive strength at twenty-eight days.

For each lot of up to 50 cubic metres of concrete placed at the one time:	One pair of specimens
--	-----------------------

(ii) For the determination of the compressive strength at seven days.

For each lot of up to 50 cubic metres of concrete placed at the one time:	One pair of specimens
--	-----------------------

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor.

For each lot of up to 50 cubic metres of concrete placed at the one time:	One pair of specimens
--	-----------------------

2. A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase. **Lot Size**

**(c) Inspection, Capping and Crushing of Specimens**

1. Specimens required by this Specification shall be tested at the NATA registered laboratory nominated by the Contractor. The cost of such testing shall be borne by the Contractor. **Contractor's Cost**
2. Specimens shall be inspected, capped and crushed in accordance with AS 1012.9. **Standards**

**C247.18 COMPRESSIVE STRENGTH OF CONCRETE**

**(a) General**

1. The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens. **Determination of Strength**
2. At the time of approving the mix design, the Superintendent shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

**(b) Adjustment of Test Compressive Strength for Age of Specimen**

1. Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table C247.2. For intermediate ages the factor shall be determined on a pro-rata basis. **Strength Age Factor**

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

**Table C247.2 - Concrete Age Conversion Factors**

**(c) Conformance for Compressive Strength**

1. If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause C247.11, the lot represented by the test cylinders shall be removed and replaced.

**Limits**

2. The cost of removal of rejected concrete, including its disposal from the site, shall be borne by the Contractor.

**Contractor's Cost**

3. In case of non-conformance the Contractor may elect to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

**Non-conformance and Coring****C247.19 SPECIMENS CUT FROM THE WORK**

1. Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

**Test Specimens**

2. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012. 14 with the following amendments:-

**Specimen Characteristics**

- (a) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.
- (b) The preferred dimension for cores shall be 100 mm diameter but in no case shall the diameter be less than 75 mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.
- (c) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5 mm from the mean diameter.
- (d) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table C247.3.
- (e) Wet Conditioning only shall be used.

Length/Diameter Ratio of Core	Adjustment Factor
1 :1	0.89
1.5:1	0.965
2 :1	1.00

**NOTE:**

For intermediate form ratios, the factor shall be determined on a pro-rata basis.

**Table C247.3 - Core Strength Factor**

- |   |   |
|---|---|
| 3. Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. | <b><i>Frequency of Coring</i></b>             |
| 4. Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.   | <b><i>Curing of Cores</i></b>                 |
| 5. The cost of cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be borne by the Contractor. The method of restoration shall be approved by the Superintendent.   | <b><i>Cutting Cores Contractor's Cost</i></b> |
| 6. The cost of core preparation for testing, curing and testing shall be borne by the Contractor.   | <b><i>Testing Contractor's Cost</i></b>       |

**C247.20 ACCEPTANCE OF CORED CONCRETE FOR COMPRESSIVE STRENGTH**

- |  |                                    |
|--|------------------------------------|
| 1. Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.                       | <b><i>Strength Requirement</i></b> |
| 2. If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.      | <b><i>Core Strength</i></b>        |
| 3. No payment shall be made for the rejected concrete nor any bond breaker placed.                                   | <b><i>Rejected Concrete</i></b>    |
| 4. The cost of removal of rejected concrete, including its disposal from the site, shall be borne by the Contractor. | <b><i>Contractor's Cost</i></b>    |

**C247.21 CONFORMANCE FOR THICKNESS****(a) General**

- |   |                                     |
|---|-------------------------------------|
| 1. No thickness measurements will be carried out if the surface of the subbase is within the tolerances as specified in Clause C247.32(b).  | <b><i>Conforming Tolerances</i></b> |
| 2. If scabbling is required to achieve these, the Superintendent may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. | <b><i>Thickness Measurement</i></b> |
| 3. Thickness measurements shall be rounded off to the nearest 5mm.  |                                     |

**(b) Thickness Below Specification**

- |   |                                  |
|---|----------------------------------|
| 1. After making due allowance for the tolerances, subbase which is more than 20mm below the theoretical thickness shall be rejected and removed from the site. The cost of removal and disposal from the site shall be borne by the Contractor. | <b><i>Remove and Replace</i></b> |
| 2. Subbase which is 20mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot.     | <b><i>Acceptance</i></b>         |

## PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

### C247.22 PRODUCTION AND TRANSPORT OF CONCRETE

1. At least four weeks before commencing work under this Specification, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

**Contractor's  
Responsibility**

### C247.23 HANDLING, STORAGE AND BATCHING MATERIALS

1. The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:-

**Methods**

- (a) Certificates of Calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales.
- (b) Cementitious material shall be weighed in an individual hopper, with the cement weighed first.
- (c) The moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.
- (d) Where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Superintendent, except for liquids which may be measured by volume or flow rate meter.

### C247.24 MIXERS AND AGITATION EQUIPMENT

1. Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379, with the following additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10mm.

**Requirements**

### C247.25 MIXING AND TRANSPORT

1. Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:-

**Methods**

- (a) The mixer shall be charged in accordance with the manufacturer's instructions.
- (b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray.
- (c) For truck-mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water : cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

- (d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:-
- (i) One and a half hours, where transported by truck mixer or agitator
  - (ii) One hour, where transported by non-agitating trucks

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

- (e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 per cent of the gross volume of the drum of the mixer. All vehicles carrying concrete shall also comply with the limits for travelling on a public road.

#### **C247.26 MAXIMUM MIXING TIME**

1. Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum shall be five minutes.

***Batch in Mixer***

2. For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

***Long Delays***

#### **C247.27 CONSISTENCY**

1. The consistency of the concrete shall be such as to allow the production of a dense, non-segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its shape and shall not sag or tear.

***Requirements***

2. The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent. The cost of consistency testing shall be borne by the Contractor.

***Contractor's Cost***

3. The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3, Method 1. The test shall be made on concrete samples obtained in accordance with AS 1012.1.

***Test Method***

4. Check tests shall be done on each truckload of concrete.

***Check Tests***

### **PLACING AND FINISHING CONCRETE SUBBASE**

#### **C247.28 GENERAL**

1. At least four weeks before commencing work under this Specification, the Contractor shall submit full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

***Contractor's Responsibility***

- |    |  |   |
|----|--|---|
| 2. | The Contractor shall give the Superintendent seven days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause C247.49). | <b><i>Written Notice</i></b>              |
| 3. | The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.  | <b><i>Surface Conditions</i></b>          |
| 4. | Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.   | <b><i>Air Temperature Limits</i></b>      |
| 5. | The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C.   | <b><i>Concrete Temperature Limits</i></b> |

**C247.29 RATE OF EVAPORATION**

- |    |   |   |
|----|---|---|
| 1. | When the value of Rate of Evaporation, determined from the graph in Figure C247.1, exceeds 0.50 kilograms per square metre per hour the Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour. | <b><i>Evaporation Limit</i></b>           |
| 2. | The cost of such precautionary measures shall be borne by the Contractor.   | <b><i>Contractor's Cost</i></b>           |
| 3. | Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull-floating, are complete.  | <b><i>Use of Retarder</i></b>             |
| 4. | The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.  | <b><i>Contractor's Responsibility</i></b> |
| 5. | The cost of providing and maintaining such equipment and providing such personnel shall be borne by the Contractor.   | <b><i>Contractor's Costs</i></b>          |



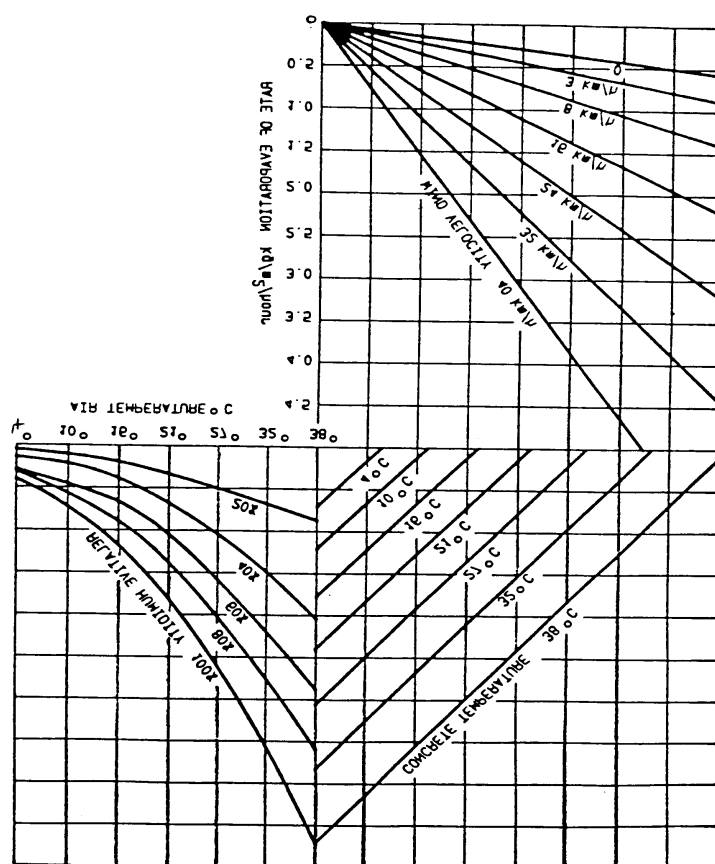


Figure C247.1 - Rate of Evaporation

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27°C
- with relative humidity at 40%
- with concrete temperature at 27°C
- with a wind velocity of 26km/h the rate of evaporation would be 1.6 kg/m<sup>2</sup>/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27°C. Move vertically down to the respective wind velocity curve - in this case interpolating for 26km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

### C247.30 MECHANICAL PAVING

1. The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:-

- An automatic control system with a sensing device to control line and level to the specified tolerances.
- Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.

**Paving  
Machine  
Requirements**

- (c) Internal vibrators capable of compacting the full depth of the concrete.
- (d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- (e) Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

2. The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

**Concrete  
Finish**

3. Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

4. The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be uniform and in accordance with the design.

**Supporting  
Surface**

5. Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

**Continuity of  
Paving  
Operation**

**Contractor's  
Cost**

#### **C247.31 HAND PLACING**

1. Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non-adhesion of concrete to the forms.

**Formwork**

2. Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

**Placing in  
Forms**

3. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

**Disruption,  
Contractor's  
Cost**

4. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

**Concrete  
Finish**

5. Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

#### **C247.32 ALIGNMENT AND SURFACE TOLERANCES**

##### **(a) Horizontal Alignment Tolerance**

1. The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of  $\pm 25$ mm.

**Outer Edge  
Location**

2. Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with Clause C247.36

**Longitudinal  
Construction  
Joint**

**(b) Surface Tolerances**

1. The level at any point on the top of the subbase shall not vary by more than 0 mm above or 20 mm below that shown on the Drawings or as directed by the Superintendent. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

**Surface Levels**

2. The top surface of the subbase shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.

**Surface Levels****C247.33 CURING**

1. The subbase shall be cured by the use of one of the following:

**Curing Compounds**

- (a) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt base is used, or
- (b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if a concrete base is used, or
- (c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt or concrete base.

2. The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.

**Efficiency Index**

3. The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with a hand lance the rates should be increased by 25 per cent.

**Application**

4. The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

**Application Rate**

5. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

**Curing Period**

6. The cost of making good such damaged curing membrane shall be borne by the Contractor.

**Contractor's Cost**

7. Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

**Equipment on Site****C247.34 PROTECTION OF WORK**

1. The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

**Temperature Control**

2. The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals for procedures and equipment to be used for such protection.

***Rain Protection***

3. Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4.0 MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:-

***Traffic Restrictions***

- (a) Bond-breaker and spall treatment and
- (b) Concrete or asphalt paving.

4. Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction. The cost of rectifying such damage to the subbase shall be borne by the Contractor.

***Damage Restoration Contractor's Cost***

## **JOINTS**

### **C247.35 TRANSVERSE CONSTRUCTION JOINTS**

1. Transverse construction joints shall:
  - be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations.
  - be constructed normal to the edge line and to the dimensions shown on the Drawings.
  - not deviate from a 3 m straightedge placed along the joint by more than 10 mm.
  - be smooth across the joint.

### **C247.36 LONGITUDINAL CONSTRUCTION JOINTS**

1. Longitudinal construction joints shall:
  - be formed no closer than 300mm of the base longitudinal joints as shown in the Drawings, unless directed otherwise by the Superintendent.
  - not deviate from the plan or nominated position at any point by more than 20 mm.
  - not deviate from a 3 m straightedge placed along the joint by more than 10 mm, having made due allowances for any planned curvature.
  - be smooth across the joint.

## **BOND BREAKER AND SPALL TREATMENT**

### **C247.37 GENERAL**

1. Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS 3799 Class A Type 2.

***Bond Breaker***

2. Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted.

***No Bond Breaker***

3. Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete. **Spalled Areas**

### C247.38 PREPARATION OF SUBBASE

1. Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Superintendent of all loose, foreign and deleterious material. **Subbase Preparation**

### C247.39 TREATMENT OF SPALLING

1. Where directed by the Superintendent, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6 : 1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches. **Method**
2. A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor. **Spalling Repair Time**
3. The cost of making good treated spalled areas which have been damaged shall be borne by the Contractor. **Contractor's Cost**

### C247.40 APPLICATION OF BOND BREAKER

1. The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete. **Wax Emulsion**
2. The method of application shall conform to the requirements of Clause C247.33.

### C247.41 TREATMENT OF UNPLANNED CRACKS

1. The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3mm if the base is asphaltic concrete. This may take the form of applying an approved 300mm minimum width Stress Alleviating Membrane (Bituthene or equivalent) over the crack prior to placement of the first asphalt layer, or an extra application of wax emulsion for a width of 300mm along the crack.
2. The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

## SUBGRADE BEAMS

### C247.42 GENERAL

1. Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the Drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the Drawings. **Scope**

**C247.43 EXCAVATION**

1. Excavation for subgrade beams shall be to the dimensions shown on the Drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompact, where required, to the degree of consolidation of the adjacent undisturbed material.

***Excavation Standards***

2. Excavated material shall be legally disposed of by the Contractor.

***Disposal of Excavated Materials***

**C247.44 CONCRETE**

1. Concrete in subgrade beams shall comply with the requirements of the Specification for CONCRETE WORKS. The minimum compressive strength at 28 days shall be 32MPa.

***Compressive Strength***

**C247.45 STEEL REINFORCEMENT**

1. Steel reinforcement shall be of the type and size shown on the Drawings and shall be supplied and installed in accordance with the Specification for PLAIN OR REINFORCED CONCRETE BASE.

***Type and Size***

**C247.46 CONSTRUCTION AND PROTECTION**

1. Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompact to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.

***Timing and Type of Finish***

2. A steel float shall be used to produce a smooth surface finish, free of any texture.

3. The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Contractor. The cost of making good such damage to the subgrade beams shall be borne by the Contractor.

***Damage Protection***

**C247.47 CURING**

1. The top surface of the subgrade beam shall be cured in accordance with Clause C247.33 before placing the subbase.

***Curing***

**C247.48 BOND BREAKER**

1. The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty-four hours nor more than seventy-two hours before placing of subbase concrete.

***Time of Placement***

**TRIAL CONCRETE SUBBASE****C247.49 GENERAL**

1. Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the Specification. This section shall be constructed so that it may be incorporated in the finished work.

***Location***

2. The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

***Purpose***

3. The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

***Quality  
Parameters***

4. A trial length of between 100m and 200m for mechanical paving equipment or between 20m and 50m for hand placement is required. The maximum width proposed to be laid, shall be constructed in one continuous operation.

***Dimensions***

5. Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this Specification, the Contractor may proceed with placing concrete subbase from a time ten working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

***Deficiencies in  
Trial***

***Section***

6. The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this Specification.

***New Trial  
Section***

7. Payment shall be made for subbase as may be constructed, in respect of the initial trial and any additional trials required, at the schedule rates for appropriate pay items, if it has been constructed without deficiencies and is incorporated into the work as subbase concrete. Trial concrete subbase, which does not comply with the Specification, shall be rejected by the Superintendent and shall be removed and disposed from the site by the Contractor.

***Payment***

8. The cost of removal of rejected trial concrete subbase and the cost of making good any damage caused by such removal to the subgrade or subgrade beams shall be borne by the Contractor.

***Contractor's  
Cost***

## LIMITS AND TOLERANCES

## C247.50 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C247.4 below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Materials for Concrete</b>		
	a. Misshapen Particles	2 : 1 ratio < 35 percent	C247.09a
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	C247.09b
	c. Durability	Wet Strength > 50 kN 10% Fines < 35 percent	C247.09c
2.	<b>Concrete</b>		
	a. Shrinkage	Drying Shrinkage <450 microstrain	C247.12
	b. Consistency	Mechanically placed: >25mm<50mm Hand Placed: >70mm <90mm	C247.13
	c. Air Content	≥3, ≤7 percent	C247.14
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	C247.21
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: a. One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non agitating trucks.	C247.25
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5°C or >38°C. Temperature of concrete shall be >10°C but <32°C.	C247.28
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	C247.29
3.	<b>Alignment and Surface Tolerances</b>		
	a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	C247.32
	b. Surface	Level on top surface to be no more	C247.32



<b>Item</b>	<b>Activity</b>	<b>Tolerances</b>	<b>Spec Clause</b>
		than +0mm or –20mm to that shown on the drawings.	
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	C247.32
4.	<b>Joints</b>		
	a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	C247.35
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm.	C247.36
		(ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	
5.	<b>Bond Breaker</b>		
	a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	C247.40

**Table C247.4 - Summary of Limits and Tolerances**

### **SPECIAL REQUIREMENTS**

<b>C247.51</b>	<b>RESERVED</b>
<b>C247.52</b>	<b>RESERVED</b>
<b>C247.53</b>	<b>RESERVED</b>
<b>C247.54</b>	<b>RESERVED</b>
<b>C247.55</b>	<b>RESERVED</b>
<b>C247.56</b>	<b>RESERVED</b>
<b>C247.57</b>	<b>RESERVED</b>

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C248

Revision 3

## CONCRETE BASE



## SPECIFICATION C248 CONCRETE BASE

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## SPECIFICATION C248 CONCRETE BASE

### GENERAL

#### C248.01 SCOPE

1. The work to be executed under this Specification consists of the construction, by mechanical or hand placement of plain or reinforced concrete base, including trial sections, slab anchors and terminal slabs to the dimensions and levels shown on the Drawings and in accordance with the provisions of the Contract.

2. The work also includes the construction of reinforced concrete approach slabs at bridge abutments and traffic signal approach slabs where specified on the Drawings.

***Approach  
Slabs***

#### C248.02 THICKNESS AND LEVELS OF BASE

1. The base thickness and levels shall be shown on the Drawings.

#### C248.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

##### (a) Council Specifications

- |      |   |                                       |
|------|---|---------------------------------------|
| C224 | - | Open Drains including Kerb and Gutter |
| C231 | - | Subsoil and Foundation Drains         |
| C247 | - | Mass Concrete Subbase                 |

##### (b) Australian Standards

- |              |   |  |
|--------------|---|--|
| AS 1012.1    | - | Methods of sampling concrete - Sampling fresh concrete.  |
| AS 1012.3.1  | - | Methods of sampling concrete - Determination of properties related to the consistence of concrete – slump test                             |
| AS 1012.4    | - | Methods for the determination of air content of freshly mixed concrete.  |
| AS 1012.8    | - | Method for making and curing concrete compression, indirect tensile and flexure test specimens, in the laboratory or in the field.         |
| AS 1012.9    | - | Method for the determination of the compressive strength of concrete specimens.  |
| AS 1012.12.1 | - | Method of testing concrete – Determination for the determination of mass per unit volume of hardened concrete – rapid measuring method.    |
| AS1012.12.2  | - | Method of testing concrete – Determination for the determination of mass per unit volume of hardened concrete – Water displacement method. |
| AS 1012.13   | - | Method of testing concrete – determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory.     |
| AS 1012.14   | - | Method for securing and testing cores from hardened concrete for compressive strength or indirect tensile strength.                        |

- AS 1141.11 - Method of sampling and testing aggregates - Particle size distribution by dry sieving.
- AS 1141.14 - Method of sampling and testing aggregates - Particle shape by proportional calliper.
- AS 1141.18 - Method of sampling and testing aggregates - Crushed particles of coarse aggregates.
- AS 1141.22 - Method of sampling and testing aggregates - Wet/dry strength variation.
- AS 1141.24 - Method of sampling and testing aggregates - Aggregate soundness evaluation by exposure to sodium sulphate solution).
- AS 1160 - Bituminous emulsions for construction and maintenance of pavements.
- AS 1302 - Steel reinforcing bars for concrete.
- AS 1303 - Steel reinforcing wire for concrete.
- AS 1304 - Welded wire reinforcing fabric for concrete.
- AS 1379 - Specification and supply of concrete.
- AS 1478 - Chemical admixtures in concrete.
- AS 1554.3 - Welding of reinforcing steel.
- AS 2758.1 - Aggregate and rock for engineering purposes - Concrete aggregates.
- AS 3582.1 - Supplementary Cementitious materials for use with portland and blended cement - flyash.
- AS 3799 - Liquid membrane - forming curing compounds for concrete.
- AS 3972 - Portland and blended cement.

**(c) RTA Specifications**

- 3204 - Preformed Joint Fillers for Concrete Road Pavements and Structures

**(d) RTA Test Methods**

- T 1160 - Low Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals for Bridge Structures.
- T 1161 - High Temperature Recovery of Polychloroprene Elastomeric Joint Seals for Bridge Structures.
- T 1163 - Resistance of Vulcanised Rubber to the Absorption of Oil.
- T1192 - Adhesion of Sealant.
- T1193 - Accelerated Ageing of Cured Sealant.

**(e) ASTM Standards**

- D792 - Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
- C793 - Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
- C794 - Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- D2240 - Test Method for Rubber Property Durometer Hardness.
- D2628 - Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete.
- D2835 - Specification for Lubricant for Installation of Preformed Compression Seal in Concrete Pavements.

**(f) US Military Specifications**

- MIL-S-8802 - Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion.



**(g) NSW Local Government Act, 1993**

Ordinance 30C - Load Limitations

**MATERIALS FOR CONCRETE****C248.04 CEMENT**

- |   |                                   |
|---|-----------------------------------|
| 1. Cement shall be Type GP Portland cement complying with AS 3972 and shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.  | <b>Quality</b>                    |
| 2. When submitting details of the nominated mix in accordance with Clause C248.19 the Contractor shall nominate the brand and source (including works) of the cement. On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work. | <b>Nominated Brand and Source</b> |
| 3. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.   | <b>Proof of Quality</b>           |
| 4. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, a re-test shall be required to ensure the cement still complies with AS 3972, before the cement is used in the work.                                 | <b>Storage Time</b>               |
| 5. The cost of re-testing the cement shall be borne by the Contractor and results of the testing forwarded to the Superintendent.   | <b>Contractor's Cost</b>          |
| 6. Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.   | <b>Transport and Storage</b>      |

**C248.05 FLYASH**

- |   |                             |
|---|-----------------------------|
| 1. Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and the quality of flyash shall comply with AS 3582.1.   | <b>Quality</b>              |
| 2. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the powerhouse source of the flyash. The Contractor shall use only flyash from the nominated powerhouse. | <b>Source</b>               |
| 3. Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent.   | <b>Documentary Evidence</b> |

**C248.06 WATER**

- |   |                |
|---|----------------|
| 1. Water used in the production of concrete shall be town supply water, meeting NH&MRC Guidelines | <b>Quality</b> |
|---|----------------|

**C248.07 ADMIXTURES**

- |   |                        |
|---|------------------------|
| 1. Chemical admixtures and their use shall comply with AS 1478. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used. An air-entraining agent shall be included in the mix and the air content of the concrete shall comply with Clause C248.13. | <b>Quality and Use</b> |
|---|------------------------|

2. Fresh concrete with an air content not complying with Clause C248.13 shall be rejected.

**Excess Air Content**

3. During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WR Re) approved by the Superintendent shall be used to control slump within the limits stated in Clause C248.12. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478 for Type Re or Type WR Re shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with Clause C248.19.

**Retarder for Warm Season**

4. During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 per cent reducing sugars (Type WR Re complying with AS 1478) may be used in the mix. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause C248.21.

**Retarder for Cool Season**

5. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the proprietary source, type and name for each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

**Source and Type**

## C248.08 AGGREGATES

### (a) General

1. At least 40 per cent by mass of the total aggregates in the concrete mix shall be quartz sand. Quartz sand is aggregate having a nominal size of less than 5 mm and shall contain at least 70 per cent quartz, by mass. Where present, chert fragments will be regarded as 'quartz' for the purpose of this specification, but the ratio of chert to quartz shall not exceed unity.

**Quartz Sand Content**

2. When submitting details of the nominated mix in accordance with Clause C248.19, the Contractor shall nominate the sources of aggregate to be used in the concrete and shall submit details of the geological type of each aggregate.

**Source and Type**

### (b) Fine Aggregate

1. Fine aggregate shall consist of clean, hard, tough, durable, uncoated grains uniform in quality. Fine aggregate shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), material finer than 2 micrometres, and impurities and reactive materials. The sodium sulphate soundness, determined by AS 1141.24, shall not exceed the limits in Table C248.1.

**Quality**

Australian Standard Sieve	Per Cent Loss by Mass
4.75mm to 2.36mm	4
2.36mm to 1.18mm	6
1.18mm to 600µm	8
600µm to 300µm	12

**Table C248.1 - Sodium Sulphate Soundness Limits**

2. In the case of a blend of two or more fine aggregates, the above limits shall apply to each constituent material. **Blending**
3. The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table C248.2. **Grading**
4. When submitting details of the nominated mix the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "Proposed Grading". **Proposed Grading**
5. If the Contractor proposes to blend two or more fine aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of this clause. **Test for Each Constituent**
6. The grading of the fine aggregate used in the work shall not deviate from that of the Proposed Grading by more than the amounts in Table C248.2. **Grading Deviation**
7. Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table C248.2.

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	± 3
2.36mm	65 - 95	± 10
1.18mm	40 - 80	± 10
600µm	24 - 52	± 10
300µm	8 - 25	± 5
150µm	1 - 8	± 2
75µm	0 - 3	

**Table C248.2 - Fine Aggregate Grading**

**(c) Coarse Aggregate**

1. Coarse aggregate shall consist of clean, crushed, hard durable rock, metallurgical furnace slag or gravel. Coarse aggregate shall comply with AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this Specification. If required, coarse aggregate shall be washed to satisfy these requirements. **Quality**
2. The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table C248.3. **Grading**
3. When submitting details of the nominated mix the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "Proposed Grading". **Proposed Grading**

4. If the Contractor proposes to blend two or more coarse aggregates to provide the Proposed Grading then Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the requirements of this clause

**Test for Each Constituent**

5. The grading of the coarse aggregate used in the work shall not deviate from that of the Proposed Grading by more than the amounts in Table C248.3.

**Grading Deviation**

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
26.50 mm	100	
19.00 mm	95 - 100	± 2
13.20 mm	(Design)	± 5
9.50 mm	25 - 55	± 5
4.75 mm	0 - 10	± 3
2.36 mm	0 - 2	

**Table C248.3 - Coarse Aggregate Grading**

6. Notwithstanding these tolerances, the coarse aggregate used in the work shall comply with the limits shown in Table C248.3.

7. The coarse aggregate shall also conform to the following requirements:-

**Additional Tests**

- (i) Wet Strength - AS 1141.22.

Shall not be less than 80 kN for any fraction and/or constituent.

- (ii) 10 per cent Fines Wet/Dry Variation - AS 1141.22.

Shall not exceed 35 per cent for any fraction and/or constituent.

- (iii) Soundness - AS 1141.24

The loss in mass when tested with sodium sulphate shall not exceed 9 per cent for any constituent.

- (iv) Particle Shape - AS 1141.14

The proportion of misshapen particles (2:1 ratio) shall not exceed 35 per cent.

- (v) Fractured Faces - AS 1141.18.

At least 80 per cent by mass of the particles shall have two or more fractured faces.

- (d) Storage**

1. Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

**Facilities**

2. The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

***Introduction of Foreign Matter***

## **QUALITY REQUIREMENTS OF CONCRETE**

### **C248.09 CEMENT AND FLYASH CONTENT**

1. The minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete. The maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

***Cement and Flyash***

### **C248.10 COMPRESSIVE STRENGTH**

1. The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at twenty-eight days shall be 32.0 MPa.

***Compressive Strength***

### **C248.11 SHRINKAGE**

1. The drying shrinkage of the nominated mix, determined by AS 1012.13, shall not exceed 450 microstrain after three weeks air drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS 1012.13.

***Shrinkage Limit***

### **C248.12 CONSISTENCY**

1. The Contractor's nominated slump, determined in accordance with AS 1012.3, Method 1, shall be neither less than 25 mm nor more than 50 mm for mechanically placed concrete and shall be neither less than 70 mm nor more than 90 mm for hand placed concrete.

***Slump Tolerance***

### **C248.13 AIR CONTENT**

1. The air content of the concrete, determined in accordance with AS 1012.4, Method 2, shall be neither less than 4 per cent nor more than 7 per cent, when discharged from the transport vehicle ready for placement.

***Tolerances***

## **STEEL REINFORCEMENT**

### **C248.14 MATERIAL**

1. Steel reinforcement shall comply with the requirements of the appropriate following Australian Standards:-

***Standards***

- (a) AS 1302 Steel Reinforcing Bars for Concrete.
- (b) AS 1303 Steel Reinforcing Wire for Concrete.
- (c) AS 1304 Welded Wire Reinforcing Fabric for Concrete.

- |    |  |   |
|----|--|---|
| 2. | The type and size of bars shall be as shown on the Drawings.   | <b><i>Type and Size</i></b>                                   |
| 3. | Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.   | <b><i>Quality</i></b>   |
| 4. | The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS 1302, AS 1303 or AS 1304, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis.  | <b><i>Documentary Evidence</i></b>                            |
| 5. | Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length. The cost of all samples and tests shall be borne by the Contractor. | <b><i>Sampling</i></b><br><br><b><i>Contractor's Cost</i></b> |
| 6. | Plastic tips for wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at $23 \pm 5^{\circ}\text{C}$ without being pierced by the wire. The Contractor shall demonstrate that the proposed chairs conform with these requirements.                                 | <b><i>Wire Chairs</i></b>                                     |

#### **C248.15 BENDING**

- |    |  |                       |
|----|--|-----------------------|
| 1. | Reinforcement shall be formed to the dimensions and shapes shown on the Drawings. Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the Drawings shall not be used. Reinforcement shall not be heated for the purpose of bending. Where the radius of a bend or hook is not stated on the Drawings, it shall be made around a pin having a diameter of not less than four times the diameter of the bar bent. | <b><i>Bending</i></b> |
|----|--|-----------------------|

#### **C248.16 SPLICING**

- |    |  |                            |
|----|--|----------------------------|
| 1. | All reinforcement shall be furnished in the lengths indicated on the Drawings. Except where shown on the Drawings, splicing of bars shall only be permitted with the approval of the Superintendent as to the location and method of splicing. | <b><i>Plan Lengths</i></b> |
|----|--|----------------------------|

The length of lapped splices not shown on the Drawings shall be as follows for unhooked bars:-

Grade 400Y	- 35 bar diameters
Grade 250R	
Steel reinforcing wire	- 45 bar diameters

- |    |  |                                 |
|----|--|---------------------------------|
| 2. | Splices in reinforcing fabric shall be measured as the overlap between the outermost wire in each sheet of fabric transverse to the direction of splice. This overlap shall not be less than the pitch of the transverse wires plus 25 mm. | <b><i>Splice Dimensions</i></b> |
| 3. | In welded splices, bars shall only be welded by an approved electrical method. Grade 400Y reinforcing bars shall not be welded.  | <b><i>Welded Splice</i></b>     |
| 4. | Welding shall comply with AS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.   | <b><i>Welding Standard</i></b>  |

#### **C248.17 STORAGE**

- |    |   |   |
|----|---|---|
| 1. | Reinforcement, unless promptly incorporated into the concrete, shall be stored under a waterproof cover and supported clear of the ground, and shall be protected from damage and from deterioration due to exposure. | <b><i>Protection of Reinforcement</i></b> |
|----|---|---|

**C248.18 PLACING**

1. Reinforcing bars and wire reinforcing fabric shall be accurately placed to the dimensions and details shown on the Drawings. They shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs or metal hangers, as approved by the Superintendent, and by wiring together where required using annealed iron wire not less than 1.25 mm diameter. These supports shall be in a regular grid not exceeding 1 m and steel shall not be supported on metal supports which extend to any surface of the concrete, on wooden supports, nor on pieces of aggregate.

***Position***

2. Tack welding instead of wire ties may be used on reinforcing steel. Cold-worked reinforcing bars shall not be tack welded.

***Tack Welding***

3. The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the Drawings.

***Bar Cover***

4. Tie bars shall be placed in the pavement such that after placement they remain in their specified location. Tie bars shall not be placed through the finished upper surface of the pavement. Tie bars shall be placed either ahead of paving or by a bar vibrator into the edge of the joint or by an automatic tie bar inserter on the mechanical paver. Irrespective of the method of placement, tie bars extending from any side face of base concrete or gutter shall be anchored in a manner which will develop 85 per cent of the yield strength of the bar in tension.

***Tie Bars***

5. Placing and fastening of all reinforcement in the work shall be approved by the Superintendent before concrete is placed and adequate time shall be allowed for inspections and any corrective work which the Superintendent may require. Notice for inspection shall not be less than four working hours before the intended time of commencement of concrete placement or such time as determined by the Superintendent.

***Inspection*****DESIGN AND CONTROL OF CONCRETE MIXES****C248.19 GENERAL**

1. The Contractor shall submit, for approval by the Superintendent, details of the concrete mix (or mixes) and the materials, including source, to be used for each of mechanically placed and hand placed base, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a 'nominated mix'.

***Nominated Mix***

2. Also, the Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

***Certified Test Results***

3. In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 2.0 MPa of the median and the compressive strength for 28 days shall not be less than 32.0 MPa.

***Compressive Strength***

4. These details shall be submitted at least 21 days before using the nominated mix in the work.

***Submission of Details***

**C248.20 VARIATIONS TO APPROVED MIXES**

- |  |   |
|--|---|
| <p>1. The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the Superintendent.</p>  | <p><b>Approval for<br/>Mix Variation</b></p>  |
| <p>2. Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C248.19. If the variations to the quantities of the constituents in the approved mix are less than 10 kg for Portland cement and flyash and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete the Superintendent may approve the changes without new trials being carried out.</p> | <p><b>Contractor's<br/>Responsibility</b></p> |
| <p>3. Notwithstanding these tolerances the minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete and the maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.</p>  | <p><b>Content per<br/>Cubic Metre</b></p>     |

## CONFORMANCE OF CONCRETE STRENGTH, COMPACTION AND THICKNESS

**C248.21 CONCRETE CYLINDERS**
**(a) Test Specimens**

- |   |   |
|---|---|
| <p>1. Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this Clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.</p> | <p><b>Contractor's<br/>Responsibility</b></p> |
| <p>2. Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.</p>   | <p><b>Sampling</b></p>                        |
| <p>3. The method of making and curing specimens shall be in accordance with AS1012.8 with compaction by internal vibration.</p>   | <p><b>Curing</b></p>                          |
| <p>4. The Contractor shall mark the specimens for identification purposes.</p>  | <p><b>Marking</b></p>                         |
| <p>5. The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.</p>   | <p><b>Contractor's<br/>Cost</b></p>           |

**(b) Frequency of Moulding of Test Specimens**
**Moulding of  
Cylinders**

- |  |                              |
|--|------------------------------|
| <p>1. Test specimens shall be moulded as follows:-</p>                               |                              |
| <p>(i) For the determination of the compressive strength at twenty-eight days.</p>   |                              |
| <p>For each lot of up to 50 cubic metres<br/>of concrete placed at the one time:</p> | <p>One pair of specimens</p> |
| <p>(ii) For the determination of the compressive strength at seven days.</p>         |                              |
| <p>For each lot of up to 50 cubic metres<br/>of concrete placed at the one time:</p> | <p>One pair of specimens</p> |



- (iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor.

For each lot of up to 50 cubic metres  
of concrete placed at the one time:

One pair of specimens

2. A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed. **Lot Size**

**(c) Inspection, Capping and Crushing of Specimens**

1. Specimens required by this Specification shall be tested at the NATA registered laboratory nominated by the Contractor. The cost of such testing shall be borne by the Contractor. **Contractor's Cost**

2. Specimens shall be inspected, capped and crushed in accordance with AS1012.9. **Standards**

3. Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS1012.12 Method 2, so that the relative compaction of cores taken from the same lot of concrete base can be determined. **Mass Unit Volume**

**C248.22 COMPRESSIVE STRENGTH OF CONCRETE**

**(a) General**

1. The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens unless the two results differ by more than 3.0 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete. **Determination of Strength**

**(b) Adjustment of Test Compressive Strength for Age of Specimen**

1. Should any specimen be tested more than twenty-eight days after moulding the equivalent twenty-eight day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table C248.4. For intermediate ages the factor shall be determined on a pro-rata basis. **Strength Age Factor**

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

**Table C248.4 - Concrete Age Conversion Factors**

**(c) Conformance for Compressive Strength**

- |  |   |
|--|---|
| <p>1. If the 28 day compressive strength of test cylinders for any lot is less than 29.0 MPa or greater than 45.0 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.</p>  | <b>Limits</b>                                       |
| <p>2. In case of non-conformance the Contractor may elect to core the in situ base concrete for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Base concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.</p> | <b>Coring</b>                                       |
| <p>3. After testing for compressive strength of cores, where required, the Superintendent shall consider the test results and shall at his absolute discretion determine the compressive strength of the concrete to be either:-</p> <p style="margin-left: 40px;">(i) The average of the twenty-eight day compressive strength of the pair of specimens moulded at the time of placing; or</p> <p style="margin-left: 40px;">(ii) The equivalent twenty-eight day compressive strength of the core.</p>   | <b>Superintendent's<br/>Absolute<br/>Discretion</b> |
| <p>4. A lot is defined as a continuous pour of up to 50 cubic metres of base represented by a pair of test specimens cast from a sample of the concrete used in its construction.</p>  | <b>Lot Size</b>                                     |

**C248.23 CONFORMANCE FOR THICKNESS**

- |  |                                  |
|--|----------------------------------|
| <p>1. Thickness measurements of the concrete base shall be determined by survey, measurements at the edges or by coring. Audit checks using a suitable probe may be carried out whilst the concrete is being placed. The readings shall be rounded off to the nearest 5mm.</p> | <b>Thickness<br/>Measurement</b> |
| <p>2. Base which is below the specified thickness shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.</p>   | <b>Remove and<br/>Replace</b>    |
| <p>3. Base which is thicker than the design thickness will be acceptable provided the finish satisfies the requirements of Clause C248.33.</p>   |                                  |

**C248.24 RELATIVE COMPACTION OF CONCRETE**
**(a) Test Specimens**

- |   |              |
|---|--------------|
| <p>1. Test specimens for determining the relative compaction of the concrete placed in the work shall be cores cut from the work. Cores shall be cut from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions:-</p> <p style="margin-left: 40px;">(i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However concrete must be not less than three days old in the warm season and six days old in the cool season, before removal.</p> <p style="margin-left: 40px;">(ii) The nominal diameter of the cores shall not be less than 75 mm.</p> | <b>Cores</b> |
|---|--------------|

2. The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars from the core. The locations are not intended to be random, but are intended to ensure that the whole of the concrete base conforms to the minimum requirements of the Specification. Cores shall be marked for identification.

***Location of Cores***

3. Cores shall be placed immediately either in a tank of lime saturated water or in an individual plastic bag and sealed to prevent water loss. Cores stored in plastic bags shall be kept in the shade.

***Storage***

4. Cores shall not be subjected to temperatures in excess of either ambient temperature or 23°C whichever is the higher and they shall not be subjected to temperature less than 10°C, until delivered to the testing laboratory.

***Temperature Control***

**(b) Frequency of Coring**

1. The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with Clause C248.21.

***Minimum***

2. In the case of hand-placed base concrete, two cores shall be taken to represent a section of work. A section of work shall be confined between construction joints. Hand-worked or placed base that is cast with machine-placed concrete and not separated from the machine-placed concrete shall be deemed to be part of the machine-placed concrete, and be cored and tested as part of the machine-placed concrete base.

***Hand Placed Concrete***

**(c) Repair of Core Holes**

1. The Contractor shall clean and restore all core holes taken in the base with non-shrink cementitious concrete having a compressive strength of not less than that in the base and a maximum nominal aggregate size of 10 mm.

***Contractor's Responsibility***

2. The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

***Surface Condition***

3. The cost of restoring core holes shall be borne by the Contractor.

***Contractor's Costs***

**(d) Testing of Cores for Compaction**

1. The core specimens shall be wet conditioned in accordance with AS 1012.14 for not less than 24 hours immediately prior to testing for compaction. Testing to determine mass per unit volume shall be carried out on specimens at age seven days.

***Curing***

2. The relative compaction of a core specimen shall be the ratio, expressed as a percentage, of the mass per unit volume of the core specimen to the average mass per unit volume of the standard cylinders used to determine the seven day compressive strength from the same lot of concrete base. The mass per unit volume of both standard cylinders and cores shall be determined in accordance with AS 1012.12 Method 2. All costs associated with obtaining, curing and testing of cores shall be borne by the Contractor.

***Relative Compaction***

***Contractor's Cost***

**(e) Conformance for Compaction**

1. If the relative compaction is less than 97.0 per cent, the lot represented by the core shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

***Rejection Percentage***

2. Core specimens for compressive strength testing shall be wet-conditioned, prepared and tested in accordance with AS 1012.14. Cores obtained for compaction shall not be re-used for compressive strength testing.

***Core Preparation***

3. The test strength shall be adjusted for age at test in accordance with Clause C248.22 and for length/diameter ratio in accordance with Table C248.5.

**Adjustment for Age**

4. If the 28 day compressive strength of the core is less than 32.0 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

**Core Compressive Strength**

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

**Table 248.5 - Correction Factors**

## PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

### C248.25 PRODUCTION AND HANDLING OF CONCRETE

1. At least four weeks before commencing work under this Specification, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

**Contractor's Responsibility**

2. The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:-

**Handling and Batching Methods**

- (a) Certificates of Calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales.
- (b) Cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first.
- (c) The moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.

3. Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379, with the additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10 mm.

**Mixer Requirements**

### C248.26 MIXING AND TRANSPORT

1. Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:-

**Methods**

- (a) The mixer shall be charged in accordance with the manufacturer's instructions.

- (b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray.
- (c) For truck-mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200 m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water : cement ratio be exceeded. Mixing of the concrete shall be completed at that location.
- (d) Admixtures shall be separately prediluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs.
- (e) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:-
  - One and a half hours, where transported by truck mixer or agitator;
  - One hour, where transported by non-agitating trucks.

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided. The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

- (f) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 per cent of the gross volume of the drum of the mixer. All vehicles carrying concrete shall also comply with the load limits of Ordinance 30C of the Local Government Act 1993.

**C248.27 MAXIMUM MIXING TIME**

1. Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum shall be five minutes.

***Batch in Mixer***

2. For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

***Long Delays***

**C248.28 CONSISTENCY**

1. At all times between mixing and discharge, the slump shall be within 10mm of the Contractor's nominated slump for the nominated mix for mechanically placed concrete and within 15mm thereof for hand placed concrete.

***Tolerances***

2. The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3.1. The test shall be made on concrete samples obtained in accordance with AS1012.1.

***Test Method***

3. The consistency of the concrete shall be checked within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, the consistency shall also be checked immediately prior to discharge. Concrete which is non-conforming in relation to consistency shall not be incorporated into the work. Check tests shall be done on each truck load of concrete. The cost of consistency testing shall be borne by the Contractor.

***Timing of Testing***

***Contractor's Cost***

4. Check tests shall be done on each truckload of concrete.

***Check Tests***

## PLACING AND FINISHING CONCRETE BASE

### C248.29 GENERAL

- |   |                                    |
|---|------------------------------------|
| 1. At least four weeks before commencing work under this Specification, the Contractor shall submit for the information of the Superintendent, full details of the equipment and methods proposed for placing and finishing the concrete base together with a paving plan showing proposed paving widths, sequence and estimated daily outputs. | <b>Contractor's Responsibility</b> |
| 2. The Contractor shall give the Superintendent seven days written notice of the intention to commence construction of the base on any section of work including the placement of the trial concrete base in accordance with Clause C248.39.  | <b>Written Notice</b>              |
| 3. The subbase surface shall be clean and free of loose or foreign matter and prepared in accordance with the Specification for MASS CONCRETE SUBBASE.  | <b>Subbase Condition</b>           |
| 4. Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.   | <b>Air Temperature</b>             |
| 5. The temperature of the concrete at the point of discharge from transport vehicles shall be neither less than 10°C nor more than 32°C.  | <b>Concrete Temperature</b>        |
| 6. Where required, slab anchors shall be constructed prior to construction of the base.   | <b>Slab Anchors</b>                |

### C248.30 RATE OF EVAPORATION

- |  |                                    |
|--|------------------------------------|
| 1. When the value of Rate of Evaporation, determined from the graph in Figure C248.1, exceeds 0.50 kilograms per square metre per hour the Contractor shall take precautionary measures satisfactory to the Superintendent for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour. | <b>Evaporation Limit</b>           |
| 2. Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull-floating, are complete.  | <b>Use of Retarder</b>             |
| 3. The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.   | <b>Contractor's Responsibility</b> |
| 4. The cost of providing and maintaining such equipment, providing suitable personnel and taking precautionary measures for the prevention of excessive moisture loss shall be borne by the Contractor.  | <b>Contractor's Costs</b>          |

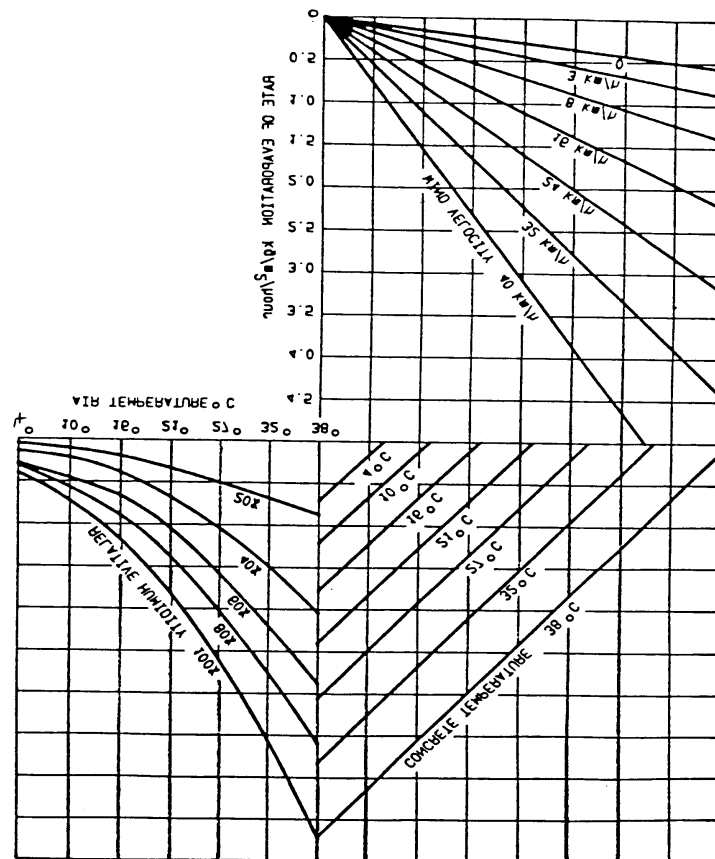


Figure C248.1 - Rate of Evaporation

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27 $^{\circ}\text{C}$
- with relative humidity at 40%
- with concrete temperature at 27 $^{\circ}\text{C}$
- with a wind velocity of 26 $\text{km/h}$  the rate of evaporation would be 1.6  $\text{kg/m}^2/\text{hour}$ .

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27 $^{\circ}\text{C}$ ), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27 $^{\circ}\text{C}$ . Move vertically down to the respective wind velocity curve - in this case interpolating for 26 $\text{km per hour}$  - and then horizontally to the left to intersect the scale for the rate of evaporation.

**C248.31 MECHANICAL PAVING**

1. The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:-

***Paving  
Machine***

- (a) An automatic control system with a sensing device to control line and level to the specified tolerances.
- (b) Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.
- (c) Internal vibrators capable of compacting the full depth of the concrete.
- (d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- (e) Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

2. The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with Clause C248.34.

***Concrete  
Finish***

3. The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

***Supporting  
Surface***

4. Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor.

***Continuity of  
Paving  
Operation  
Contractor's  
Cost***

5. Where an interruption to paving occurs, which is likely to result in a non-monolithic concrete mass, the Contractor shall form a transverse construction joint in accordance with Clause C248.41.

***Interruption to  
Paving***

6. Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.

***Non-monolithic  
Concrete***

**C248.32 HAND PLACING**

1. Hand placement shall only be used in areas where mechanical placement is impracticable or where it has been approved by the Superintendent prior to commencement of work.

***Restriction***

2. Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non-adhesion of concrete to the forms.

***Formwork***

3. Concrete shall be delivered in agitator vehicles and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

***Placing in  
Forms***



- |   |   |
|---|---|
| 4. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Contractor. | <b><i>Disruption,<br/>Contractor's<br/>Cost</i></b> |
| 5. A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with Clause C248.34.  | <b><i>Concrete<br/>Finish</i></b>                   |
| 6. Where an interruption to placing occurs, which is likely to result in a non-monolithic concrete mass, the Contractor shall form a transverse construction joint in accordance with Clause C248.41.                                   | <b><i>Transverse<br/>Construction<br/>Joint</i></b> |
| 7. Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with Clauses C248.50, C248.51 and C248.52.                  | <b><i>Non-Monolithic<br/>Concrete</i></b>           |

**C248.33 ALIGNMENT AND SURFACE TOLERANCES****(a) Horizontal Alignment Tolerance**

- |   |   |
|---|---|
| 1. The outer edges of the base shall be square to the subbase and shall not deviate from the plan position at any point by more than 10 mm.     | <b><i>Outer Edge</i></b>                  |
| 2. Where an edge of a slab is to form a longitudinal joint line the allowable horizontal alignment tolerances shall comply with Clause C248.46. | <b><i>Longitudinal<br/>Joint Line</i></b> |

**(b) Tolerances and Rideability**

- |  |                                     |
|--|-------------------------------------|
| 1. The tolerance on thickness of the base shall be zero below the specified thickness and in accordance with Clause C248.23 for excess thickness.  | <b><i>Top of Base<br/>Level</i></b> |
| 2. The top surface of the base shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm. Notwithstanding this requirement, the surface shall not pond water. | <b><i>Surface Level</i></b>         |

**C248.34 TEXTURING OF SURFACE**

1. Texturing of the concrete surface may be effected by use of a fine broom or hessian-drag. The Contractor shall submit to the Superintendent details of the proposed texturing method and equipment.

**C248.35 CURING**

- |  |                                    |
|--|------------------------------------|
| 1. The base shall be cured by the use of one of the following:   | <b><i>Compounds</i></b>            |
| (a) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt wearing surface is used, or  |                                    |
| (b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or  |                                    |
| (c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.  |                                    |
| 2. The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance from an Australian laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799. | <b><i>Efficiency<br/>Index</i></b> |

3. The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with an hand lance the rates shall be increased by 25 per cent.

4. The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

***Application  
Rate***

5. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

***Curing Period***

6. The cost of making good such damaged curing membrane shall be borne by the Contractor.

***Contractor's  
Cost***

7. Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

***Equipment on  
Site***

### **C248.36 PROTECTION OF WORK**

1. The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

***Temperature  
Control***

2. The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals for procedures and equipment to be used for such protection.

***Rain Protection***

3. Neither traffic nor construction equipment, other than that associated with testing, sawcutting, groove cleaning or joint sealing, shall be allowed on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached a compressive strength of at least 20MPa.

***Traffic  
Restrictions***

### **C248.37 ODD-SHAPED AND MISMATCHED SLABS**

1. A slab is a portion of concrete base bounded by joints or free edges. A slab shall be considered to be odd-shaped if the ratio of the longer dimension to the shorter dimension exceeds 1.6 or if the joint pattern produces an angle of less than 80 degrees between two adjacent sides. Slab dimensions shall be taken as the average dimension measured normal and parallel to the longitudinal joints. Slabs containing blockouts for drainage structures shall be considered as odd-shaped.

***Definition***

2. Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

3. Unless otherwise shown on the Drawings, odd-shaped and mismatched slabs shall be reinforced with F82 reinforcing fabric placed with 50 mm to 60 mm cover to the surface of the base. Fabric shall be clear of all transverse and longitudinal joints by 50 mm to 100 mm.

***Reinforcing  
Fabric***

**C248.38 TERMINAL SLABS**

1. Terminal slabs shall be constructed adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Terminal slabs shall be constructed to the dimensions and details shown on the Drawings.

***Position*****C248.39 TRIAL CONCRETE BASE**

1. Before the commencement of paving, the Contractor shall construct a trial section of concrete base on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing base in accordance with the Specification. This section shall be constructed so that it may be incorporated in the finished work.

***Location***

2. The trial base shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining base work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound, the construction and sawing of joints and the placement of tie bars and dowels.

***Purpose***

3. The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

***Quality  
Parameters***

4. A trial length of between 100m and 200m for mechanical paving equipment or between 20m and 50m for hand placement is required. The maximum width proposed to be laid, shall be constructed in one continuous operation.

***Dimensions***

5. Unless advised by the Superintendent of any deficiencies in the trial concrete base, due to failure to comply with this Specification, the Contractor may proceed with placing concrete base from a time ten working days after the completion of the trial concrete base or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete base, the Superintendent may order the Contractor to construct a further length of trial concrete base which shall be treated as the first. If, after three trials, the base still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

***Deficiencies in  
Trial Section***

6. The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this Specification.

***New Trial  
Section***

7. Payment shall be made for base as may be constructed, in respect of the initial trial and any additional trials required, at the schedule rates for appropriate pay items, if it has been constructed without deficiencies and is incorporated into the work as base concrete. Trial concrete base, which does not comply with the Specification, shall be rejected by the Superintendent and shall be removed by the Contractor in accordance with Clauses C248.50, C248.51 and C248.52.

***Payment*****JOINTS****C248.40 GENERAL**

1. Joints shall be provided at locations indicated on the Drawings or as approved by the Superintendent.

***Location***

**C248.41 TRANSVERSE CONSTRUCTION JOINTS**

1. Transverse construction joints shall:

- be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations.
- not be placed closer than 1.5 m to a transverse contraction joint. Where necessary, the Superintendent shall authorise a change in the spacing and/or skew of transverse contraction joints to ensure that sufficient clearance is obtained.
- be constructed normal to the control line and to the dimensions and details shown on the Drawings. The tie bars shall comply with Clauses C248.14 and C248.18.
- be smooth across the joint before texturing.
- not deviate from a 3 m straightedge placed along the joint by more than 10 mm.

***Location***

2. Prior to placing adjacent concrete the surface of the concrete shall be roughened to expose coarse aggregate. The roughened surface and the projecting reinforcement shall be washed clean and all excess water and loose material removed.

***Placing  
Adjoining  
Concrete***

**C248.42 TRANSVERSE CONTRACTION JOINTS**
**(a) General**

1. Transverse contraction joints shall be continuous across the full width of the base and shall be sawn unless otherwise approved by the Superintendent.

***Details***

2. Where the concrete base is to be overlaid with asphalt wearing course, the Superintendent may approve the joint to be formed with a suitable plastic joint inducing system.

3. Transverse contraction joints shall be constructed normal to the control line and to the dimensions and details shown on the Drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.

***Skewed Joints***

**(b) Sawcutting**

1. The Contractor shall ensure that sawcutting proceeds in a timely manner so as to prevent cracking of the base concrete other than at the bottom of the 3 mm sawcut. The Contractor shall use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn and shall have sufficient standby equipment available on site to maintain continuity of sawing.

***Timing and  
Equipment***

2. The line of the transverse contraction joint shall be without any discontinuities. No edge shall deviate from a 3 m straight edge by more than 10 mm.

***Tolerances***

3. The surface of the transverse contraction joint shall not exhibit more than 5 mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300 mm in any 1 m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

4. Sawcuts, which do not conform to the requirements of this Clause, shall be rejected by the Superintendent. Rejected sawcuts may be repaired by a method approved by the Superintendent.

***Rejected  
Sawcuts***

**(c) Cleaning**

1. Immediately after any sawing, the sawcut shall be cleaned of all debris. The cleaning method used shall not damage the sawcut nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants to be used. The method shall incorporate a pressurised liquid or liquid/air jet. Cleaning liquid shall not be gravity fed from tanks.

**Debris  
Removed**

**(d) Temporary Sealing**

1. Immediately after cleaning following the second sawcut, if the transverse contraction joint is produced by a two-cut operation, the joint shall be temporarily sealed by a continuous closed-cell polyethylene backer rod of diameter shown on the Drawings or as required by the Superintendent.

**Material**

2. The top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface. The backer rod shall pass over any longitudinal joint seal already in place.

**Tolerance**

3. The temporary sealant shall be maintained by the Contractor until the joint is sealed permanently. Damaged or disturbed temporary sealants shall be removed, the transverse contraction joint recleaned to the satisfaction of the Superintendent and a new temporary sealant inserted.

**Maintenance**

**(e) Permanent Sealing****(i) General**

1. Within ten days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint.

**Timing**

2. The permanent sealant shall be either a neoprene compression seal or an in situ cast silicone sealant. The Contractor shall submit for the approval of the Superintendent, a full technical description of the proposed sealant, including its operating parameters and the method of installation recommended by its manufacturer.

**Sealant Quality**

**(ii) Neoprene Compression Sealants**

1. Neoprene compression sealants shall comply with all the requirements of ASTM 2628. Test methods used to determine compliance with these requirements shall include Test Methods T1160, T1161 and T1163.

**Standards**

2. At least four weeks before installation of the sealant, the Contractor shall submit to the Superintendent a Certificate of Compliance from a NATA registered laboratory showing that the sealant meets all the requirements of ASTM 2628.

**Certification of  
Compliance**

3. At the time of installation, the sides of the neoprene sealant shall be coated with a clear or concrete-coloured lubricant compound approved by the Superintendent and complying with ASTM D-2835. The sealant shall be inserted into the joint by means of suitable equipment which shall not damage the sealant during its insertion. The maximum increase in length of the sealant after installation shall be 5 per cent of original length. Any sealant exceeding 5 per cent extension shall be rejected. The sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle.

**Installation**

4. The sealant shall be continuous between formed longitudinal joints. Where such a discontinuity occurs, the sealant shall be angle butt jointed by a method approved by the Superintendent. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base and shall overlay any longitudinal sealants.

**Tolerances**

**(iii) Silicone Sealants**

1. Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table C248.6. At least four weeks before the installation of the sealant, the Contractor shall submit to the Superintendent a Certificate of Compliance, from a NATA registered laboratory, showing that the sealant meets all the requirements of Table C248.6.

***Certificate of Compliance***

2. The silicone joint sealant shall be grey in colour and shall be stored and installed in accordance with the manufacturer's written instructions. Installation of a silicone sealant shall take place only when the side walls of the groove have been grit blasted and are surface dry.

***Installation***

3. Immediately before introducing the silicone sealant into the groove, any foreign or disturbed material shall be cleaned from the joint and from the top of the backer rod by dry air jet. The backer rod shall then be depressed to the depth such that the bottom of the silicone sealant shall be at the planned location and of the correct shape.

***Action Before Sealing***

4. If the backer rod is damaged in any way it shall be replaced for the full length of the joint.

5. The method to be used for permanent sealing with silicone sealant shall be approved by the Superintendent before permanent sealing commences. Notwithstanding any approval given by the Superintendent to a proposed method, the Contractor shall be responsible for producing a permanent seal complying with all requirements of this Specification.

***Contractor's Responsibility***

Test Method	Test	Requirements
ASTM-D-792	Specific Gravity	1.1 to 1.55
MIL-S-8802	Extrusion Rate	90 to 250 g per min
MIL-S-8802	Tack Free Time	30 to 70 min
ASTM D 2240	Durometer	10 to 25
T1192 T1193	Durability	Extension to 70% Compression to 50%
ASTM C794	Adhesion to Concrete	35N minimum average peel strength
ASTM C 793-7	Accelerated Weathering at 5,000 hours	No cracks, blisters or bond loss

**Table C248.6 - Silicone Joint Sealant Requirements.****C248.43 TRANSVERSE ISOLATION JOINTS**

1. Transverse isolation joints shall be provided at bridge approach slabs and at slab anchors where shown on the Drawings and where directed by the Superintendent.

***Location***

2. Transverse isolation joints shall be continuous across the full width of the base normal to the control line and shall be constructed in accordance with the Drawings.

***Construction***

- |  |                  |
|--|------------------|
| 3. Transverse isolation joints shall not be placed closer than 2.0 m to other transverse joints. Where necessary, the Superintendent shall authorise a change in the spacing and/or skew of adjacent transverse contraction joints to ensure that sufficient clearance is obtained.                                | <b>Spacing</b>   |
| 4. Joint filler shall comply with RTA Specification 3204 and joint sealant with the silicone sealant requirements of Clause C248.42. They shall be installed in accordance with the Drawings and in a manner conforming to the manufacturers recommendations except that reference to backer rods shall not apply. | <b>Standards</b> |
| 5. The line of the isolation joint shall not deviate from a 3m straightedge more than 10mm.  | <b>Tolerance</b> |

**C248.44 LONGITUDINAL TIED JOINTS****(a) General**

- |   |                              |
|---|------------------------------|
| 1. Longitudinal tied joints shall be provided at the locations shown on the Drawings or where directed by the Superintendent. The joints shall be parallel to the control line and/or to the dimensions and details shown on the Drawings.  | <b>Location</b>              |
| 2. Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.  | <b>Formation</b>             |
| 3. The ties shall be deformed steel bars Grade 400Y, 12 mm diameter and 1 m long and shall be inserted in accordance with Clause C248.18. Tie bars shall be located and spaced as shown on the Drawings. All parts of any tie bar shall lie within 50 mm of its designed position. Tie bars shall be omitted within 500 mm of a transverse joint. The epoxy to be used when installing tie bars in existing concrete shall be hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar. | <b>Ties</b>                  |
| 4. The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10 mm. The line shall also not deviate from a 3 m straightedge by more than 10 mm having made due allowance for any planned curvature.   | <b>Tolerances</b>            |
| 5. Where the longitudinal tied joint is formed or slipformed, the joint face shall be corrugated in accordance with the details shown on the Drawings.  | <b>Corrugated Joint Face</b> |
| 6. Where the multi-lane width is greater than 18 m, a longitudinal isolation joint shall be constructed at each location shown on the Drawings and in accordance with Clause C248.46.   | <b>Isolation Joint</b>       |

**(b) Sawn-Induced Joints**

- |  |                          |
|--|--------------------------|
| 1. Sawn longitudinal tied joints shall be provided to the dimensions shown on the Drawings. Sawcutting shall comply with Clause C248.42(b).  | <b>Location</b>          |
| 2. Within twenty-four hours of sawing, the longitudinal tied joint shall be thoroughly cleaned of all debris and a neoprene backing rod, shall be inserted in accordance with the details shown on the Drawings.   | <b>Sealant Quality</b>   |
| 3. The sealant shall be coated with a lubricant-adhesive compound approved by the Superintendent. The compound shall have a colour compatible with the pavement colour. The sealant shall be inserted into the groove by means of suitable equipment which shall not damage the sealant during insertion. The maximum increase in length of the sealant after installation shall be 10 per cent of the original length, otherwise the sealant shall be rejected. | <b>Sealant Insertion</b> |

4. Joints in the sealant shall be kept to a minimum and shall be cemented together by an adhesive recommended by the Manufacturer. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base, except where the sealant is depressed to lie under the transverse joint sealant.

**Sealant Joints**

**(c) Ribbon-Induced Joints**

1. Ribbon-induced longitudinal tied joints shall be provided to the dimensions and details shown on the Drawings. The inducer ribbon shall be machine-inserted so that the top of the ribbon does not protrude above the surface of the base, nor shall it lie below the surface of the base by more than 3 mm.

**Location and Insertion**

2. The inducer ribbon shall be a minimum of 0.5 mm thick. When placed, it shall be within 5° of the vertical plane. Inducer ribbon which curls on placement and when cut in the base is found to be curved in transverse section by more than 3 mm from straight shall be rejected.

**Finish**

3. At transverse construction joints, the inducer ribbon shall be carried through the joint sufficiently to allow a connection by strong stapling, or other method approved by the Superintendent, to the inducer ribbon to be used on the other side of the joint. When a join is necessary in the inducer ribbon during paving, the inducer ribbon on the new spool shall be similarly joined to the tail of the inducer ribbon on the old spool.

**Join in Ribbon**

**(d) Treatment of Sawn Longitudinal Tied Joints Prior to Asphalt Overlay**

1. Where asphalt surfacing over sawn longitudinal tied joints is specified, the sealant shall be depressed to a depth below the concrete surface of not less than 10 mm and, following thorough cleaning, the joint shall be sealed flush with the concrete surface with a bituminous rubber compound, approved by the Superintendent, compatible with the narrow groove.

**Bituminous Rubber Compound**

**C248.45 LONGITUDINAL JOINT WITH KERB AND/OR GUTTER**

1. Where kerbs and/or gutters are to be constructed within the shoulder of a concrete base, they shall be formed directly onto the concrete subbase and they may be cast either integrally with the concrete base or separately.

**Form**

2. Where constructed separately, they shall be tied to the concrete base by deformed steel tie bars Grade 250R or 400Y 12 mm diameter 1000 mm long at 1 m centres.

**Tie Bars**

3. The longitudinal joint shall be constructed parallel to the control line (parallel to the centre line for ramps) and to the dimensions shown on the Drawings. The tie bars shall be inserted in accordance with the Drawings and Clause C248.18.

**Location**

4. The face of the longitudinal joint need not be scabbled and the joint need not be sealed.

**Face of Joint**

5. The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with Clause C248.44.

**Tolerances**

6. The construction of kerb and/or gutter shall be in accordance with the Specification for OPEN DRAINS INCLUDING KERB AND GUTTER regardless of method of construction except that the strength of the concrete used in the kerb and/or gutter shall be 32 MPa.

**Specification**



**C248.46 LONGITUDINAL ISOLATION JOINTS**

- |   |                           |
|---|---------------------------|
| 1. Longitudinal isolation joints shall be provided where shown on the Drawings and where directed by the Superintendent.  | <b>Location</b>           |
| 2. The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10 mm. The line of the joint shall not deviate from a 3 m straightedge by more than 10 mm.   | <b>Tolerances</b>         |
| 3. The joint filler shall comply with RTA Specification 3204 and joint sealant with the silicone sealant requirements of Clause C248.42. They shall be installed in accordance with the Drawings and in a manner conforming to the manufacturer's recommendations except that reference to backer rods shall not apply. | <b>Filler and Sealant</b> |

**SLAB ANCHORS****C248.47 GENERAL**

- |  |                         |
|--|-------------------------|
| 1. Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the Drawings.   | <b>Location</b>         |
| 2. Slab anchors shall extend over the full width of the base and the associated transverse expansion joint shall not be placed closer than 2.0 m to other transverse joints. Where necessary, the Superintendent shall authorise a change in the spacing of transverse contraction joints to ensure that this minimum clearance is obtained. | <b>Transverse Joint</b> |

**C248.48 EXCAVATION**

- |  |                                      |
|--|--------------------------------------|
| 1. Excavation of trenches for slab anchors shall be to the dimensions and details shown on the Drawings.   | <b>Dimensions</b>                    |
| 2. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompact, where required, to the degree of consolidation of the adjacent undisturbed material.   | <b>Trim and Consolidate</b>          |
| 3. The Contractor shall dispose of excavated material at locations approved by the Superintendent.   | <b>Spoil</b>                         |
| 4. Where a slab anchor is required at the junction of an existing flexible pavement, a straight sawcut to the full depth of the asphaltic concrete or bituminous seal shall be made in the flexible pavement along the joint line. Excavation of the trench shall then take place as described above without disturbance or damage to the existing flexible pavement. Any disturbance or damage to the flexible pavement shall be made good as directed by the Superintendent. | <b>Adjacent to Flexible Pavement</b> |
| 5. The cost of making good any disturbance or damage to the flexible pavement shall be borne by the Contractor.  | <b>Contractor's Cost</b>             |
| 6. A subsoil drain shall be provided at the bottom of the trench, in accordance with the Specification for SUBSOIL AND FOUNDATION DRAINS and details shown on the Drawings.  | <b>Sub-Soil Drains</b>               |

**C248.49 CONCRETE**

- |  |                                     |
|--|-------------------------------------|
| 1. Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand-placed base concrete.  | <b><i>Slab Anchors</i></b>          |
| 2. Slab anchors shall be poured separately from the base slabs to the dimensions and details shown on the Drawings up to the top surface of the subbase.   | <b><i>Detail</i></b>                |
| 3. A transverse isolation joint shall be provided on the downhill side of the slab anchor.   | <b><i>Isolation Joint</i></b>       |
| 4. Steel reinforcement in slab anchors shall be of the type and size shown on the Drawings and shall be supplied and fixed in accordance with Clauses C248.14 and C248.18 of the Specification.                  | <b><i>Steel Reinforcement</i></b>   |
| 5. Bridge approach slabs, if not in the bridge contract, shall be constructed at bridge abutments to the dimensions and details shown on the Drawings and in accordance with the requirements for base concrete. | <b><i>Bridge Approach Slabs</i></b> |

## REMOVAL AND REPLACEMENT OF BASE

**C248.50 GENERAL**

- |   |                                  |
|---|----------------------------------|
| 1. Where directed by the Superintendent, rejected base shall be removed and replaced in accordance with this Clause. Rejected base, which extends more than 25 m longitudinally, shall be replaced by mechanical means unless the slabs are odd-shaped or mismatched. Replacement shall be in full slab widths between longitudinal joints and/or external edges. | <b><i>Replacement Method</i></b> |
| 2. At least seven days before the commencement of base removal, the Contractor shall submit, for the approval of the Superintendent, details of the proposed methods of carrying out the work which shall be such as to prevent damage to the adjoining base and the underlying subbase.  | <b><i>Details</i></b>            |
| 3. The cost of all work and materials under this Clause shall be borne by the Contractor.   | <b><i>Contractor's Cost</i></b>  |

**C248.51 REMOVAL AND DISPOSAL OF BASE**

- |  |   |
|--|---|
| 1. At each end of the section of base to be removed, a transverse sawcut shall be made for the full depth of the base layer. Such transverse sawcuts shall be normal to the control line and not closer than 1.5 m to an existing contraction joint in the base. No oversawing into the adjoining base or underlying subbase shall be permitted. | <b><i>Transverse Sawcut</i></b>           |
| 2. Longitudinal sawcuts shall be made along existing longitudinal joints to define the edges of the base section to be removed. Such longitudinal sawcuts shall not extend more than 250 mm past the transverse sawcut at each end of the section to be removed and shall not extend into the underlying subbase.                                | <b><i>Longitudinal Sawcuts</i></b>        |
| 3. No oversawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base.   | <b><i>Oversawing</i></b>                  |
| 4. The Contractor shall dispose of the removed base slabs at locations of his choice acceptable to the Superintendent.   | <b><i>Disposal</i></b>                    |
| 5. Any slab, adjoining the removed slabs, damaged by the Contractor's operations shall also be removed and replaced in accordance with this Clause.  | <b><i>Contractor's Responsibility</i></b> |

### C248.52 REPLACEMENT OF BASE

1. Before construction of the replacement base, the subbase shall be prepared and debonded in accordance with the Specification for MASS CONCRETE SUBBASE.

***Subbase  
Preparation***

2. All work involved in the replacement of base shall comply with the Specification, including the following additional requirements:-

***Additional  
Requirements***

- (a) The joint faces on the adjoining slab at the transverse sawcuts shall be deeply scabbled below the top 25 mm which shall be left smooth. Tie bars shall be provided to form a transverse construction joint in accordance with Clause C248.41.
- (b) Transverse contraction joints shall be continuous across the full width of the base containing the replaced section. The length of the joint across the full width of the base shall be sealed with the same sealant as in adjacent work and in accordance with Clause C248.42.
- (c) The lower two-thirds of the depth of the longitudinal joint faces shall be deeply scabbled and any concrete considered to be unsound by the Superintendent shall be removed. A crack inducer ribbon shall be attached to the surface of any formed longitudinal joint in the replacement base and tie bars provided to form a longitudinal tied joint in accordance with Clause C248.44.
- (d) Tie bars placed into hardened concrete shall be set by the use of a hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar.
- (e) Neither traffic nor construction equipment other than that associated with testing, sawcutting, groove cleaning or joint sealing shall be allowed on the section of base containing the replacement base until the joints have been permanently sealed and at least ten days have elapsed since placing replacement base concrete or the concrete has reached a compressive strength of at least 20MPa.

## LIMITS AND TOLERANCES

### C248.53 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C248.7 below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Aggregates</b>		
	a. General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	C248.08a
	b. Fine Aggregate		
	(i) Grading	To be within the limits as per Table C248.2 and shall not deviate from Proposed Grading by more than amounts in Table C248.2	C248.08b
	(ii) Wet Strength	Not less than 80kN for any fraction and/or constituent	C248.08c
	(iii) 10% Fines Wet/Dry Variation	Not to exceed 35% for any fraction and/or constituent	C248.08c
	(iv) Soundness	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	C248.08c
	(v) Particle Shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	C248.08c
	(vi) Fractured Faces	At least 80% by mass of the particles shall have two or more fractured faces	C248.08c
2.	<b>Concrete Quality</b>		
	a. Cement Content	At least 270kg per yielded cubic metre of concrete	C248.09
	b. Flyash	Not greater than 50kg per yielded cubic metre of concrete	C248.09
	c. Compressive Strength	The minimum 28 day compressive strength shall be 32.0 Mpa	C248.10
	d. Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	C248.11

## CONCRETE BASE

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Item	Activity	Tolerances	Spec Clause
2.	<b>Concrete Quality</b> (Cont'd) d. Consistency	Nominated slump shall be neither less than 25mm nor more than 50mm for mechanically placed concrete. It shall be neither less than 70mm nor more than 90mm for hand placed concrete.	C248.12
	e. Air content	Shall not be less than 4% nor more than 7% when discharged from the transport vehicle ready for placement	C248.13
3.	<b>Concrete Mixing and Transport</b>	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non-agitating trucks.	C248.26
4.	<b>Concrete Placing</b>	Concrete shall not be placed when the air temperature in the shade is below 5°C or above 38°C. The temperature of the concrete shall be neither less than 10°C nor more than 32°C.	C248.29
		Where the value of Rate of Evaporation exceeds 0.50kg per square metre per hour, the Contractor shall cease work.	C248.30
5.	<b>Alignment and Surface</b> a. Horizontal Alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10mm.	C248.33a
	b. Surface Level	The level at any point on the top of the base shall not vary by more than +10mm or -0mm from that shown on the Drawings or as directed by the Superintendent. The top surface of the base shall not deviate from a 3m straightedge, laid in any direction, by more than 5mm.	C248.33b

Item	Activity	Tolerances	Spec Clause
6.	<b>Concrete Protection</b>		
	a. Temperature	The temperature of the concrete shall not be permitted to fall below 5°C during the first twenty-four hours after placing.	C248.36
7.	<b>Joints</b>		
	a. Transverse Construction	The line of the transverse construction joints shall not deviate from a 3m straightedge placed along the joint by more than 10mm.	C248.41
	b. Transverse Contraction	<p>(i) May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors.</p> <p>(ii) No edge shall deviate from a 3m straightedge by more than 10mm.</p> <p>(iii) The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300mm in any 1m length of joint on each edge.</p> <p>(iv) Temporary Sealing - the top of the sealant shall be neither higher than nor more than 10mm below the concrete surface.</p> <p>(v) Permanent Sealing The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.</p>	C248.42
	c. Transverse Isolation	The line of the transverse expansion joint shall not deviate from a 3m straight edge more than 10mm.	C248.43

Item	Activity	Tolerances	Spec Clause
7.	d. Longitudinal Tied Joints	<p>(i) All parts of any tie bar shall be within 50mm of its designed position.</p> <p>(ii) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10mm. The line shall also not deviate from a 3m straightedge by more than 10mm having made due allowance for any planned curvature.</p> <p>(iii) For Sawn-Induced joints, the maximum increase in length of the sealant after installation shall be 10% of the original length. The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.</p> <p>(iv) For Ribbon-Induced joints, the inducer ribbon shall be a minimum of 0.5mm thick and when placed it shall be within 5° of the vertical plane.</p>	C248.44
	e. Longitudinal Isolation Joints	The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10mm. The line of the joint shall not deviate from a 3m straightedge by more than 10mm.	C248.46
8.	<b>Slab Anchors</b>	Not placed closer than 2.0m to transverse joints (other than associated transverse expansion joints).	C248.47

**Table C248.7 - Summary of Limits and Tolerances**

## **SPECIAL REQUIREMENTS**

**C248.54    RESERVED**

**C248.55    RESERVED**

**C248.56    RESERVED**

**C248.57    RESERVED**

**C248.58    RESERVED**

**C248.59    RESERVED**



# DEVELOPMENT CONSTRUCTION

**C254**  
Revision 3

## **SEGMENTAL PAVING**



## SPECIFICATION C254 - SEGMENTAL PAVING

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## SEGMENTAL PAVING

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## SPECIFICATION C254 - SEGMENTAL PAVING

### GENERAL

#### C254.01 SCOPE

1. This Specification covers the construction of both clay masonry and concrete segmental paving for carparks, medians, traffic islands, driveways, footpaths and other pedestrian areas. However, where works to be carried out on council owned assets the prior approval of Council's Development Engineer is required.
2. The work to be executed under this Specification consists of the supply, placement and compaction of segmental paving units including the provision of sand bedding course and joint filling sand, over bound or unbound base and/or subbase layer/s.
3. This Specification should be read in conjunction with the appropriate Specifications for the construction of the base and subbase layers beneath the segmental paving, ie. FLEXIBLE PAVEMENTS, MASS CONCRETE SUBBASE.

#### C254.02 TERMINOLOGY

1. Concrete segmental paving units are units of not more than 0.09 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges.

**Size**

2. Concrete paving units are identified by shape as being one of the following types:

**Concrete  
Pavers**

##### Shape Type A

Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.

##### Shape Type B

Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces.

##### Shape Type C

Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

##### Shape Type X

Units which may or may not conform to the above definitions but which are designed to have specific characteristics to provide interlock.

3. Clay masonry pavers are manufactured from clay, shale or argillaceous materials which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.

**Clay Pavers**

## SEGMENTAL PAVING

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4. Clay pavers are classified as either Class 1, 2, 3 or 4 according to their intended application, with increasing performance requirements (and thickness) from Class 1 to Class 4. (See C254.04 1(d) Clay Brick & Paver Institute Specifications Paver Note 1 – Specifying and laying Clay Pavers.)

**Classification**

5. Laying patterns of paving units are identified as being either Herringbone, Basket-weave, or Stretcher as shown in Annexure C254-A. Each of these may be laid at either 90° or 45° to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in Annexure C254-A.

**Pattern**

### C254.03 CHOICE OF PAVER TYPE, SHAPE, CLASS AND LAYING PATTERN

1. The choice of concrete or clay segmental paving units, the paver dimensions, class, shape and laying pattern shall be as shown on the Drawings.

**Type**

2. If not otherwise specified, concrete paving units shall be Shape Type A concrete paving units, 80mm thick, and placed in herringbone laying pattern.

**Thickness**

3. If not otherwise specified, clay pavers shall be Class 4, (See C254.04 1(d) Clay Brick & Paver Institute Specifications Paver Note 1 – Specifying and laying Clay Pavers) minimum 65mm nominal thickness, and placed in a herringbone laying pattern.

### C254.04 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

#### (a) Council Specifications

- C213 - Earthworks
- C224 - Open Drains including Kerb and Gutter
- C241 - Stabilisation
- C242 - Flexible Pavements
- C247 - Mass Concrete Subbase
- C271 - Concrete Works

#### (b) Australian Standards

- AS 1141.11 - Method of sampling and testing aggregates - Particle size distribution by dry sieving.
- AS/NZS 4455 - Masonry Units and segmental pavers.

#### (c) Concrete Masonry Association of Australia Specifications

- MA20 - Specification for Concrete Segmental Paving Units.

#### (d) Clay Brick and Paver Institute Specifications

- Paver Note 1 - Specifying and Laying Clay Pavers

#### (e) RTA Specifications

- 3204 - Preformed Joint Fillers for Concrete Road Pavements and Structures

## MATERIALS

### C254.05 GENERAL

1. The Contractor shall submit details of all proposed segmental paving materials, including bedding sand and joint filling sand. These details shall be submitted to the Superintendent for approval supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this Specification.

**Details  
Required**

2. No material shall be delivered until the Superintendent has approved the sources of supply. Such approval shall not relieve the Contractor of any responsibility for supplying materials that comply with this Specification.

**Superinten-  
dent's  
Approval**

### C254.06 CONCRETE SEGMENTAL PAVING UNITS

1. Concrete segmental paving units shall comply with the requirements of MA20 - Specification for Concrete Segmental Paving Units.

**Specification**

2. Unless otherwise indicated, concrete paving units for all pavements shall be 80mm thick with a minimum 28 day characteristic compressive strength of 45MPa, as determined in accordance with MA20. The minimum 28 day characteristic compressive strength for footpaths, carparks, medians, traffic islands and other pedestrian areas shall be 45Mpa.

**Strength**

3. The abrasion resistance, tested in accordance with MA20 - Appendix D, shall conform to the recommended minimum abrasion indices contained in MA20.

**Abrasion  
Resistance**

### C254.07 CLAY SEGMENTAL PAVING UNITS

1. Clay segmental pavers shall comply with the requirements of Part 1 - Specifying Clay Pavers of Paver Note 1 - 'Specifying and Laying Clay Pavers' and with the requirements of AS 1225.

**Specification**

2. Clay pavers shall be classified as Class 1, 2, 3 or 4 in accordance with Paver Note 1 - Specifying and Laying Clay Pavers. Class 4 pavers shall be used.

**Class 4 pavers**

3. The abrasion resistance as determined by the SCC Abrasion Test (Paver Note1) shall conform to the recommended characteristic abrasion losses contained in Paver Note 1.

**Abrasion  
Resistance**

### C254.08 BEDDING SAND

1. The bedding sand shall be a well-graded sand, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75mm sieve. The bedding sand shall be from a single source or blended to achieve, when tested in accordance with AS 1141.11, the following grading:

**Grading**

<b><u>AS Sieve</u></b>	<b><u>% Passing</u></b>
9.52mm	100
4.75	95 - 100
2.36	80 - 100
1.18	50 - 85
600µm	25 - 60
300	10 - 30
150	5 - 15
75	0 - 10

## SEGMENTAL PAVING

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2. The sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration. **Protection**
3. The bedding sand shall be free of deleterious soluble salts or other contaminants which may cause, or contribute to, efflorescence. **Cleanliness**

### C254.09 JOINT FILLING SAND

1. The joint filling sand shall be well graded passing a 2.36mm sieve, and when tested in accordance with AS 1141.11, having the following grading: **Grading**

<u>AS Sieve</u>	<u>% Passing</u>
2.36mm	100
1.18	90 - 100
600µm	60 - 90
300	30 - 60
150	15 - 30
75	5 - 10

2. Joint filling sand shall have added at ratio 1:10 General Purpose Cement
3. The sand shall be free of deleterious soluble salts or other contaminants. **Cleanliness**
4. Sand used for bedding is not suitable for joint filling.
5. The sand shall be dry when spread. It shall be covered when stored on site to protect it from rain penetration. **Protection**

### C254.10 CONCRETE FOR EDGE RESTRAINTS

1. Concrete supplied and placed for the construction of edge strips shall comply with the Specification for MINOR CONCRETE WORKS. **Specification**
2. Unless otherwise indicated on the Drawings, or where the edge restraint is provided by kerb and/or gutter, the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 25Mpa. **Strength**

## CONSTRUCTION

### C254.11 SUBGRADE PREPARATION

1. The subgrade shall be formed to the required depth below finished surface level as shown on the Drawings in accordance with the Specification for EARTHWORKS. **Levels**
2. The finished subgrade foundation for the provision of subbase and/or base shall be subject to the approval of the Superintendent. **Superintendent's Approval**

### C254.12 SUBBASE

1. Where shown on the Drawings a subbase or working platform shall be constructed in accordance with the relevant Specification for STABILISATION, FLEXIBLE PAVEMENTS, or MASS CONCRETE SUBBASE. **Specifications**
2. The subbase shall be constructed to the specified thickness and depth below finished surface level and to the design grade and crossfalls of the finished surface. **Levels**
3. The finished subbase shall be subject to the approval of the Superintendent. **Superintendent's Approval**



**C254.13 BASE****COUNCIL OWNED ASSETS**

- |  |                                  |
|--|----------------------------------|
| 1. Mass concrete base shall be in accordance with plain concrete base C248 EXCEPT that there is no requirement for mass concrete subbase. The minimum thickness of mass concrete base is 100mm, or in accordance with Austroads Pavement Design for road Pavement. | <b>Thickness</b>                 |
| 2. The base course shall extend in width to at least the rear face of all new edge restraints.   | <b>Extent</b>                    |
| 3. The finished surface of the base shall drain freely without ponding.  | <b>Free Drainage</b>             |
| 4. The finished base shall be subject to the approval of the Superintendent.   | <b>Superintendent's Approval</b> |

**C254.14 EDGE RESTRAINTS**

- |   |                     |
|---|---------------------|
| 1. Edge restraints in the form of Kerb and/or Gutter, concrete or paver/brick soldier course shall be constructed along the perimeter of all segmental paving as shown on the Drawings. Concrete Kerb and/or Gutter and paver soldier course shall be constructed in accordance with the Specifications for OPEN DRAINS INCLUDING KERB AND GUTTER and MINOR CONCRETE WORKS. | <b>Requirements</b> |
| 2. Faces of edge restraints abutting paving units shall be vertical.  |                     |
| 3. Edge restraints shall be supported on compacted base and/or subbase of the thickness as shown on the Drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints shall be minimum 100mm adjacent to all pavements.   | <b>Support</b>      |
| 4. Unless otherwise shown on the Drawings, contraction joints, 20mm depth shall be formed every 5m of edge restraint length.  | <b>Joints</b>       |
| 5. After the concrete has hardened and not earlier than three days after placing, unless otherwise directed by the Superintendent the spaces at the back of the edge restraint shall be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding of design levels.   | <b>Back Filling</b> |

**C254.15 SAND BEDDING COURSE**

- |  |                         |
|--|-------------------------|
| 1. The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 20-25mm layer following final compaction of the segmental paving. However, when the concrete base is used the nominal thickness may be reduced to a minimum 10mm. | <b>Allowance Levels</b> |
| 2. Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and rescreeded before laying paving units.   | <b>Depressions</b>      |
| 3. For the manual placing of paving units, the bedding sand shall be maintained at a uniform loose density. For mechanised laying, the bedding sand shall be uniformly and firmly, but not fully, compacted.   | <b>Compaction</b>       |
| 4. Screeded sand left overnight and subjected to rain shall be checked for level and rescreeded where necessary before paving units are placed. The sand shall not be screeded more than two metres in advance of the laying face at the completion of work on any day.  | <b>Screeding</b>        |

**C254.16 LAYING PAVING UNITS**

- |   |                                    |
|---|------------------------------------|
| 1. Paving units shall be uniformly placed on the screeded sand bedding to the nominated laying pattern. Paving units shall be placed so that they are not in direct contact with each other and shall have uniform 3mm nominal joint widths.  | <b><i>Joints</i></b>               |
| 2. The first row shall be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of paving units in the completed pavement.  | <b><i>Sequence</i></b>             |
| 3. In each row, full units shall be laid first. Edge or closer units shall be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Where possible the paving pattern shall be designed and laid to reduce the use of cut pieces which are smaller in size than one half of the full block. | <b><i>Odd Shapes</i></b>           |
| 4. Manholes, drainage gullies and other penetrations through the pavement shall be finished against the paving and cut to fit the laying pattern.   | <b><i>Penetrations</i></b>         |
| 5. Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, the pavers may continue to be laid in the pattern used. The joint shall consist of 10mm thick preformed joint filler in accordance with RTA Specification 3204.  | <b><i>Formed Joints</i></b>        |
| 6. Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic shall be allowed on the pavement prior to compaction and provision of joint filling sand.   | <b><i>Construction Traffic</i></b> |
| 7. On completion of subsequent bedding compaction and joint filling operations, no more than 10 per cent of joints along any 10 metre line along a major axis of the laying pattern shall have widths outside the range 2-4mm.  | <b><i>Tolerance</i></b>            |

**C254.17 BEDDING COMPACTION**

- |   |                                      |
|---|--------------------------------------|
| 1. After laying the paving units the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.   | <b><i>Compaction</i></b>             |
| 2. Any units which are structurally damaged during bedding compaction shall be removed and replaced. The pavement shall then be recompacted for at least one metre surrounding each replacement unit.   | <b><i>Damage</i></b>                 |
| 3. The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.  | <b><i>Progressive Compaction</i></b> |
| 4. The finished surface level shall not vary from the design level at any point laid in any direction, by more than 6mm for all areas. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes by more than 6mm. At any location water shall not pond. | <b><i>Finished Levels</i></b>        |
| 5. The channels formed between abutting chamfered units shall finish with their inverts not less than 5mm nor more than 10mm above adjacent drainage inlets.  | <b><i>Drainage Inlets</i></b>        |
| 6. All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.  | <b><i>Joint Filling</i></b>          |

**C254.18 FILLING JOINTS**

- |  |                  |
|--|------------------|
| 1. As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, joint filling sand for joint filling shall be spread over the pavement and the joints filled by brooming. | <b>Timing</b>    |
| 2. To ensure complete filling of the joints, both the joint filling sand and paving units shall be as dry as practicable when sand is spread and broomed into the joints.  | <b>Condition</b> |
| 3. The pavement shall then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.        | <b>Process</b>   |

**C254.19 PROTECTION OF WORK**

- |  |                       |
|--|-----------------------|
| 1. Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until bedding compaction and joint filling operations have been completed. | <b>Restricted Use</b> |
|--|-----------------------|

**C254.20 OPENING TO TRAFFIC**

- |  |                    |
|--|--------------------|
| 1. As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area (no tracking) of pavement to assist in the development of 'lock-up'. Care should be taken to avoid repetition tracking over the same area to avoid rutting. | <b>No Tracking</b> |
| 2. Excess joint filling sand shall be removed prior to opening to traffic.   | <b>Excess Sand</b> |
| 3. The pavement shall then be inspected by the Contractor at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.   | <b>Inspections</b> |

## LIMITS AND TOLERANCES

## C254.21 SUMMARY OF LIMITS AND TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	<b>Base</b>		
	(a) Surface Level	Finished level of base for pavements to be within +10mm or -0mm of design levels.	C254.13
		The top surface of the base for all segmental paving shall not deviate from a 3m straight edge, laid in any direction, by more than 10mm.	C254.13
2.	<b>Laying Paving Units</b>		
	(a) Joint widths	No more than 10% of joints along any 10 metre line of joints along a major axis of the laying pattern shall have widths outside the range 2 -4mm.	C254.16
3.	<b>Completed Segmental Paving</b>		
	(a) Surface level	Finished surface level of pavers shall not vary from design levels by more than $\pm 6$ mm.	C254.17
		Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 6mm.	C254.17
	(b) Level adjacent to drainage inlets	Invert level of channels between abutting chamfered units shall be not less than 5mm and not more than 10mm above the level of adjacent drainage inlets.	C254.17

Table C254.1 - Summary of Limits and Tolerances

**SPECIAL REQUIREMENTS**

**C254.22    RESERVED**

**C254.23    RESERVED**

**C254.24    RESERVED**

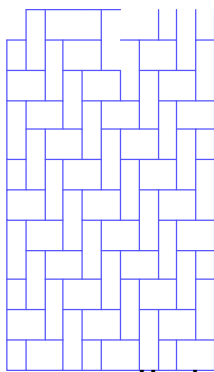
**C254.25    RESERVED**

**C254.26    RESERVED**

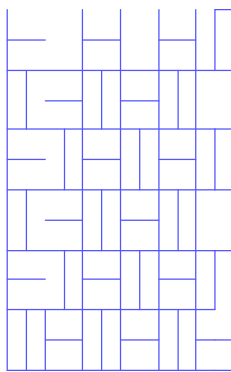
**C254.27    WITHDRAWN**

**ANNEXURE C254-A**

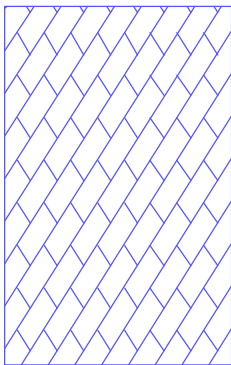
**LAYING PATTERNS**



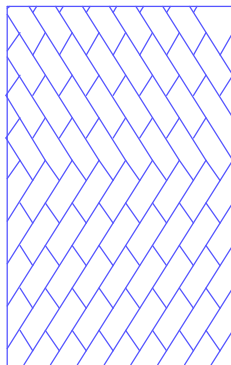
**Herringbone**



**Basketweave**



**Stretcher**



**Zig Zag Running Bond**

DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C255

Revision 3

**BITUMINOUS  
MICROSURFACING**





## SPECIFICATION C255: BITUMINOUS MICROSURFACING

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## **BITUMINOUS MICROSURFACING**

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## SPECIFICATION C255 : BITUMINOUS MICROSURFACING

### GENERAL

#### C255.01 SCOPE

1. The work to be executed under this Specification consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carpark, cycleways and footpaths.

2. Bituminous microsurfacing shall consist of a mixture of emulsified polymer modified bitumen binder, mineral aggregate, mineral filler, additives and water proportioned and mixed to form a slurry which is placed and spread evenly on the road surface. It shall be capable of being spread in variably thick layers for surface correction and for wearing surface applications.

***Bituminous  
Slurry***

3. The size, nominal thickness, and extent of bituminous microsurfacing shall be as shown on the Drawings or as directed by the Superintendent.

***Size and Extent***

4. For all new works on road and carpark pavements, this Specification should be read in conjunction with the Specification for SPRAYED BITUMINOUS SURFACING. For new works on road and carpark pavements, bituminous microsurfacing shall be preceded by the application of a sprayed bituminous seal a minimum of two weeks prior to the application of the bituminous microsurfacing wearing course.

***Preceded by  
Sprayed  
Bituminous  
Seal***

#### C255.02 TERMINOLOGY

1. Bituminous microsurfacing is a slurry seal incorporating the use of polymer and/or other additives to the bituminous binder.

***Polymer  
Modified  
Binder***

2. Bituminous microsurfacing is also commonly known under various proprietary names such as 'cold overlay', 'microsealing', 'paveseal', 'microasphalt', etc.

***Proprietary  
Names***

3. The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this Specification, the size shall be either Size 5 or Size 7.

***Size***

#### C255.03 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

##### (a) Council Specification

C244 - Sprayed Bituminous Surfacing

##### (b) Australian Standards

AS 1141.11	-	Methods of sampling and testing aggregates - Particle size distribution by dry sieving
AS 1141.12	-	Methods of sampling and testing aggregates - Material finer than 75 µm in aggregates (by washing)
AS 1141.22	-	Methods of sampling and testing aggregates - Wet/dry strength variation
AS 1141.23	-	Methods of sampling and testing aggregates - Los Angeles value
AS 1141.25.1	-	Methods of sampling and testing aggregates - Degradation factor - source rock

## BITUMINOUS MICROSURFACING

- AS 1141.42 - Methods of sampling and testing aggregates - Pendulum friction test.
- AS 1160 - Bituminous emulsions for the construction and maintenance of pavements
- AS 1289.3.7.1 - Soil classification tests - Determination of the sand equivalent of a soil using a power-operated shaker
- AS 2008 - Residual bitumen for pavements
- AS 2357 - Mineral fillers for asphalt
- AS/NZS 2891.3.1 - Methods of sampling and testing asphalt - Bitumen content and aggregate grading - Reflux method.

### (c) International Slurry Surfacing Association

- ISSA TB 100 - Test method for wet track abrasion of slurry surfaces
- ISSA TB 114 - Wet stripping test for cured slurry seal mix
- ISSA TB 139 - Test method to classify emulsified asphalt/aggregate mixture systems by modified cohesion tester measurement of set and cure characteristics
- ISSA TB 144 - Test method for classification of aggregate filler-bitumen compatibility by Schulze-Breuer and ruck procedure

## MATERIALS

### C255.04 BINDER

1. The binder supplied and used in the works shall be an emulsified polymer modified bitumen, formulated to meet the performance requirements of the mix specified in Clauses C255.10 and C255.18.

**Polymer  
Modified  
Bitumen  
Emulsion**

2. Prior to emulsification, incorporation of polymer and/or additives, the bitumen shall comply with AS 2008.

**Specification**

3. The Contractor shall provide the Superintendent with sufficient information to verify that the binder supplied is the same as that nominated in the mix design.

**Verification**

### C255.05 MINERAL AGGREGATES

1. Mineral aggregates shall consist of crushed rock or crushed gravel, or a mixture of crushed rock or crushed gravel and natural sand. It shall consist of clean, hard, angular, durable particles, and free from clay, dirt, organic material or other deleterious matter.

**Quality**

2. The aggregate from each source shall comply with the requirements given in Table C255.1.

**Aggregate  
Properties**

Property	Test Method	Requirement
Degradation Factor	AS 1141.25	50 minimum
Los Angeles Value	AS 1141.23	30 maximum
Aggregate Wet Strength	AS 1141.22	150 kN minimum
Wet/Dry Strength Variation	AS 1141.22	30% maximum
Polished Aggregate Friction Value	AS 1141.42	45 minimum
Sand Equivalent	AS 1289.3.7.1	60 minimum

**Table 255.1 - Aggregate Properties**

3. When tested in accordance with AS 1141.11 and AS 1141.12, the aggregate (including mineral filler) shall conform with the grading limits given in Table C255.2.

**Grading Limits**

Sieve Size	Percent Passing by Mass	
	Size 5	Size 7
13.2 mm	100	100
9.50 mm	100	100
6.70 mm	100	85-100
4.75 mm	90-100	70-90
2.36 mm	50-70	45-70
1.18 mm	30-50	28-50
600 µm	20-35	19-34
300 µm	12-25	12-25
150 µm	7-18	7-18
75 µm	4-10	5-15

**Table C255.2 - Grading Limits for Combined Aggregate/Filler**

4. The Contractor shall nominate the source/s of aggregates to the Superintendent, and shall submit NATA certified test reports on the quality and grading of the combined aggregate proposed to be used.

**NATA  
Certification**

5. The Contractor shall submit test results to the Superintendent for each lot/stockpile of aggregate a minimum of seven days prior to incorporation in the works.

**7 Days**

#### **C255.06 MINERAL FILLER**

1. Mineral filler shall consist of hydrated lime, flyash, portland cement, or other material approved by the Superintendent.

**Type**

2. The mineral filler shall be dry, free from lumps and any deleterious material, with a minimum of 85 per cent passing a 75 µm sieve. In all other respects, the mineral filler shall comply with the requirements of AS 2357.

**Quality**

3. The quantity of filler added to the bituminous slurry during placement shall not vary by more than 1 per cent from the filler content nominated in the mix design.

**Proportion**

#### **C255.07 WATER**

1. Water added to the bituminous slurry shall comply with N H & MRC Guidelines and shall be compatible with the component materials.

**Potable**

#### **C255.08 ADDITIVES**

1. Details of the type, source and nominal proportions of additives shall be submitted to the Superintendent with the mix design.

**Type and  
Proportion**

#### **C255.09 SAMPLING AND TESTING OF MATERIALS**

1. Sampling and testing of materials shall be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods.

**Contractor's  
Responsibility**

2. All costs associated with sampling and testing of materials shall be borne by the Contractor.

**Contractor's  
Costs**

## MIX DESIGN

### C255.10 MIX PROPERTIES

1. The nominated mix design shall satisfy the properties given in Table C255.3.

**Mix Properties**

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 1 hour 6 day	540 g/m <sup>2</sup> maximum 800 g/m <sup>2</sup> maximum
Traffic Time	ISSA TB 139 30 minutes 60 minutes	12 kg.cm minimum 20 kg.cm minimum
Adhesion	ISSA TB 114 or ISSA TB 144	≥ 90% or 11 grade points minimum (AAA, BAA)

**Table C255.3 - Mix Properties**

### C255.11 NOMINATED MIX

1. At least seven days before commencing bituminous microsurfacing work, the Contractor shall submit to the Superintendent for approval, details of the nominated bituminous microsurfacing mix design for the work including the target application rate (m<sup>3</sup> of mix/m<sup>2</sup> of road surface) and the corresponding nominal layer thickness, together with NATA certification and test results demonstrating that the nominated mix and its constituents meet the requirements of the Specification.

**Submit for Approval**

2. The details of the nominated mix design shall include the following:

**Mix Design Details**

- (a) Bitumen emulsion content of the mix, and the residual binder content of the emulsion;
- (b) Target combined aggregate/filler grading;
- (c) Proportions of constituent materials used; and
- (d) Type and sources of aggregates, filler and binder.

### C255.12 APPROVED MIX

1. When a nominated mix has been approved by the Superintendent, it shall be known as the 'approved mix'. Work shall not commence until a bituminous microsurfacing mix has been approved.

**Approved Mix**

2. The combined aggregate/filler grading and the binder content of the approved mix will be termed the 'approved grading' and the 'approved binder content' respectively.

**Grading and Binder Content**

## PRODUCTION AND PAVING

### C255.13 REQUIREMENTS OF PRODUCTION MIX

1. Bituminous microsurfacing produced in the paving unit at the site shall be known as the 'production mix'. **Production Mix**
2. The production mix shall comply with the requirements given in Table C255.4. **Permitted Variation**

Production Mix Properties	Maximum Permitted Variations from Approved Mix (by mass)	
	Size 5	Size 7
Grading*		
Passing 9.50mm AS sieve and larger	Nil	Nil
Passing 6.70mm	± 6%	± 7%
Passing 4.75mm	± 5%	± 6%
Passing 2.36mm and 1.18mm	± 4%	± 5%
Passing 0.600mm	± 3%	± 4%
Passing 0.300mm	± 2%	± 3%
Passing 0.150mm	± 1.5%	± 2%
Passing 0.075mm	± 1.5%	± 1.5%
Residual Binder Content	- 0.5% + 1.0%	- 0.5% + 1.0%
* Notwithstanding, these allowable variations shall not fall outside the limits for design of nominated mix as given in Table C255.2.		

**Table C255.4 - Maximum Permitted Variations from Approved Mix**

### C255.14 PAVING UNIT CALIBRATION

1. The paving unit to be used shall be calibrated for the component materials of the approved mix prior to the commencement of paving. Previous calibration documentation covering the same materials and approved mix shall be acceptable provided that calibration has been carried out within the previous twelve months. **Calibration**
2. The documentation shall include an individual calibration for each component material at various settings which can be related to the paving unit's metering devices. **Documentation**
3. No paving unit shall be allowed on the work until the calibration has been completed and approved by the Superintendent. **Approval by Superintendent**

### C255.15 PREPARATION OF PAVEMENT

1. The existing surface shall be clean and free from any loose stones, dirt, dust and foreign matter. The surface shall be swept beyond the edge of the area to be surfaced by at least 300mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent. **Clean Pavement**

## **BITUMINOUS MICROSURFACING**

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2. Minor surface defects existing in the primerseal or seal shall be repaired to the satisfaction of the Superintendent prior to the spreading of bituminous slurry. **Minor Repairs**

3. The Contractor shall take all necessary precautions to prevent the bituminous slurry or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks or other road fixtures. After the bituminous slurry has been spread the Contractor shall clean off any such material and leave such gratings, manholes and other road fixtures, in a clean and satisfactory condition. **Protection of Services**

### **C255.16 WEATHER LIMITATIONS**

1. Bituminous microsurfacing shall not commence if either the pavement or air temperature is below 10°C and falling. **Temperature**

2. Spreading shall not proceed during rain or when rain appears imminent. **Rain**

### **C255.17 SPREADING**

1. The surface may be pre-dampened if necessary by fogging ahead of the spreader box. Water used for pre-wetting the surface shall be applied so that the entire surface is damp with no apparent flowing water ahead of the spreader box. The application rate of the fog spray shall be adjusted to suit temperature, surface texture, humidity and dryness of the surface being covered. **Water Fog Spray**

2. Bituminous microsurfacing shall be mixed and applied using a purpose built paver. The slurry mix shall be of the desired consistency when deposited in the spreader box, and nothing more shall be added other than minor amounts of water for the purpose of overcoming temporary build-up of slurry in the corners of the spreader box. **Paving Unit**

3. The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture shall be conveyed into the moving spreader box at a sufficient rate to always maintain an ample supply across the full width of the strike-off blade. **Mixing Time and Rate**

4. The strike-off blade shall be adjusted to provide an application rate which will completely fill the surface voids and provide the nominal application rate of bituminous microsurfacing as scheduled. **Application Rate**

5. After the bituminous slurry has been spread, the Contractor shall ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, manhole covers, etc are uncovered and left in a clean and satisfactory condition. **Clean Services**

6. After the emulsion has broken and the mix is sufficiently stable, and if instructed by the Superintendent, rolling shall be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface. **Rolling**

7. Bituminous microsurfacing shall be capable of carrying slow moving traffic (<40km/h) within one hour of application without undue permanent damage occurring, such as rutting or ravelling. When the time before the slurry is capable of carrying traffic exceeds one hour, work shall cease if so directed by the Superintendent. **Traffic**

### **C255.18 SURFACE TEXTURE**

1. The resulting surface after spreading shall be uniform in appearance, and free of areas exhibiting segregation or excessive or insufficient binder. **Uniform Texture**

2. The surface texture shall be demonstrated on a short test run for approval by the Superintendent. If the surface texture is acceptable to the Superintendent, then all subsequent work shall be finished to an equivalent surface texture. **Test Run**



3. Where an increased surface friction is required, a fabric skirt may be trailed behind the spreader box. **Surface Friction**

### C255.19 JOINTS

1. Longitudinal joints in the wearing course shall be straight and placed at either the edge or the centre of a traffic lane. If necessary, the edges and joints shall be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material. **Uniform Joints**

### C255.20 SAMPLING AND TESTING OF PRODUCTION MIX

#### (a) Lot Definition

1. Compliance sampling and testing of bituminous microsurfacing shall be undertaken on a lot by lot basis. For this purpose, a lot shall be 50m<sup>3</sup> or one day's production (whichever is the lesser). **Lots**

#### (b) Responsibility of Sampling

1. The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose. **Contractor's Responsibility**
2. The costs associated with taking samples of production mix shall be borne by the Contractor. **Contractor's Cost**

#### (c) Frequency of Sampling

1. For the testing of production mix, two 1.5kg representative samples of bituminous slurry shall be taken from each lot at random intervals. The samples shall be taken from the discharge for the paving unit and the sample containers immediately sealed. **Mix Samples**
2. For the testing of the binder, two 2L samples of bitumen emulsion shall be taken from each bulk delivery in accordance with AS 1160. **Bitumen Emulsion**

#### (d) Testing

1. The samples of bituminous slurry shall be treated and tested at a NATA registered laboratory to confirm compliance with Table C255.4. Prior to testing for Residual Binder Content and Aggregate Gradation, as determined by AS 2891.3.1, the samples shall be dried to constant weight in an oven at 60°C for a minimum of 15 hours. **Mix Tests**
2. Each delivery of emulsion shall be tested for residual binder content or accompanied by a certification of specification compliance traceable to the relevant batch at the suppliers storage tank. If testing is required, then one sample of bituminous emulsion shall be tested for Residue from Evaporation in accordance with AS 1160 Appendix D, and the second sample retained as a referee sample. **Emulsion Tests**

### C255.21 SHAPE AND LEVELS

1. The finished surface level shall not vary from the design level at any point by more than ± 10mm. Additionally immediately adjacent to any kerb and/or gutter the finished surface level shall not be below nor more than 5mm above the level of the lip of the adjacent gutter. **Level Tolerances**
2. Notwithstanding the above, the deviation from a 3m long straight edge placed anywhere on the top of the finished surface shall not exceed 5mm and notwithstanding this requirement, the surface shall not pond water. **3m Straight Edge**

### C255.22 NONCONFORMANCE OF MATERIALS AND FINISHED SURFACING

1. If any materials supplied fail to conform to the requirements in this Specification or if any section of bituminous microsurfacing fails to conform to the requirements of this Specification - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures shall constitute a 'Nonconformance' under the Contract. Such nonconforming sections of bituminous microsurfacing work shall be either replaced or corrected.

***Non-  
conformance  
Conditions***

2. The cost of rectifying nonconformances, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, shall be borne by the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this Specification.

***Contractor's  
Cost***

## LIMITS AND TOLERANCES

### C255.23 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C255.5 below.

Item	Activity	Tolerances	Spec Clause
1.	Mineral Aggregate	As per Table C255.1	C255.05
2.	Combined Aggregate/filler	As per Table C255.2	C255.05
3.	Mineral Filler	> 85% passing a 75µm Sieve	C255.06
4.	Mix Properties		
	a) Design properties	As per Table C255.3	C255.10
	b) Permitted variations	As per Table C255.4	C255.13
5.	Surface Preparation	Sweeping shall extend at least 300mm beyond edge of area to be surfaced	C255.15
6.	Weather Limitations	Microsurfacing shall not commence if both air and surface temperature is below 10°C and falling.	C255.16
7.	Shape and Levels		
	a) Finished Levels	Shall not vary at any point by more than $\pm 10$ mm from design levels. Immediately adjacent to kerb and/or gutters, levels shall not be less than the kerb level nor more than 5mm from design level	C255.21
	b) Finished Shape	Deviation from the bottom of a 3m straight edge shall not vary by more than 5mm	C255.21

**Table C255.5 - Summary of Limits and Tolerances**

**SPECIAL REQUIREMENTS**

**C255.24    RESERVED**

**C255.25    RESERVED**

**C255.26    RESERVED**

**C255.27    RESERVED**

**C255.28    RESERVED**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C261

Revision 3

## **PAVEMENT MARKINGS**



## SPECIFICATION C261 - PAVEMENT MARKINGS

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**PAVEMENT MARKINGS**

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## SPECIFICATION C261 : PAVEMENT MARKINGS

### GENERAL

#### C261.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply and application of pavement marking paint, thermoplastic pavement marking material, pavement marking tape and raised pavement markers as shown on the Drawings and in accordance with this Specification.

#### C261.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated..

**Documents  
Standards Test  
Methods**

**(a) Council Specifications**

C201 - Control of Traffic

**(b) Australian Standards**

- AS 1742.2 - Traffic control devices for general use.
- AS 1906.3 - Raised pavement markers (retroreflective and non-retroreflective).
- AS 2009 - Glass beads for road-marking materials.
- AS 4049.1 - Solvent-borne paint - For use with drop-on beads.
- AS 4049.2 - Road Marking materials - Thermoplastic road marking materials.
- AS/NZS 4049.3 Road Marking materials - Waterborne paint - For use with drop-on beads.

#### C261.03 TYPE OF MARKINGS

1. Details of the various types of pavement markings are in accordance with the requirements of AS 1742.2 (specifically refer to Section 4 – Pavement Markings & Devices).

**Standard**

#### C261.04 TYPES OF MATERIALS TO BE APPLIED

1. The materials shall be applied as follows:

**Locations for  
Use**

- (a) Pavement Marking Paint  
Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified.
- (b) Thermoplastic Pavement Marking Material  
Permanent markings where explicitly indicated on the Drawings.
- (c) Pavement Marking Tape  
Temporary markings on final wearing surfaces.
- (d) Reflective Glass Beads  
To be applied to all painted and thermoplastic markings.
- (e) Raised Pavement Markers  
To be installed as permanent and temporary markings as shown on the Drawings.

#### C261.05 MATERIAL QUALITY

1. The Contractor shall submit to the Superintendent NATA Registered Laboratory Test Reports, at least seven days before work is scheduled to commence, on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use.

**Contractor's  
Responsibility**

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## PAVEMENT MARKINGS

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2. Only materials conforming to the requirements of the referenced Specifications/Standards shall be used.

**Quality  
Requirements**

### **C261.06 SETTING OUT**

1. The Contractor shall set out the work to ensure that all markings are placed in accordance with the Drawings.
2. The locations of pavement markings shall not vary by more than 20mm from the locations shown on the Drawings.

**Contractor's  
Responsibility**

**Tolerance**

### **C261.07 SURFACE PREPARATION**

1. Pavement markings shall only be applied to clean dry surfaces. The Contractor shall clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement.
2. Pavement marking shall not be carried out during wet weather or, if in the opinion of the Superintendent, rain is likely to fall during the process.
3. Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled.

**Clean Dry  
Surface**

**Wet Weather**

**Scabbling**

### **C261.08 PROVISION FOR TRAFFIC AND PROTECTION OF WORK**

1. The Contractor shall provide for traffic, in accordance with the Specification for CONTROL OF TRAFFIC, while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage.

**Contractor's  
Responsibility**

### **C261.09 MAINTENANCE OF PAVEMENT MARKINGS**

1. The Contractor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement marking during the contract period and the contract defects liability period.

**Responsibility  
in Contract  
Period**

## **PAVEMENT MARKING PAINT**

### **C261.10 MATERIALS**

1. Paint shall comply with the requirements of AS 4049.1 or AS/NZS 4049.3 as directed by the Superintendent. In this Specification, the term 'paint' shall mean 'pavement marking paint'.
2. Glass beads shall comply with the requirements of AS 2009 for drop-on beads..
3. Reflective Glass Beads - To be applied to all painted and thermoplastic markings

**Paint Quality**

**Glass Beads  
Quality`**

### **C261.11 MIXING OF PAINT**

1. All paint shall be thoroughly mixed in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product.

**Uniform  
Product**

### **C261.12 APPLICATION OF PAINT AND BEADS**

1. All longitudinal lines shall be sprayed by an approved self propelled machine. The two sets of lines forming a 1-way or 2-way barrier line shall be sprayed concurrently.
2. Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.
3. The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.35 mm nor more than 0.40 mm.

**Longitudinal  
Lines**

**Hand Spraying**

**Paint  
Thickness**

4. Glass beads shall be pressure applied to the surface of all longitudinal lines at a net application rate of 0.30 kilograms per square metre immediately after application of the paint. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

**Beads for  
Longitudinal  
Lines**

5. Glass beads shall be applied to all other paint markings at a net application rate of 0.30 kilograms per square metre immediately after application of the paint by a method approved by the Superintendent.

**Beads for other  
Markings**

6. Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement.

**Pavement  
Marking Finish**

7. The lengths of longitudinal lines shall not vary by more than 200mm from the lengths shown on the Drawings. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown on the Drawings.

**Longitudinal  
Line  
Tolerances**

8. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown on the Drawings.

**Transverse  
Line Tolerance**

9. The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 10mm from the dimensions shown on the Drawings. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

**Arrows,  
Chevrons  
Tolerance**

### **C261.13 FIELD TESTING**

1. The thickness of the wet film applied to the road pavement shall be checked by the method described in Annexure C261A.

**Paint  
Application**

2. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure C261B.

**Beads  
Application**

Road Speed km/h	Line Widths			
	75mm	100mm	125mm	150mm
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

**Table 261.1 - Volume of glass beads (ml) required in 10 seconds of operation.**

**NOTE:**

1. Tolerance of +10% shall be permissible when measuring the above volume.
2. When 2 or more glass bead dispensers are used, each dispenser shall be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53 grams per millilitre.

## **THERMOPLASTIC PAVEMENT MARKING MATERIAL**

### **C261.14 MATERIALS**

1. Thermoplastic pavement marking material shall comply with the requirements of AS 4049.2.

**Thermoplastic  
Quality**

2. In this Specification, the term 'thermoplastic material' shall mean 'thermoplastic pavement marking material'.

**Definition**

3. Glass beads shall be incorporated in thermoplastic material, in the proportion of 10 per cent of the total mass, as part of the aggregate constituent and shall comply with the requirements of AS 2009, Intermix type.

**Glass Bead  
Proportion**

4. Glass beads for surface application shall comply with the requirements of AS 2009, Drop-on beads..

**Glass Bead  
Quality**

5. Tack coat material shall be to the manufacturer's specification as approved by the Superintendent.

**Tack Coat**

6. Thermoplastic Pavement Marking Material - Permanent markings where explicitly

indicated on the Drawings.

**C261.15 PREPARATION OF THERMOPLASTIC MATERIAL ON SITE**

1. Immediately before application, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than six hours for hydrocarbon resins and four hours for wood and gum resins.

***Heating***

**C261.16 APPLICATION OF THERMOPLASTIC MATERIAL AND BEADS**

1. Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the Superintendent and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material.

***Tack Coat Requirement***

2. All longitudinal lines shall be sprayed by a self propelled machine approved by the Superintendent. The 2 sets of lines forming a one-way or two-way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 1.0 mm with a tolerance of plus or minus 0.2 mm.

***Longitudinal Lines***

3. Glass beads shall be pressure applied to the surface of all longitudinal lines at a net application rate of 0.30 kilograms per square metre immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

***Beads for Longitudinal Lines***

4. All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, approved by the Superintendent, and templates to control the pattern.

***Screed***

5. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 4.5 mm, plus or minus 1.5 mm. The surface finish shall be smooth.

***Tolerance***

6. Glass beads shall be applied to screeded markings at a net application rate of 0.30 kg's per sq.m immediately after application of the thermoplastic material by a method approved by the Superintendent.

***Beads for Other Markings***

7. Pavement marking shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement.

***Pavement Marking Finish***

8. The lengths of longitudinal lines shall not vary by more than 200mm from the lengths shown on the Drawings. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown on the Drawings.

***Tolerance***

9. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown on the Drawings.

***Tolerance***

10. The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 10mm from the dimensions shown on the Drawings. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

***Tolerance***

**C261.17 FIELD TESTING**

1. The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate.

***Thickness of Thermoplastic Material***

2. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure C261B.

***Glass Beads Application Rate***

## PAVEMENT MARKING TAPE

### C261.18 MATERIALS

1. Pavement marking tape shall be a strippable type of tape, such as 'Staymark - Detour Grade', or equivalent tape approved by the Superintendent.
2. Pavement Marking Tape - Temporary markings on final wearing surfaces.

**Brands**

### C261.19 APPLICATION OF PAVEMENT MARKING TAPE

1. The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations.

**Manufacturer's Recommendation**

### C261.20 REMOVAL OF PAVEMENT MARKING TAPE

1. When directed by the Superintendent, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations.

**Manufacturer's Recommendation**

## RAISED PAVEMENT MARKERS

### C261.21 MATERIALS

1. Raised pavement markers, both reflective and non-reflective, shall comply with AS1906.3 and shall have the dimensions shown on the Drawings.
2. The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be an epoxy resin of appropriate pot life or an equivalent product approved by the Superintendent.
3. Raised Pavement Markers - To be installed as permanent and temporary markings as shown on the Drawings.

**Standard**

**Epoxy Resin**

### C261.22 INSTALLATION OF RAISED PAVEMENT MARKERS

1. Raised pavement markers shall be fixed to the wearing surface of the pavement using an epoxy resin type adhesive. The epoxy resin adhesive shall be freshly and thoroughly mixed, shall not have exceeded its working time and shall be used in accordance with the manufacturer's recommendations.
2. The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set.
3. On rough surfaces, such as newly laid coarse sprayed bituminous seals, and where directed by the Superintendent, an initial pad of adhesive of diameter 10 mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level. The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the underside of the raised pavement marker, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface within the time specified by the adhesive manufacturer to ensure good adhesion.

**Adhesive Quality**

**Method**

**Rough Surfaces**

## REMOVAL OF PAVEMENT MARKINGS

### C261.23 GENERAL

1. The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements to leave a clean, undamaged pavement with a surface texture and colour comparable to the adjacent pavement surface.
2. The method of removal shall be approved by the Superintendent before commencement of the work.

**Undamaged Pavement**

**Removal Method**

## LIMITS AND TOLERANCES

## C261.24 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses of this Specification are as follows:

Item	Activity	Tolerances	Clause
1.	<b>Location of Markings</b>	± 20mm from specified location	C261.06
2.	<b>Longitudinal Lines</b> (a) Length (b) Width	± 200mm from lengths shown on the Drawings ± 10mm from widths shown on the Drawings	C261.12 C261.16 C261.12 C261.16
3.	<b>Transverse Lines</b> (a) Length) (b) Width )	± 10mm from lengths and widths shown on the Drawings	C261.12 C261.16
4.	<b>Arrows, Chevrons, Painted Medians, Speed Markings etc.</b>	± 10mm from the dimensions shown on the Drawings	C261.12 C261.16
5.	<b>Application of Paint</b> (a) Film Thickness	>0.35mm <0.40mm	C261.12
6.	<b>Application of Thermoplastic</b> (a) Longitudinal Lines - Cold Film Thickness	1.0mm ± 0.2mm	C261.16
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	4.5mm ± 1.5mm	C261.16
7.	<b>Glass Beads</b> (a) Volume used in operation	0.30 kg/sq m + 10%	C261.12 C261.16

Table C261.2 - Summary of Limits and Tolerances

## PROCEDURE FOR MEASUREMENT

### **C261.25    PROCEDURE FOR PAVEMENT MARKING PAINT –**

#### ***LONGITUDINAL AND TRANSVERSE LINES***

1. The unit of measurement shall be the lineal metre.
2. The lineal metres shall be shown in each of the specified widths and line types (excluding tolerances) and the actual length measured along the centre line of the longitudinal line.

#### ***SYMBOLS, LEGENDS, ARROWS, CHEVRONS, ISLANDS & KERBS***

1. The unit of measurement shall be the square metre.
2. The area of the painted surface shall be determined.

### **C261.26    PROCEDURE FOR THERMOPLASTIC PAVEMENT MARKING MATERIAL -**

#### ***LONGITUDINAL AND TRANSVERSE LINES***

1. The unit of measurement shall be the lineal metre.
2. The lineal metres shall be shown in each of the specified widths and line types (excluding tolerances) and the actual length measured along the centre line of the longitudinal line.

#### ***SYMBOLS, LEGENDS AND ARROWS***

1. The unit of measurement shall be the square metre.
2. The surface area of the thermoplastic material applied shall be determined.

### **C261.27    PROCEDURE FOR RAISED PAVEMENT MARKERS (all applications)**

1. The unit of measurement shall be 'each' raised pavement marker installed.

## SPECIAL REQUIREMENTS

**C261.28    RESERVED**

**C261.29    RESERVED**

## **ANNEXURES**

### **ANNEXURE C261A**

#### **PROCEDURE FOR MEASUREMENT OF WET FILM THICKNESS OF PAINT**

##### **1. SCOPE**

The following procedure shall be adopted for measuring Wet Film Thickness of paint by means of a wet paint film thickness comb gauge, with measuring range 50 to 500 microns.

##### **2. MATERIAL**

The paint shall be a commercial pavement marking paint conforming to the requirements of AS 4049.1 or AS /NZS 4049.3.

##### **3. MEASUREMENT**

The method of measurement shall be as follows:

- (a) Place the gauge carefully and vertically into the wet film immediately after the wet film has been sprayed or applied onto a metal test panel, of approximate dimension 75mm x 200mm.
- (b) Hold the gauge firmly for between five and ten seconds in the wet film and then withdraw the gauge vertically.
- (c) Determine which of the prongs have been covered with paint. For correct wet film thickness, the paint shall touch the prong of the gauge marked with the specified thickness of paint but shall not touch the prong marked with the next higher thickness.
- (d) Repeat the measurement at 3 locations on the test panel, and calculate the average wet film thickness in microns.



**ANNEXURE C261B****PROCEDURE FOR MEASUREMENT OF  
RATE OF APPLICATION OF SPHERICAL GLASS BEADS****1. SCOPE**

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

**2. SPHERICAL GLASS BEADS**

The glass beads shall comply with AS 2009.

**3. MEASUREMENT**

The method of field measurement shall be as follows:

- (a) Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.
- (b) Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level but do not compact the glass beads in the cylinder.
- (c) Compare the volume of glass beads collected with the correct figure given in Table C261.1.

Table C261.1 shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kilograms per square metre for different line widths and road speeds. The glass bead volume figures given in Table C261.1 are calculated for an actual application rate of 0.34 kilograms per square metre. These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line and the volume is measured with beads not compacted.

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C262

Revision 3

## **SIGNPOSTING**



**SPECIFICATION C262 - SIGNPOSTING**

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## SPECIFICATION C262 : SIGNPOSTING

### GENERAL

#### C262.01 SCOPE

1. The work to be executed under this Specification consists of:
  - (a) the supply and erection of the Regulatory, Warning, Guide, Information and Direction signs as described in AS 1742 (Set), AS 1743 and AS 1744.
  - (b) the supply and erection of sign support structures, and
  - (c) the adjustment of existing signs and sign support structures.
2. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the Specification Part for Quality Requirements.

**Quality**

#### C262.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

##### (a) Council Specifications

- C201 - Control of Traffic  
C271 - Concrete Works

##### (b) Australian Standards

- AS 1163 - Structural steel hollow sections  
AS 1214 - Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)  
AS 1250 - The use of steel in structures (known as the SAA Steel Structures Code) (incorporating Amdt1)  
AS 1379 - Specification and supply of concrete  
AS/NZS 1554.1 - Structural Steel Welding - Welding of steel structures  
AS/NZS 1580.602.2 - Paints and related materials - Methods of Tests - Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°  
AS 1580.108.2 - Paints and related materials - Methods of Tests - Dry film thickness - Paint inspection gauge  
AS 1650 - Hot dipped galvanised coatings on ferrous articles  
AS/NZS 1734 - Aluminium and aluminium alloys - flat sheet, coiled sheet and plate  
AS 1742 (Set) - Manual of uniform traffic control devices  
AS 1743 - Road Signs – Specifications  
AS 1744 - Forms of letters and numerals for road signs (known as standard alphabets for road signs)  
AS/NZS 1866 - Aluminium and aluminium alloys - extruded rod, bar, solid and hollow shapes  
AS 2700 (Set) - Colour standards for general purposes  
AS/NZS 3678 - Structural steel – hot-rolled plates, floorplates and slabs  
AS/NZS 3679.1 - Structural steel – hot-rolled bars and sections

#### C262.03 PROVISION FOR TRAFFIC

1. The Contractor shall provide for traffic in accordance with the requirements of the Specification for CONTROL OF TRAFFIC while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic.
2. Where a sign is erected before its intended use by traffic and is visible to traffic, the face of the sign shall be completely wrapped in black plastic sheeting or other opaque covering, until the Superintendent directs to uncover the sign.

**Minimise  
Inconvenience****Premature Sign  
Exposure**

### MATERIALS

#### C262.04 GENERAL

1. The Contractor shall advise the names of proposed sign and sign support structure

**Approved**

## SIGNPOSTING

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- |  |   |
|--|---|
| suppliers for the Superintendent's concurrence. Only suppliers who can show their competence to carry out the work in accordance with this Specification shall be used.  | <b>Supplier</b>                                 |
| 2. The Contractor shall supply documentary evidence, satisfactory to the Superintendent, that all materials and parts proposed for use comply with the requirements of the appropriate Australian Standard(s). | <b>Proof of Quality</b>                         |
| 3. Details of the signs and sign support structures to be provided under the Contract shall be as shown on the Drawings.   | <b>Details</b>                                  |
| 4. The dimensions, legend and background for each sign shall be in accordance with this Specification and the Drawings.  | <b>Dimensions<br/>Legend and<br/>Background</b> |

### C262.05 SIGN BLANKS

- |  |                                 |
|--|---------------------------------|
| 1. Sign blanks shall be 1.6 mm thick aluminium sheet alloy. The aluminium alloy shall be Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS/NZS 1734.   | <b>Aluminium<br/>Quality</b>    |
| 2. Sign blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blank shall be within plus or minus 1.5 mm of the dimensions specified and the finished sign shall be flat within a maximum allowable bow of 0.5 per cent of the maximum dimension of the sign blank in any direction.                  | <b>Dimension<br/>Tolerances</b> |
| 3. Sign blanks shall be one piece except where the sign is of such a size as to require more than one full sheet of aluminium in which case a multi-piece sign shall be allowed.   | <b>One Piece</b>                |
| 4. A multi-piece sign shall be made up of the minimum number of pieces practical and sheets of the multi-piece sign shall be butted together with a maximum gap of 1 mm at any point along the joint.  | <b>Multi-piece Sign</b>         |
| 5. All joints shall be covered by a backing strip. The backing strip shall be riveted to each sheet with rivets, coloured to match the background material on the face of the sign, at a spacing not exceeding 200 mm. Backing strips shall be of the same material and colour as used for the sign blank and shall have a minimum width of 50 mm over the full length of the joint. | <b>Joint Backing<br/>Strips</b> |
| 6. The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.   | <b>Backing Strip</b>            |
| 7. The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. Where the sign blank is to receive a paint background, the face shall be spray painted with a compatible etch primer.   | <b>Face Treatment</b>           |
| 8. The back of each sign blank shall be uncoated and the surface finish shall be rendered dull and non-reflective either by mechanical or chemical means and shall be free of scratches and blemishes.   | <b>Back Treatment</b>           |
| 9. Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the Drawings.  | <b>Mounting</b>                 |

### C262.06 ALUMINIUM EXTRUSION BACKING

- |   |                       |
|---|-----------------------|
| 1. The signs shall include special aluminium extruded sections for mounting purposes. The aluminium shall be Type 6063-T5 in accordance with AS/NZS1866.  | <b>Design Section</b> |
| 2. The aluminium extrusion shall be fixed at the centre spacings as shown on the Drawings and shall be riveted to the sign blank with correctly coloured rivets at a spacing not exceeding 200mm. | <b>Fixing</b>         |

### C262.07 RETRO-REFLECTIVE MATERIAL FOR BACKGROUND AND LEGEND

- |   |                    |
|---|--------------------|
| 1. The retro-reflective material shall be 'Scotchlite', 'Seibulite', 'Kiwalite' or approved equivalent. The background and legend material shall be compatible both in application and durability.                              | <b>Brand Names</b> |
| 2. Retro-reflective material shall conform in colour and class to the requirements of AS 1743 for diamond grade Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the Drawings, the material shall be Class 1. | <b>Standard</b>    |

**C262.08 NON-REFLECTIVE BACKGROUND MATERIAL**

- |   |                          |
|---|--------------------------|
| <b>(a) Background Paint</b>   | <b>Quality</b>           |
| 1. Background paint shall be an approved long life industrial quality, two compound polyurethane paint. The paint shall exhibit high standards of adhesion, abrasion resistance, resistance to weathering and colour fastness under widely varying conditions of exposure. The paint shall be compatible with the etch primer used on the sign blank.   |                          |
| 2. The paint shall be applied using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested in accordance with AS 1580.108.2.  | <b>Application</b>       |
| 3. Background paint shall be as specified from one of the following colours:<br>(i) White - Gloss<br>(ii) 'Dark' Green - Matt Colour No G61 as specified in AS 2700.<br>(iii) 'Tourist' Brown - Matt Colour No X65, Dark Brown, as specified in AS 2700.<br>(iv) 'Dark Grey' – Matt Colour No N64, Dark Grey as specified in AS2700.<br>(v) Any colour or colour combination specified by Council.                        | <b>Colours</b>           |
| 4. Exact colorimetric values are set out in AS 2700.<br>(i) For matt coatings, the gloss level, determined by AS/NZS 1580.602.2, using an 85° head, shall be neither less than 12 per cent of gloss nor more than 15 per cent of gloss.<br>(ii) For gloss coatings, the gloss level, determined by AS/NZS 1580.602.2 using a 20° head shall be neither less than 85 per cent of gloss nor more than 95 per cent of gloss. | <b>Gloss Levels</b>      |
| <b>(b) Background Sheet Material</b>  | <b>Quality</b>           |
| 1. Adhesive cast vinyl sheet material such as 'Scotchcal' or other equivalent material approved by the Superintendent may be used in place of background paint. The material shall be of uniform density and compatible with the material used for the legend both in application and durability.   |                          |
| 2. The colours and gloss levels shall be uniform and conform to the requirements of Clause C262.08(a).  | <b>Colours and Gloss</b> |

**C262.09 NON-REFLECTIVE MATERIAL FOR LEGEND**

- |  |                          |
|--|--------------------------|
| <b>(a) Legend Screening Ink</b>  | <b>Quality</b>           |
| 1. Screening ink shall be a high quality, full gloss, non-fade, non-bleed and scratch resistant type compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which it is applied.   |                          |
| <b>(b) Legend Sheet Material</b>   | <b>Quality</b>           |
| 1. Adhesive cast vinyl sheet material such as 'Scotchcal' or other equivalent material approved by the Superintendent may be used in place of screening ink. The material shall be of uniform density and compatible with the material used for the background both in application and durability. |                          |
| <b>(c) Colours and Finish</b>  | <b>Colours and Gloss</b> |
| 1. The requirements of Clause C262.08(a) shall also apply to non-reflective materials for legends but additional colours complying with AS 2700 may be specified.  |                          |

**C262.10 RIVETS**

- |   |                          |
|---|--------------------------|
| 1. Each rivet shall consist of a domed head and shank made of aluminium alloy and a steel mandrel which is discarded after securing the rivet.  | <b>Head and Shank</b>    |
| 2. A paint coating shall be applied to the domed head so that when the rivet is in position it will show the same colour as the material to which it is attached. Paint may cover the shank of the rivet, providing the coating thickness does not restrict the insertion of the shank into the standard drilled hole for that rivet. | <b>Painted Head</b>      |
| 3. The paint shall be an alkyd enamel, which shall be applied after an appropriate treatment of the shank of the rivet to ensure long lasting adhesion.   | <b>Paint Application</b> |



**C262.11 REFERENCE MARKINGS**

- |    |   |                            |
|----|---|----------------------------|
| 1. | All signs shall be clearly and permanently stamped or engraved with an identification coding. The coding shall appear in ciphers of height neither less than 6 mm nor more than 10 mm on the rear of the sign and shall be carried out in such a manner that the front face of the sign is not damaged. | <b>Identification Code</b> |
| 2. | For rectangular signs, the coding shall appear as near as practicable to the bottom rear left hand corner. For other shaped signs, the coding shall be positioned on or below the horizontal centre line and as near as practicable to the left hand rear edge.   | <b>Location</b>            |
| 3. | Manufacturers shall include coding information in the following format:-<br>Manufacturer's Name<br>Month and Year of Manufacture<br>Manufacturer and Class of Retro-Reflective Material   | <b>Information Shown</b>   |

**C262.12 SIGN SUPPORT STRUCTURES****(a) General**

- |    |  |                  |
|----|--|------------------|
| 1. | Sign support structures shall be unwelded fabricated from steel sections which shall comply with the requirements of AS 1163, AS/NZS 3678 and AS/NZS3679.1.  | <b>Standards</b> |
| 2. | Signs support structures shall be standard round galvanised posts of 60mm or 80 mm nominal bore or purpose-designed steel structures as shown on the Drawings and manufactured in accordance with the requirements of AS 1250. | <b>Size</b>      |
| 3. | Sign support structures shall include galvanised steel weatherproof post caps in accordance with AS 1742.  |                  |

**(b) Protective Treatment**

- |    |  |                            |
|----|--|----------------------------|
| 1. | Except for standard galvanised posts, all steel components including brackets shall be protected by hot-dip galvanising after all fabrication processes are completed.   | <b>Hot-Dip Galvanising</b> |
| 2. | The steel components shall be finished by the hot-dip galvanising process in accordance with AS 1650 to provide a minimum thickness of 100 microns and a bright finished surface free from white rust and stains.  | <b>Finish</b>              |
| 3. | Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214. Bolts and nuts shall be an 'anti-theft' type.   | <b>Bolts, Nuts etc.</b>    |
| 4. | Splices in standard galvanised posts shall be painted by using a zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer.   | <b>Splices</b>             |
| 5. | Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using a zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer. This method of renovation shall be restricted to areas not exceeding 2500 mm <sup>2</sup> on any one structure. Any structure with totally-damaged coating areas exceeding 2500 square millimetres shall be regalvanised by the Contractor. | <b>Damaged Surfaces</b>    |
| 6. | The cost of regalvanising such damaged coating areas shall be borne by the Contractor.   | <b>Contractor's Costs</b>  |

**(c) Attachment of Signs**

- |    |   |                                    |
|----|---|------------------------------------|
| 1. | Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the Drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolt hole in the sign panel. | <b>Typical Systems</b>             |
| 2. | The Contractor shall submit details of the proposed attachment systems for the Superintendent's approval.   | <b>Contractor's Responsibility</b> |

## ERECTION OF NEW SIGNS

### C262.13 SETTING OUT

- |    |  |   |
|----|--|---|
| 1. | The location of signs shall be as shown on the Drawings or as directed by the Superintendent. The Contractor shall set out the work to ensure that all signs and support structures are placed in accordance with the Drawings or as directed by the Superintendent.   | <b><i>Location</i></b>                    |
| 2. | Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve or as directed by the Superintendent. On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located. | <b><i>Alignment</i></b>                   |
| 3. | The Contractor shall submit details of and set out, for the Superintendent's inspection and approval, the proposed location and alignment of each sign support structure.  | <b><i>Contractor's Responsibility</i></b> |
| 4. | Work on the foundations of the sign support structure shall not commence until the Superintendent has approved the location and alignment of the sign support structure.   | <b><i>Approval of Superintendent</i></b>  |

### C262.14 CLEARING

- |    |   |                              |
|----|---|------------------------------|
| 1. | Any trees and undergrowth within three metres of the sign support structure and along a motorist's line of sight to the sign shall be trimmed or removed. | <b><i>Extent of Work</i></b> |
|----|---|------------------------------|

### C262.15 SIGN STRUCTURE FOOTINGS

- |    |   |                                      |
|----|---|--------------------------------------|
| 1. | The footings for a simple pipe support or the footings for each post of a purpose-designed sign support structure shall be constructed in accordance with the Drawings or as directed by the Superintendent.  | <b><i>Details</i></b>                |
| 2. | The footings shall be neatly excavated to the depth and width shown on the Drawings. The material from the excavation shall be disposed of in a responsible and legal manner.   | <b><i>Excavation</i></b>             |
| 3. | When anchor bolt assemblies are specified they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure baseplates to allow adjustment of the structure after installation. | <b><i>Anchor Bolt Assemblies</i></b> |
| 4. | Steel reinforcement shall be placed as shown on the Drawings.   | <b><i>Reinforcement</i></b>          |
| 5. | Concrete in the footings of sign support structures shall comply with the Specification for CONCRETE WORKS and have a minimum compressive strength at 28 days of 20MPa for pipe support footings and 32MPa for purpose-designed support footings.         | <b><i>Concrete Quality</i></b>       |
| 6. | If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.  | <b><i>Ready Mixed Concrete</i></b>   |

### C262.16 ERECTION

- |    |   |   |
|----|---|---|
| 1. | All components shall be accurately positioned and supported during erection.  | <b><i>Position &amp; Support</i></b>        |
| 2. | The top of each pipe support post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel.  | <b><i>Top of Post Level</i></b>             |
| 3. | For pipe support multi-post installations, the tops of the posts shall be at the same level except where sign shape or the arrangement of sign panels dictates otherwise.   | <b><i>Multi-Post Installation</i></b>       |
| 4. | During erection, sign panels shall be suitably supported and braced and the sign face protected from damage. Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Contractor at the Contractor's cost.  | <b><i>Sign Damage Contractor's Cost</i></b> |
| 5. | Galvanised coatings on purpose-designed support structures which are scratched or slightly damaged during erection shall be renovated by using a zinc-rich paint in accordance with Appendix G of AS 1650 to provide a zinc-rich coating at least equal to the thickness specified for the galvanised layer. This method of renovation shall be restricted to areas not exceeding 2500 mm <sup>2</sup> on any one structure. Any structure with | <b><i>Treatment of Damaged Areas</i></b>    |

totally-damaged coating areas exceeding 2500 mm<sup>2</sup> shall be regalvanised.

6. The cost of regalvanising such damaged coating areas shall be borne by the Contractor. **Contractor's Costs**

### **ADJUSTMENT OF EXISTING SIGNS AND SUPPORT STRUCTURES**

#### **C262.17 GENERAL**

1. Where shown on the Drawings and where directed by the Superintendent, the Contractor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including footings and re-erection of signs including all fittings. **Extent of Work**

### **STREET AND COMMUNITY FACILITY NAME SIGNS**

#### **C262.18 BLADE SPECIFICATIONS**

1. All street and community facility name blades shall comply with Council's adopted signage system and with the details as shown on the Drawings. **Signage System**
2. Proprietary signs shall be manufactured and installed in accordance with the requirements of AS 1742.5, Street Name Blades and Community Facility Name blades, to the following details: **Proprietary Sign Requirements**

#### **COLOUR**

##### **a. Street Name Blade**

COLOUR:

- LEGEND:- BLACK
- BACKGROUND:- WHITE

##### **b. Community Facility Name Blades**

COLOUR:

- LEGEND:- WHITE (Reflective)
- BACKGROUND:- BLUE (Non Reflective)

#### **LETTERING AND NUMERALS:**

- FONT TYPE SERIES D
- HEIGHT 100mm

3. Details of Council's logo shall be supplied to the Contractor by the Council upon request. **Logo**

4. Details of the signs and legends to be provided under the Contract shall be as shown on the Drawings. **Legends**

5. The Contractor shall submit details of Manufacturer, all sign materials and sign attachment system to the Superintendent for approval by the Council prior to commencement of sign manufacture.

#### **C262.19 WITHDRAWN.**

### **SPECIAL REQUIREMENTS**

#### **C262.20 RESERVED**

#### **C262.21 RESERVED**

## LIMITS AND TOLERANCES

### C262.22 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C262.1 below:

Item	Activity	Limits/Tolerances	Spec Clause
1.	<b>Sign Blanks</b>		
	(a) Dimensions	± 1.50mm	C262.05
	(b) Bow	< 0.5% of maximum dimension	C262.05
	(c) Butt gap in multipiece sign	< 1mm	C262.05
	(d) Rivet spacing in backing strip	< 200mm	C262.05
	(e) Backing strip width	>50mm	C262.05
2.	<b>Extrusion Backing</b>		
	(a) Rivet Spacing	<200mm	C262.06
3.	<b>Background Paint</b>		
	(a) For matt coatings, gloss level	>12% and <15%	C262.08
4.	<b>Reference Marking</b>		
	(a) Height of Coding	>6mm and <10mm	C262.11
5.	<b>Sign Support Structures</b>		
	(a) Protective Treatment thickness	>100 microns	C262.12b
	(b) Paint coating over Splices in standard galvanised posts	>100 microns	C262.12b
	(c) Damaged Surface of galvanised surfaces:		
	(i) Coating with zinc rich paint	Area <2500 sq. mm	C262.12b
	(ii) Regalvanise	Area >2500 sq. mm	C262.12b
6.	<b>Clearing</b>		
	(a) Trees and Undergrowth to be cleared	<3 metres from sign support structure	C262.14
7.	<b>Concrete in Foundations of Sign Support Structures</b>		
	(a) Strength	20 MPa for pipe support footings 32Mpa for purpose design support footings	C262.15

Table C262.1 - Summary of Limits and Tolerances

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C263

Revision 3

## **GUIDE POSTS**



**SPECIFICATION C263 - GUIDE POSTS**

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## SPECIFICATION C263 : GUIDE POSTS

### GENERAL

#### C263.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply of all materials and erection of guide posts at the locations shown on the Drawings or as directed by the Superintendent in areas where streetlighting is not provided.

#### C263.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

##### (a) Council Specifications

C201	-	Control of Traffic
C213		Earthworks
C242		Flexible Pavements

##### (b) Australian Standards

AS 1580 (Set)	-	Paints and related materials - Methods of test.
AS/NZS 1580.101.1	-	Paints and related materials – Methods of test – Conditions of test – temperature, humidity and air flow control.
AS/NZS 1580.481.1.11		Paints and related materials – Methods of test – Coatings - Exposed to weathering – Degree of chalking.
AS/NZS 1580.481.1.12		Paints and related materials – Methods of test – Exposed to weathering - Degree of colour change.
AS 1580.483.1	-	Paints and related materials – Methods of test – Resistance to artificial weathering (carbon-arc type instruments)
AS/NZS 1580.602.2	-	Paints and related materials – Methods of test – Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°.
AS 1906.2	-	Retroreflective materials and devices for road traffic control purposes - Retroreflective devices (non-pavement application).
AS 2082	-	Visually stress-graded hardwood for structural purposes.
AS1604		Timber preservative treated – sawn and round.

##### (c) RTA Test Methods

T 1550	Heat Ageing Test
--------	------------------

#### C263.03 MATERIALS

##### (a) Posts

1. Guide Posts shall be a timber post conforming to the requirements of this specification. They shall be cut from Select Grade hardwood and conform with AS 2082. All surfaces shall be smooth and free from obvious saw marks.

**Posts and Quality**

2. The posts shall be of rectangular cross-section having dimensions of 100mm x 50mm and shall be 1,400mm in length. The tops of the guide posts shall be sloped so that one 100mm edge is 10mm lower than the opposite edge.

**Dimensions**

##### (b) Delineators

1. Corner-cubed delineators, conforming to AS 1906.2 shall be attached to each post.

**Standard**

2. The delineators shall be neither less than 80mm nor more than 85mm diameter.

**Diameter**



## CONSTRUCTION

### C263.04 GENERAL

- |    |   |                               |
|----|---|-------------------------------|
| 1. | The Contractor shall at all times conform to the requirements of the Specification for CONTROL OF TRAFFIC.            | <b><i>Traffic Control</i></b> |
| 2. | The guide posts shall be placed near the outer edge of the shoulder and at a uniform distance from the pavement edge. | <b><i>Positioning</i></b>     |
| 3. | Guide posts shall be erected at the locations shown on the Drawings or as directed by the Superintendent.             | <b><i>Location</i></b>        |

### C263.05 PROTECTIVE TREATMENT

- |    |   |                             |
|----|---|-----------------------------|
| 1. | All guide posts shall be treated with "Copper Chrome Arsenic (CCA)" , conforming to AS 1604.  | <b><i>Treatment</i></b>     |
| 2. | All timber above ground level shall be painted with pink primer and any holes, cracks, or other surface imperfections in the timber, shall be stopped with white putty. This work shall be followed by painting with a white undercoat and a white enamel finishing coat. | <b><i>Painting</i></b>      |
| 3. | Painted surfaces shall be thoroughly dry before a further coat is applied. Paints shall be handled and applied in accordance with the manufacturer's directions.  | <b><i>Dry Surfaces</i></b>  |
| 4. | All paints shall be premium quality paint approved by the Superintendent and in accordance with AS 1580.  | <b><i>Paint Quality</i></b> |

### C263.06 ERECTION OF GUIDE POSTS

- |    |   |   |
|----|---|---|
| 1. | Guide posts shall be set vertically in the ground to a depth of approximately 500mm. In order to offset shoulder irregularities this depth shall be varied so as to give uniform display of guide posts to a height of approximately 900mm above ground level, with the tops evenly graded. Each guide post shall be erected with the 100mm axis at right angles to the centre line of the road and with the higher 100mm face visible to drivers in the lane nearest the post. | <b><i>Details</i></b>                     |
| 2. | Allowance shall be made in the height of guide posts above the ground for the effects of superelevation and other road geometry in order to keep the guide posts within the range of the beam of vehicle headlights.  | <b><i>Vertical Alignment</i></b>          |
| 3. | Backfilling shall be compacted in layers of depth not more than 150mm for the full depth of the guide posts up to ground level. The density of the compacted backfilling shall not be less than that of the adjacent undisturbed ground. Guide posts shall be firm in the ground to the satisfaction of the Superintendent.   | <b><i>Backfilling</i></b>                 |
| 4. | All necessary steps shall be taken to prevent people and stock from stepping into the post holes during the erection of the guide posts.  | <b><i>Contractor's Responsibility</i></b> |

### C263.07 DELINEATORS

- |    |   |                           |
|----|---|---------------------------|
| 1. | 'Corner Cubed' delineators, complying with AS 1906.2, shall be attached to each guide post.   | <b><i>Fixing</i></b>      |
| 2. | The delineators shall be mounted so that the top of the reflector is 50mm below the top of the guide post.  | <b><i>Position</i></b>    |
| 3. | The delineators shall be arranged so that approaching drivers will see only red delineators on their left side and white delineators on their right side. | <b><i>Arrangement</i></b> |

**SPECIAL REQUIREMENTS**

**C263.08    RESERVED**

**C263.09    RESERVED**

**C263.10    RESERVED**

**C263.11    WITHDRAWN**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C264

Revision 3

## **GUARDFENCE**



## SPECIFICATION C264 - GUARDFENCE

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## SPECIFICATION C264 : GUARDFENCE

### GENERAL

#### C264.01 SCOPE

1. The work to be executed under this Specification consists of the setting out, supply of all materials and erection of guardfence at the locations shown on the Drawings or as directed by the Superintendent.

#### C264.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

##### (a) Council Specifications

C201	-	Control of Traffic
C213	-	Earthworks
C242		Flexible Pavements

##### (b) Australian Standards

AS/NZS 1110	-	ISO metric precision hexagon bolts and screws.
AS/NZS 1111	-	ISO metric hexagon commercial bolts and screws.
AS 1214	-	Hot-dip galvanised coatings on threaded fasteners. (ISO metric coarse thread serves)
AS/NZS 1365	-	Tolerances for flat-rolled steel products.
AS 1391	-	Method for tensile testing of metals.
AS/NZS 1594	-	Hot-rolled steel flat products.
AS 1627.1	-	Metal finishing – preparation and pretreatment of surfaces - Cleaning using liquid solvents and alkaline solutions.
AS 1627.4	-	Metal finishing – preparation and pretreatment of surfaces - Abrasive blast cleaning.
AS 1650	-	Hot-dipped galvanised coatings on ferrous articles.
AS 1906.2	-	Retroreflective materials and devices for road traffic control purposes - Retroreflective devices (non pavement application).
AS 2082	-	Visually stress-graded hardwood for structural purposes.
AS1604	-	Preservative treated - Sawn and round

##### (c) Other Standards

Roads and Traffic Authority	-	Road Design Guide.
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### MATERIALS

#### C264.03 STEEL COMPONENTS

1. Posts and blocking pieces shall be mild steel conforming to AS/NZS 1594, minimum Grade HU1, to the dimensions as detailed on the drawings. **Posts**

2. Rail elements and terminal pieces shall be mild steel conforming to AS/NZS 1594, minimum Grade HA250, to the dimensions as detailed on the drawings. **Rails**

3. The mechanical properties of the rail elements and terminal pieces, when tested in accordance with AS 1391, shall conform to the following requirements: **Tests**

Yield Stress, typical	272 MPa
Ultimate Tensile Stress, typical	372 MPa
Elongation in 80mm, typical	31%

4. The rail elements shall comply with AS/NZS 1365 to the following tolerances: **Tolerances**

Metal thickness	2.6mm ± 0.21mm
Mill tolerance on strip width	+2.50mm, -0.0
Mill camber tolerance on 2000mm length	4.0mm max

5. All guardfence components are to be hot-dip galvanised after fabrication in accordance with AS 1650 to Class Z 600. Prior to galvanising, the surfaces shall be treated in accordance with AS 1627.1 and AS 1627.4.

**Protection**

6. Splice and post bolts shall comply with AS/NZS 1110 Grade 8.8 and other bolts to AS/NZS 1111 Grade 4.6. All bolts, nuts and washers shall be hot-dip galvanised in accordance with AS 1214.

**Bolts**

#### **C264.04 TIMBER POSTS**

1. Timber posts are to be used only in end panels, as detailed on the drawings in RTA Road Design Guide. Timber posts and blocking pieces shall be cut from Grade F8 Australian slash pine.

**Timber**

### **CONSTRUCTION**

#### **C264.05 GENERAL**

1. The Contractor shall at all times conform to the requirements of the Specification for CONTROL OF TRAFFIC.

**Traffic Control**

2. Guardfence is to be erected after construction of base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by the Superintendent.

**Timing of Construction**

#### **C264.06 ERECTION OF STEEL POSTS**

1. Underground cables and ducts laid in the guardfence area shall be located prior to the erection of posts and care must be taken not to damage such cables and ducts.

**Cables and Ducts**

2. Steel posts are to be erected by driving, with the open section pointing in the same direction as adjacent traffic.

**Orientation**

3. The face of guardfence posts are to be located 285mm from the edge of shoulder and the top of the post shall be 700mm  $\pm$  20mm above the edge or ground level, unless otherwise shown on the Drawings. When erected the posts shall be on a smooth line (horizontally and vertically).

**Positioning of Posts**

4. Posts shall stand vertical and be spaced such that when the guardfence is erected no post movement is necessary in order to align holes or for any other reason.

**Spacing**

5. The posts should be driven to the full depth shown on the Drawings. If this is not possible due to the presence of an underground obstruction, an alternative method of setting the posts, as approved by the Superintendent, shall be used.

**Underground Obstruction**

6. The posts are to be firm in the ground to the satisfaction of the Superintendent.

**Firmness**

7. The posts shall not have any obvious deformation as a result of driving. Any damage which does occur to the galvanising of the post is to be repaired within 24 hours using an approved cold galvanising compound.

**Damage to Posts**

8. Any post which has been excessively damaged will be rejected and shall be replaced by the Contractor at his own expense.

**Contractor's Cost**

#### **C264.07 ERECTION OF TIMBER POSTS**

1. Timber posts shall be cut to the dimensions shown on the Drawings.

**Dimensions**

2. All timber posts (grade F8 Australian Slash Pine) shall be preservative treated to hazard level H4 (H5 in extreme wet conditions) to AS 1604.

**Protective Treatment**

3. The surface area of the posts which will be above ground shall be painted with a pink primer and two coats of grey acrylic paint.

**Painting**

**C264.08 ERECTION OF GUARDFENCE PANELS**

1. Steel blocking pieces are to be erected with the open section pointing in the same direction as the flow of adjacent traffic.
2. All rail laps shall be in accordance with the drawings in RTA RDG.
3. Backing/stiffening pieces, 300mm long, shall be used on intermediate posts.
4. Guardfence panels and steel blocking pieces are to be handled and erected in such a manner to not damage the galvanising. Any damage to the galvanising shall be repaired within 24 hours using an approved cold galvanising compound.
5. Any guardfence panels or steel blocking pieces which have been damaged will be rejected and shall be replaced by the Contractor at his own expense.
6. Guardfence attachment bolts and splice bolts are to be tightened initially such that the fence can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kicks or bumps. The overall line of the top of the guardfence panels is to visually conform with the vertical alignment of the road pavement.
7. When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head should be in full bearing with the rail. The recess in the nut should face the bolt shoulder, otherwise the splice will not be tight.

**Orientation****Rail Laps****Backing Pieces****Minor Damage to Galvanising****Contractor's Cost****Erection Procedure****Splices****C264.09 END TREATMENT OF GUARDFENCE**

1. End treatments (terminals) for all guardfences shall be in accordance with the NSW RTA Road Design Guide (Part 6).

**C264.10 DELINEATORS**

1. Where shown on the Drawings, delineator brackets shall be attached to the centre of the guardfence under the special washer of the post bolt of the first post and then in accordance with the following table:-

**Spacing**

<b>Radius of Curve</b>	<b>Spacing of Reflectors on Guardfence</b>
<b>m</b>	<b>every</b>
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365 (including straight road)	16th post

**Table C264.1**

2. Circular corner cube delineators, complying with AS 1906.2 shall be fixed to the brackets.
3. The delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.



**LIMITS AND TOLERANCES****C264.11 SUMMARY OF LIMITS AND TOLERANCES**

<b>Activity</b>	<b>Tolerances</b>	<b>Spec Clause</b>
<b>Vertical Alignment</b>		
(a) At the top of the post above edge or ground level	710mm $\pm$ 20mm	C264.06

**Table C264.2 - Limits and Tolerances****SPECIAL REQUIREMENTS**

<b>C264.12</b>	<b>RESERVED</b>
<b>C264.13</b>	<b>RESERVED</b>
<b>C264.14</b>	<b>RESERVED</b>
<b>C264.15</b>	<b>RESERVED</b>
<b>C264.16</b>	<b>RESERVED</b>

# DEVELOPMENT CONSTRUCTION SPECIFICATION

C265

Revision 3

## **BOUNDARY FENCING**

## SPECIFICATION C265 - BOUNDARY FENCING

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## SPECIFICATION C265 - BOUNDARY FENCING

### GENERAL

#### C265.01 SCOPE

- The work to be executed under this Specification includes setting out, clearing of fence line, supply of material and erection of boundary fencing and gates, in accordance with the Drawings or as directed by the Superintendent.

#### C265.02 REFERENCE DOCUMENTS

- Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

##### (a) Council Specifications

- |      |   |                       |
|------|---|-----------------------|
| C212 | - | Clearing and Grubbing |
| C271 | - | Concrete Works        |

##### (b) Australian Standards

- |               |   |  |
|---------------|---|--|
| AS 1725       | - | Galvanised Rail-less Chainwire Security Fences and Gates   |
| AS 2423       | - | Galvanised Wire Fencing Products   |
| AS 1289.5.1.1 | - | Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort. |
| AS1604        | - | Preservative Treated – Sawn - round  |

### MATERIALS

#### C265.03 GENERAL

- All materials shall be supplied by the Contractor and shall be of dimensions, manufacture and quality in accordance with the requirements of this Specification and shall conform to AS 2423.
- For each type of material to be supplied, the Contractor shall submit to the Superintendent for approval the source, manufacturer, and also the type if applicable.
- No materials shall be used until approved by the Superintendent.

***Dimensions  
and Quality***

***Details to be  
Provided***

***Approved  
Materials***

### MATERIALS - CHAINLINK FENCING

#### C265.04 GALVANISED POSTS AND BRACES

- All posts and bracing shall be galvanised iron pipe in accordance with AS 1725. The pipes shall be to the dimensions shown on the Drawings.
- All pipe joints shall be made using standard fittings.
- All concrete backfilling of post holes specified on the drawings shall be of minimum 20Mpa 28 day compressive strength and shall conform with to the requirements of the Specification Concrete Works C271.

***Dimensions***

***Joints***

***Concrete  
Backfilling***

**C265.05 CHAIN WIRE**

1. Galvanised chain wire mesh, 1830mm wide shall be of 3.15mm diameter wire woven to a 50 x 50mm square mesh. The selvedge edges of the chain wire shall be left barbed, and it shall be supplied in lengths of not less than 30m. The zinc coating shall be uniform, continuous, free from imperfections and thoroughly adherent. The coating shall be applied to the wire before the mesh is woven. The weight of the zinc coating shall not be less than 290 g/sq m of wire surface.

***Dimensions  
and Zinc  
Coating***

**C265.06 WITHDRAWN**

**C265.07 GATES**

1. Gates shall be of galvanised tubular steel construction, 3.6 metres in width by 1.8 metres in height, and shall be fitted with substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the Drawings or directed by the Superintendent.

***Dimensions  
and Fittings***

**C265.08 WITHDRAWN**

**C265.09 WITHDRAWN**

**MATERIALS - RURAL FENCING**

**C265.10 POSTS & GATES**

1. For Rural Fencing timber posts shall be used and cut from either Eucalyptus acrenoides (white mahogany) or Eucalyptus crebra (Narrow leaf ironbark-red). Timber strainer and intermediate posts shall be of the nominated size as indicated on Drawings C265.1 and C265.2.

***Timber Type***

2. Steel posts shall be "Star" pattern. Posts shall be drilled to suit the spacing of the wires shown on the drawing(s), and shall be black varnished or galvanised.

***Steel Type***

3. The total weight of 300 posts each 1.65m long shall be at least one (1) tonne.

***Weight***

4. Gates shall be of galvanised tubular steel construction, 3.6m in width by 1.2m in height, and shall be fitted with substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the drawings or directed by the Superintendent.

***Gates***

**C265.11 WITHDRAWN**

**C265.12 WIRES**

**(a) Plain Wire**

1. Plain wire shall be standard galvanised drawn annealed steel wire of diameters shown on the drawings.

***Type***

**(b) High Tensile Plain Wire**

1. High Tensile wire shall be galvanised and of diameters shown on the drawings C265-1 and C265-2.

***Type***

**(c) Barbed Wire**

1. Barbed wire including barbs shall be IOWA BARB 2.5mm diameter galvanised drawn annealed steel wire, with clusters of four barbs spaced at 90mm maximum. Alternatively barbed wire may be of 1.6mm diameter high tensile steel wire, with clusters of barbs spaced at 90mm maximum.

**Type and Dimensions**

**(d) Tie Wire**

1. The wire shall be 2mm diameter galvanised wire.

**Type**

**C265.13 WITHDRAWN**

**CONSTRUCTION**

**C265.14 GENERAL**

1. All fencing shall be erected in a workmanlike manner, and when completed shall be sound, strong and of neat appearance.

**Quality**

2. For a clear width of one metre on either side of the fence line, and for the full length of the line, all logs, trees, boulders, stumps, roots, undergrowth and rubbish shall be removed and disposed of by the contractor in accordance with the Specification for CLEARING AND GRUBBING.

**Clearing**

3. If trees on or adjacent to the fence line are to be retained the arrangement of the fencing at the trees shall be as directed by the Superintendent.

**Trees Retained**

4. Where minor irregularities occur in the ground the vertical alignment of the fence shall not follow these irregularities, but shall be aligned to a uniform grade between definite changes in the natural slope of the ground.

**Uniform Grade**

5. All survey pegs shall be left undisturbed and the post spacing shall be altered slightly where necessary to avoid pegs.

**Survey Pegs**

6. The Contractor shall maintain the fencing at all times in a condition secure against the ingress or egress of stock, and shall take such precautions as are necessary to prevent people or stock from stepping into holes excavated for the construction of fencing.

**Stock Proof**

7. Where old fencing is to be replaced by new fencing, all holes left after removal of the old fencing shall be backfilled and rammed firmly in layers of maximum depth 150mm.

**Backfilling of Old Holes**

8. The Contractor shall be held responsible for any loss, damage, or injury to buildings, goods, crops, livestock, property of any kind or persons due to negligence on his part.

**Contractor's Responsibility**

**C265.15 CHAIN LINK FENCING**

**(a) Erection of Posts**

1. All posts shall be erected vertically and set in concrete approximately 250mm diameter and 600mm deep except for end, corner, strainer and gate posts which shall be set in concrete approximately 250mm diameter and 900mm deep unless otherwise shown on the Drawings. Concrete shall have a minimum compressive strength of 20MPa at 28 days and shall conform to the requirements of the Specification for Concrete Works C271.

**Concrete Blocks and Quality**

2. Galvanised weather caps shall be fitted to all galvanised posts.

**Weather Caps**

3. Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. Distances between strainer posts shall not

**Strainer Posts**

exceed 120 metres.

**(b) Erection of Wire**

1. All wire shall be spaced as shown in the Drawings. Wire shall be securely fastened and strained to an even tension between strainer posts. **Fasten and Strain**
2. Where specified, or shown on the Drawings, chain wire mesh shall be erected on the outside of the posts and fastened with two turns of the wire to each cable wire on both sides of each post and at intervals of not more than 900mm between posts and to each post midway between cable wires. **Chain Wire Mesh**

**C265.16 RURAL FENCING**

**(a) Erection of Timber Posts**

1. All posts shall be erected vertically. Timber posts shall be erected in neatly cut holes sunk in earth, or in rock where this is encountered. **Method**
2. All posts shall be installed according to Drawings C265.1 and C265.2.
3. All posts shall be sunk to the depths shown in Drawings C265.1 and C265.2.
4. Strainer posts shall be stayed in each direction of the strain.
5. Earth shall be backfilled around intermediate and strainer posts in layers of maximum depth 150mm for the full depth of the hole and up to ground level. The relative compaction of the rammed material shall be not less than that of the original undisturbed ground. **Backfilling at posts**
6. Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. **Strainer Posts Position**

**(b) Erection of Steel Posts**

1. Steel posts, except where placed in rock, shall be driven with suitable driving equipment, care being taken not to damage the tops of the posts during driving.
2. A steel cap with a plywood cushion shall be used to protect the top of the post during driving. **Protection Cap**
3. If the post cannot be driven for the full depth specified, or if it becomes significantly damaged, or cannot be driven vertically, it shall be removed. The same post if undamaged, or a new post, shall be erected. **Removal of Posts**

**(c) Erection of Wires**

1. All wire shall be placed as shown on the Drawings C265-1 and C265-2. Wires shall be securely fastened and strained to an even tension between strainer posts with an approved wire strainer. Where barbed wire is to be used, it shall be tied in position to steel posts and passed through timber posts. **Fastening and Straining**

**C265.17 WITHDRAWN**

**C265.18 CROSSING OF WATERCOURSES AND DEPRESSIONS**

1. The crossing of all watercourses and depressions, shall be made secure by longer posts, suitably struttled as directed by the Superintendent. Additional cable wire and chain wire/wire netting shall be provided as necessary to make the fence stock proof. **Marsupial Proof**



2. The fence shall allow the passage of floodwater without the accumulation of debris. ***Floodwater***  
 If directed by the Superintendent, flood gates shall be provided in accordance with Clause C265.20.

## **C265.19 CONNECTIONS TO EXISTING FENCES**

1. Existing cross fences shall be connected to the new fence using a strainer post with stays in each direction of strain (including cross fence) and the wires in both fences properly fastened to the post. ***Strainer Posts***

## **C265.20 FLOOD GATES**

### **(a) General**

1. Suitable provision for the passage of flood waters past the fence shall be made at all watercourses. In all cases flood gates shall be of the type indicated on the Drawings, or as directed by the Superintendent, and shall be erected so as to prevent the accumulation of flood debris, while remaining stock-proof. ***Requirements***

### **(b) Small Watercourses**

1. Flood gates, in accordance with the Drawings, shall be provided in small gullies at the locations indicated on the Drawings or as directed by the Superintendent. The opening of each flood gate shall provide a waterway area at least twice that of the culvert opposite to which it is placed, or as otherwise directed by the Superintendent. ***Waterway Area***

### **(c) Large Gullies and Creeks**

1. Flood gates, in accordance with the approved Drawings, shall be provided in gullies and creeks at the locations indicated on the Drawings, or as directed by the Superintendent. ***Location***
2. A 9mm galvanised wire rope shall be carried over the gully in one span, threaded through a strainer post and tied back to an anchor at an adjacent concrete intermediate post. Turnbuckles are to be provided at each end to tension the wire rope. Netting shall be suspended from the wire rope and shall be overlapped and securely tied. The netting shall be of sufficient length to lie on the ground for a distance of not less than 1.0m on the downstream side. ***Construction Detail***
3. Ballast, of sound timber securely tied to the netting, shall be provided at the downstream end of the netting. ***Netting Ballast***
4. The sides of the gully shall be trimmed, as necessary, to ensure that the flood gate shall be stock-proof or rabbit-proof. The flood gate shall have sufficient movement of the suspended portion under the flow of flood waters to prevent damage to the fence and the accumulation of debris against it. Each strainer post shall be stayed in accordance with the Drawings and with the Superintendent's approval. ***Construction Requirements***

**C265.21 ERECTION OF GATES**

- |   |   |
|---|---|
| <p>1. Where gates are specified or shown on the Drawings, or are directed by the Superintendent, they shall be erected so that they swing away from the road. Double gates shall be supplied if directed by the Superintendent, otherwise a single gate only shall be supplied.</p> | <p><b><i>Swing Away<br/>From Road</i></b></p> |
| <p>2. At the location of gates the surface shall be levelled and shall be nearly horizontal. The area where the gates swing shall be similarly levelled.</p>  | <p><b><i>Level Surface</i></b></p>            |
| <p>3. The gates shall be hung as indicated in the Drawings.</p>   | <p><b><i>Hanging</i></b></p>                  |

**C265.22 REMOVAL OF EXISTING FENCING**

- |   |  |
|---|--|
| <p>1. Where required, existing fencing is to be removed as shown on the Drawings.</p>   | <p><b><i>Location</i></b></p>                        |
| <p>2. No fencing is to be removed if there is a risk of egress or ingress of stock.</p>   | <p><b><i>Contractor's<br/>Responsibility</i></b></p> |
| <p>3. All material removed in demolishing existing fencing shall be disposed by the Contractor as provided by Clause C265.23.</p> | <p><b><i>Old Material</i></b></p>                    |

**C265.23 REMOVAL AND DISPOSAL OF SURPLUS MATERIAL AND RUBBISH**

- |  |  |
|--|--|
| <p>1. All surplus material, offcuts, timber, roots and other debris resulting from the fencing contract shall be removed or otherwise disposed of to the satisfaction of the Superintendent.</p> | <p><b><i>Contractor's<br/>Responsibility</i></b></p> |
| <p>2. The Contractor shall be responsible for any damage which may result from his lighting of fires.</p>  | <p><b><i>Fire Damage</i></b></p>                     |

**C265.24 GRIDS**

No grids shall be erected on a public road without Council's written consent.

- |  |   |
|--|---|
| <p>1. Where grids are to be erected on private land and where shown on the Drawings, or as directed by the Superintendent, grids shall be erected in accordance with the Drawings.</p>                   | <p><b><i>Standard</i></b></p>             |
| <p>2. The grid shall be evenly bedded on a continuous layer of compacted sand or other granular material approved by the Superintendent.</p>   | <p><b><i>Bedding</i></b></p>              |
| <p>3. Grids shall be installed on raised abutments with approach ramps where possible. Alternatively, a grid may be placed over an excavated pit, in which case adequate drainage shall be provided.</p> | <p><b><i>Raised<br/>Abutments</i></b></p> |
| <p>4. The grid construction shall include all activities associated with the grid including any adjustments to the fencing as shown on the Drawings.</p>   | <p><b><i>Extent of Work</i></b></p>       |
| <p>5. Grids are to be installed in accordance with the Manufacturer's recommendations.</p>   | <p><b><i>Installation</i></b></p>         |

**C265.25    WITHDRAWN**

**SPECIAL REQUIREMENTS**

**C265.26    RESERVED**

**C265.27    RESERVED**

**C265.28    RESERVED**

**C265.29    RESERVED**

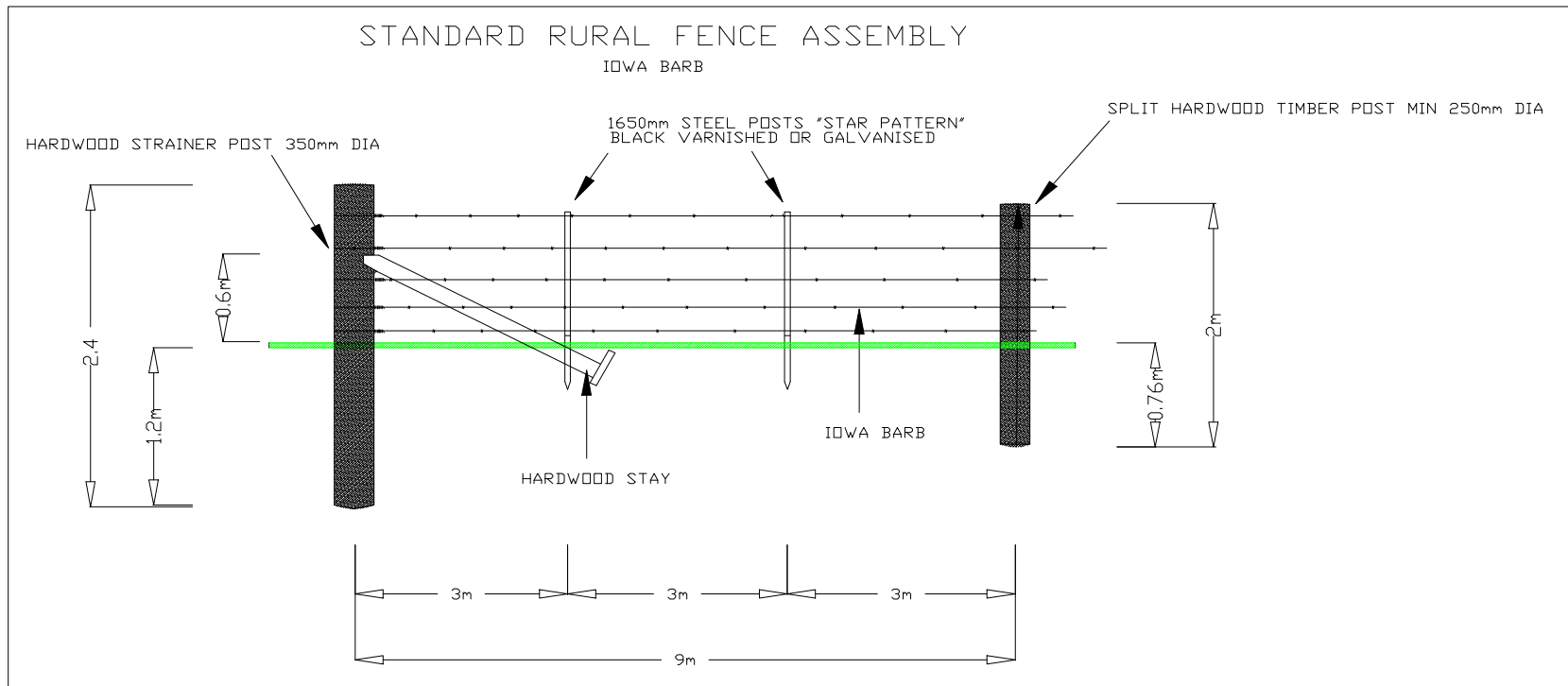
**C265.30    RESERVED**

**C265.31    RESERVED**

## BOUNDARY FENCING

### STANDARD RURAL FENCE – IOWA BARB

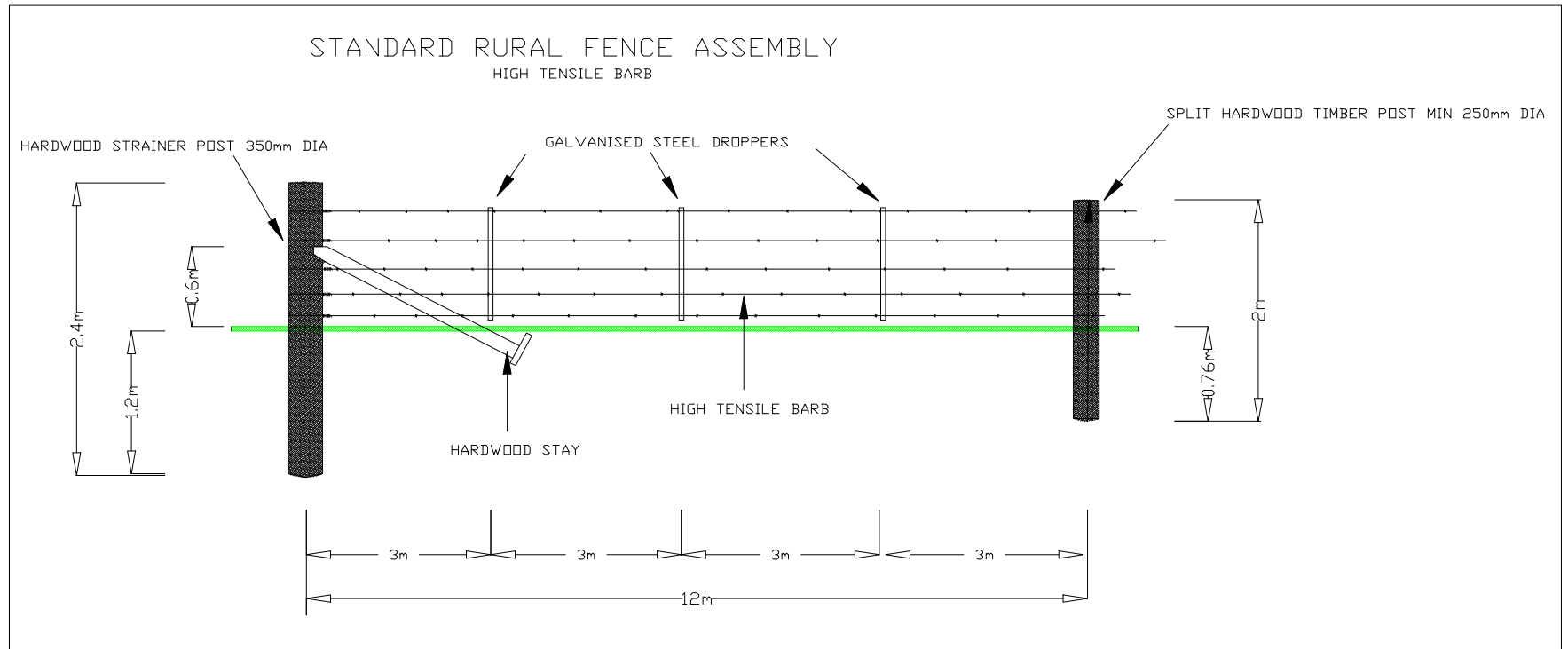
Figure C265-1



## BOUNDARY FENCING

### STANDARD RURAL FENCE – HIGH TENSILE BARB

Figure C265-2



DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C271

Revision 3

**CONCRETE WORKS**



## SPECIFICATION C271 CONCRETE WORKS

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## SPECIFICATION C271 CONCRETE WORKS

### GENERAL

#### C271.01 SCOPE

1. The Work to be executed under this Specification consists of the supply and placement of concrete and ancillary requirements like excavation, backfilling and preparation of foundations for work shown on the Drawings but not having individual Specifications. These include New Jersey type barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

2. The work also includes supply and placement of sprayed concrete and miscellaneous concrete work for water and sewerage construction such as valve chambers, thrust and anchor blocks, bulkheads, pumping stations, bedding, encasement and cast-in-situ access chambers.

#### C271.02 REFERENCE DOCUMENTS

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.:

***Documents  
Standards Test  
Methods***

##### (a) Australian Standards

- |               |   |   |
|---------------|---|---|
| AS 1012.1     | - | Sampling fresh concrete   |
| AS 1012.3.1   | - | Methods of Testing concrete - Methods of Determination of properties related to the consistency of concrete – slump test              |
| AS1012.3.2    | - | Methods of Testing concrete - Methods of Determination of properties related to the consistency of concrete – compacting factor test. |
| AS1012.3.3    | - | Methods of Testing concrete - Methods of Determination of properties related to the consistency of concrete – vebe test               |
| AS1012.3.4    | - | Methods of Testing concrete - Methods of Determination of properties related to the consistency of concrete – compactibility test.    |
| AS 1012.8     | - | Methods of making and curing concrete compression, indirect tensile and flexure test specimens in the laboratory or in the field.     |
| AS 1012.9     | - | Methods of determination of the compressive strength of concrete specimens.   |
| AS 1012.14    | - | Method of securing and testing cores from hardened concrete for compressive strength.   |
| AS 1141.14    | - | Methods for sampling and testing aggregates - Particle shape by proportional calliper.  |
| AS 1141.21    | - | Methods for sampling and testing aggregates - Aggregate crushing value.   |
| AS 1141.23    | - | Methods for sampling and testing aggregates - Los Angeles value.  |
| AS 1141.24    | - | Methods for sampling and testing aggregates - Soundness (by use of sodium sulphate solution).   |
| AS 1289.3.3.1 | - | Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil.        |
| AS 1289.5.1.1 | - | Methods of testing soils for engineering purposes - Soil compactibility and density tests. Determination of the dry                   |

		density/moisture content relation of a soil using standard compactive effort.	
AS 1289.5.2.1	-	Methods of testing soils for engineering purposes - Determination of the dry density/moisture content relation of a soil using modified compactive effort.	
AS 1302	-	Steel reinforcing bars for concrete.	
AS 1303	-	Steel reinforcing wire for concrete.	
AS 1304	-	Welded wire reinforcing fabric for concrete.	
AS 1379	-	The specification and manufacture of concrete.	
AS 1478	-	Chemical admixtures for concrete.	
AS/NZS 4266	-	Reconstituted wood-based panels.	
AS 2082	-	Visually stress-graded hardwood for structural purposes.	
AS/NZS 2271	-	Plywood and blockboard for exterior use.	
AS 2758.1	-	Aggregates and rock for engineering purposes. Concrete aggregates	
AS 3600	-	Concrete structures	
AS 3610	-	Formwork for concrete.	
AS 3799	-	Liquid membrane-forming curing compounds for concrete,	
AS 3972	-	Portland and blended cements.	

**(b) RTA Specification**

3204	-	Preformed joint fillers for concrete road pavements and structures.
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## EXCAVATION AND FOUNDATIONS

### C271.03 GENERAL

1. The subgrade or subbase where specified shall be formed at the required depth below the finished surface levels shown on the Drawings. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and swept clean. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified).

**Foundations**

2. All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Superintendent, and the subgrade shall be compacted to provide a minimum relative compaction of 95 per cent as determined by AS 1289.5.1.1 for standard compactive effort. If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

**Unsuitable Material**

3. The Contractor shall supply all necessary sheeting and bracing to support the excavation in accordance with the Workcover Authority of NSW Regulations. The excavation shall be kept free of water.

**Shoring**

### C271.04 NEW JERSEY TYPE BARRIERS, DRIVEWAYS AND FOOTPATHS

1. For New Jersey type barriers, driveways and footpaths a subbase of approved quality and of minimum 100mm compacted thickness unless otherwise shown on the Drawings shall be placed over the subgrade. The surface shall then be checked for uniformity and all irregularities shall be made good.

**Subbase**

2. The subbase material shall be compacted to provide a minimum relative compaction as determined by AS 1289.5.1.1 of 100 per cent for standard compactive effort or 98 per cent for modified compactive effort as appropriate.

**Compaction**

3. The finished subbase shall not deviate more than 12mm under a straight edge 3 metres long, subject to any necessary allowance on vertical curves.

**Subgrade and Subbase Tolerances**

**C271.05 WITHDRAWN****C271.06 RETAINING WALLS, HEADWALLS AND WINGWALLS**

1. Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a concrete sub-base at least 50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the sub-base within a period of 24 hours after the concrete has been placed.

***Earth  
Foundations***

2. Unless otherwise specified, precast concrete wall sections shall be placed on a bed of fresh concrete while it is still in plastic state and shall not be less than 50mm thick.

***Pre-cast  
Concrete***

## **FORMWORK**

**C271.07 GENERAL**

1. Formwork shall be provided in accordance with AS 3610 to produce hardened concrete to the lines, levels and shapes shown on the Drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workmen and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

***Formwork  
Requirements***

2. Where concrete is placed in earth excavations, side forms are not required except when shown on the drawings or when directed by the Superintendent.

***Side Forms***

3. Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2 metres or to move concrete along the formwork after deposition.

***Placement of  
Concrete***

4. Material used shall be sound and suitable for the purpose intended and surface finish specified.

***Material***

5. Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the Drawings.

***Formwork  
Fittings***

6. Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the Drawings.

***Edge  
Treatment***

7. Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

***Cleaning and  
Inspection***

8. All formwork shall be removed unless otherwise directed by the Superintendent.

**C271.08 APPROVAL OF FORMWORK DESIGN**

1. For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted for the Superintendent's concurrence before manufacture of the formwork is commenced.

***Approval to  
Design***

## C271.09 PROVISION FOR DRAINAGE

- |    |  |                   |
|----|--|-------------------|
| 1. | Where shown on the Drawings, weepholes shall be provided in retaining walls and wingwalls. | <b>Weep Holes</b> |
|----|--|-------------------|

## C271.10 CONSTRUCTION

- |    |  |   |
|----|--|---|
| 1. | The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.  | <b>Formwork Material</b>                    |
| 2. | Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.  | <b>Timber Requirements</b>                  |
| 3. | Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with AS 2271, the hardwood shall comply with AS 2082 and the particle board with AS/NZS 1859. All Timber (plywood, hardwood and particle board) used shall be approved by the Superintendent.  | <b>Timber Standards</b>                     |
| 4. | Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1m and uniform lengths of not less than 2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than 15mm thick. Form panels less than 15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern. | <b>Formwork Panels for Exposed Surfaces</b> |
| 5. | Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board.   | <b>Hidden Surfaces</b>                      |
| 6. | Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.  | <b>Mild Steel Surfaces</b>                  |

## C271.11 ERECTION

- |                    |   |                                     |
|--------------------|---|-------------------------------------|
| <b>(a) General</b> |   | <b>Formwork Position Tolerances</b> |
| (i)                | Dimensions and position of forms, shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.  |                                     |
| (ii)               | Joints as erected shall be mortar tight.  | <b>Mortar Tight</b>                 |
| (iii)              | The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints. | <b>Coating of Internal Surfaces</b> |
| (iv)               | Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.   | <b>Release Agent</b>                |

<b>(b) Approval by the Superintendent is required prior to the pouring of the concrete in the following instances:</b>	<b><i>Reinforcement Placement</i></b>
(i) After the formwork has been placed.	
(ii) After the reinforcement has been placed (all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms).	<b><i>Concrete Placement</i></b>
(iii) When an inspection is requested, the Contractor shall give not less than one business day (excluding Saturdays, Sundays and public holidays) notice to the Superintendent prior to the date of inspection.	<b><i>Notice of Inspection</i></b>

## MATERIALS FOR CONCRETE

### C271.12 CEMENT AND FLYASH

#### ***CEMENT***

1. Cement shall be Type GP (General Purpose) Portland Cement complying with AS 3972 and shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.	<b><i>Quality</i></b>
2. When submitting details of the nominated mix in accordance with Clause C271.17, the Contractor shall nominate the brand and source (including works) of the cement. On approval of the nominated mix by the Superintendent, the Contractor shall only use the nominated cement for the work.	<b><i>Nominated Brand and Source</i></b>
3. Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.	<b><i>Proof of Quality</i></b>
4. If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, a re-test shall be required at the Contractor's expense before the cement is used.	<b><i>Storage Time</i></b>
5. All cement shall be transported in watertight containers, and shall be protected from moisture until used. Caked or lumpy cement shall not be used.	<b><i>Transport and Storage</i></b>

#### ***FLYASH***

Flyash is permitted to be added to concrete to a maximum 100kg/m<sup>3</sup> however no reduction in the cement content is permitted.

### C271.13 WATER

Water used in the production of concrete shall be town supply water, meeting NH& MRC Guidelines	<b><i>Quality &amp; Potability</i></b>
---	--

### C271.14 FINE AGGREGATE

1. Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent) material finer than 2 micrometres, impurities and reactive materials.	<b><i>Quality</i></b>
2. Fine aggregates shall be evenly graded within the absolute limits shown in Table C271.1, and shall not deviate from the proposed grading by more than the amounts in Table C271.1.	<b><i>Grading Requirements</i></b>

Australian Standard Sieve	Proportion Passing (% of Mass)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	±5
1.18mm	40 - 85	±10
300µm	8 - 30	±10
150µm	2 - 10	±5
75µm	0 - 4	±3

Table C271.1 - Fine Aggregate Grading

**C271.15 COARSE AGGREGATE**

1. Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag and shall conform to the requirements of AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this Specification. If required, coarse aggregate shall be washed to satisfy these requirements.

**Quality**

2. The percentage of wear shall be determined by AS 1141.23, and the loss of weight shall not exceed 30 per cent.

**Wear Test**

3. When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

**Additional Tests**

- (i) Crushing Value - AS 1141.21  
The aggregate crushing value shall not exceed 25 per cent.
- (ii) Soundness - AS 1141.24  
The loss of mass when tested with sodium sulphate shall not exceed 12 per cent.
- (iii) Particle Shape - AS 1141.14  
The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35 per cent.

4. Coarse aggregate shall be evenly graded within the absolute limits shown in Table C271.2 and shall not deviate from the grading of the samples submitted under Clause C271.17 by more than shown.

**Grading Requirements**



Australian Standard Sieve  (mm)	Proportion Passing (% of Mass)			Deviation Proposed Grading  (% of Mass of Sample)
	40mm Nominal	20mm Nominal	Extrusion Concrete	
	For Walls exceeding 150mm thickness	For all other structures		
53.0	100		100	±10
37.5	95 - 100			
26.5		100		±10
19.0	30 - 70	95 - 100		
13.2				±5
9.50	10 - 35	25 - 35		
4.75	0 - 10	0 - 10		±5
2.36	0 - 2	0 - 2		

**Table C271.2 - Coarse Aggregate Gradings**
**C271.16 ADMIXTURES**

Admixtures or combination of additives may be used only if approved by the Superintendent and shall be incorporated as directed by the Superintendent.

**C271.17 TESTING OF MATERIALS**

1. The Contractor shall submit to the Superintendent a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed to be used in the work.

**Contractor's  
Responsibility**

2. The materials shall only be used after receipt of the Superintendent's notification of acceptance, and then only so long as the materials accord with the specification.

**Use of Material**

**HANDLING AND TREATMENT OF CONCRETE**
**C271.18 MEASURING**

1. All materials shall be measured by weight, except that:-

**Measurement of  
Material**

- (a) Water may be measured by volume with an approved adjustable water-measuring and discharging device, and,
- (b) Cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement, and for this purpose one bag of cement shall be assumed to weigh 40kg. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper.
- (c) Measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

## C271.19 MEASURING BY WEIGHT, ON-SITE MIXING

1. Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table C271.3 may be used as a guide to produce the classes of concrete specified. Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete. The use of proportions shown in Table C271.3 shall not relieve the Contractor of his obligation to provide concrete of the specified compressive strength.

**Mixing by  
Weight on Site**

MPa	Cement Kg	Fine Aggregates Kg	Coarse Aggregates Kg	Total Aggregates Kg
10	40	130	250	380
15	40	100	190	290
20	40	88	126	214

**Table C271.3 - Materials in Batch containing 1 bag (40Kg) Cement**

2. The proportions set out in Table C271.3 make allowance for moisture contents of aggregates of 6 per cent for fine aggregates and 1 per cent for coarse aggregates. Where the moisture content of aggregates exceeds 8 per cent or 3 per cent respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

**Variation in  
Aggregate  
Moisture  
Content**

## C271.20 MEASURING BY VOLUME, ON-SITE MIXING

1. Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

**Mixing by  
Volume on Site**

2. The nominal proportions given in Table C271.4 may be used as a guide for volume batching.

**Volume  
Batching**

MPa	Parts by Volume		
	Cement	Fine Aggregate	Coarse Aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

**Table C271.4 - Volume Batching**

3. The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins. The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level. Measurements by shovels or like methods will not be permitted. Batch proportions shall be so arranged that each batch contains 1 bag of cement. One 40kg bag of cement shall be assumed to have a volume of 27.5 litres.

**Batch  
Measurement**

## C271.21 CONSISTENCY

- |    |   |                                      |
|----|---|--------------------------------------|
| 1. | A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface. The water to cement ratio shall not exceed .55. If required by the Superintendent, the Contractor shall determine the consistence of the concrete in accordance with AS 1012.3, Method 1. Except for extruded concrete, the nominated slump shall not exceed 80mm, plus the field tolerance of $\pm 15$ mm. | <b>Consistency Requirements</b>      |
| 2. | In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10mm to 15mm.   | <b>Extruded Concrete Consistence</b> |

## C271.22 MIXING AND DELIVERY

### (a) General

- |      |  |                                |
|------|--|--------------------------------|
| (i)  | Concrete may be mixed either at the site or at a central mixing plant. All concrete shall be mixed with mechanically operated mixers. In an emergency, hand mixing may be permitted. | <b>Mechanical Mixing</b>       |
| (ii) | Any concrete which exhibits signs of segregation shall not be used.  | <b>Segregation of Concrete</b> |

### (b) Machine Mixing at Site

- |       |  |                            |
|-------|--|----------------------------|
| (i)   | The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.  | <b>Mixer Requirements</b>  |
| (ii)  | The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer's rated capacity of the mixer. | <b>Mixer Capacity</b>      |
| (iii) | The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.                                       | <b>Mixing Time</b>         |
| (iv)  | The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.  | <b>Total Mix Discharge</b> |

### (c) Mixing in an Emergency

- |       |  |                               |
|-------|--|-------------------------------|
| (i)   | In the case of breakdown of the mechanical mixing equipment, hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint is permitted.  | <b>Hand Mixing</b>            |
| (ii)  | Hand mixing shall be done on a water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10 per cent more than the amount specified for machine mixed concrete.   | <b>Hand Mixing Conditions</b> |
| (iii) | The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer. The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler. After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance. Hand-mixed batches shall not exceed 0.25 cubic metres each. | <b>Hand Mixing Procedure</b>  |

**(d) Ready-Mixed Concrete**

(i) The concrete shall be mixed and delivered in accordance with the requirements of AS 1379 relating to:-

**Mixing  
Standard and  
Discharge  
Times**

(1) Mixing and Delivery; and

(2) Use of Non-Agitating Equipment,

with the exception that in (1) the time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours, and in (2) not more than 30 minutes.

(ii) The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

**Cleansing and  
Positioning of  
Chutes**

**C271.23 PLACING AND COMPACTING CONCRETE**

1. No concrete shall be mixed or placed, without the approval of the Superintendent, while the air temperature is, or is likely to be within 24 hours, below 5°C, while the shade temperature exceeds 38°C. All concrete shall be placed in the dry.

**Air  
Temperature  
Requirements**

2. No concrete shall be mixed or placed unless the forms are free of water and all items not intended to be in the concrete structure are removed.

3. The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

**Placement  
within Time  
Limit**

4. The concrete shall be deposited in the forms, without segregation. Concrete shall not be dropped freely from a height greater than 1.2 metres, or be deposited in large quantities at any point and moved or worked along the forms. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed. The concrete shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms. The freshly placed concrete shall be compacted by vibrator units. Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement.

**Placement in  
Forms,  
Vibrating**

5. Exposed surfaces of the concrete shall be finished with an appropriate float. Where shown on the Drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

**Exposed  
Surfaces**

6. Concrete shall not be moved after it has been in the forms for more than 10 minutes.

**Initial Set**

**C271.24 FINISHING OF UNFORMED SURFACES**

**(a) Surfaces other than Wearing Surfaces**

1. Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water which comes to the surface. A capping of mortar will not be permitted.

**Finish for  
Unformed  
Surfaces**

- |   |  |
|---|--|
| <p>2. All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.</p> | <p><b><i>Future Contact Surfaces</i></b></p> |
|---|--|

**(b) Wearing Surfaces**

- |   |  |
|---|--|
| <p>1. Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and finally dressed with broom finish or a wooden template or float unless shown otherwise on the drawings or specified by the Superintendent. The departure from grade shall not exceed 5mm in any 3 metre length.</p> | <p><b><i>Finish for Wearing Surfaces</i></b></p> |
| <p>2. Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.</p>  | <p><b><i>Surface to receive Asphalt</i></b></p>  |

**(c) Finished Levels**

- |   |  |
|---|--|
| <p>1. The finished levels of concrete structures shall not vary more than 10mm from the specified levels. Barriers, footpaths and similar shall not deviate from level or alignment by more than 5mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical and horizontal curves.</p> | <p><b><i>Surface Tolerance</i></b></p> |
|---|--|

**C271.25 CURING AND PROTECTION**

- |   |  |
|---|--|
| <p>1. The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance from an Australian laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.</p>   | <p><b><i>Efficiency Index</i></b></p>  |
| <p>2. The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. When applied with an hand lance the rates shall be increased by 25 per cent.</p>   |  |
| <p>3. The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.</p>  | <p><b><i>Application Rate</i></b></p>  |
| <p>4. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.</p>   | <p><b><i>Curing Period</i></b></p>     |
| <p>5. The cost of making good such damaged curing membrane shall be borne by the Contractor.</p>  | <p><b><i>Contractor's Cost</i></b></p> |
| <p>6. Equipment and materials for curing operations shall be kept on site at all times during concrete pours.</p>   | <p><b><i>Equipment on Site</i></b></p> |
| <p>7. Freshly cast concrete shall be protected from premature drying and excessively hot or cold temperatures by:-</p> <ul style="list-style-type: none"> <li>(i) Ponding or continuous sprinkling of water</li> <li>(ii) The use of an absorptive cover kept continuously wet</li> <li>(iii) The use of curing compounds below: <ul style="list-style-type: none"> <li>• Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, or</li> </ul> </li> </ul> |  |

- White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2,

Curing shall continue until the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of air in contact with the concrete is above 10 C has totalled 7 days for normal Portland Cement concrete.

Steel forms heated by the sun and all wood forms in contact with the concrete during the final curing period, shall be kept wet. If forms are removed during the curing period, one of the methods of final curing shall be employed immediately and continued for the remainder of the curing period.

Notwithstanding the preceding requirements, all concrete placed during the months of November through March shall be sprayed with curing compound immediately on completion of finishing or on stripping and then water-cured as specified.

The concrete shall be protected from damage due to overstresses, heavy shocks and excessive vibration, particularly during the curing period.

All finished concrete surfaces shall be protected from damage caused by construction equipment, materials, or methods and by rain or running water.

Water used for curing shall comply with AS 1379.

## C271.26 REMOVAL OF FORMS

1. All forms shall remain in place for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10°C during the periods specified.

***Walls, Sumps etc.***

Mass retaining walls, headwalls, wingwalls, gully pits, sumps, and similar drainage structures	48 hours
--	----------

Footpaths, driveways and similar	48 hours
----------------------------------	----------

Sides of reinforced concrete walls when height of each day pour is:

(i) under 0.6 metres	1 day
(ii) 0.6m to 3m	2 days
(iii) 3m to 6m	3 days
(iv) 6m to 9m	5 days
Supporting forms under deck slabs of culverts	10 days

2. To permit the satisfactory finishing of kerbs, gutters and channels, forms shall be removed in not less than 12 hours nor more than 48 hours after placing concrete, depending upon weather conditions.

***Kerbs, Gutters & Channels***

3. Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

***Protection of Concrete***

4. No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70 per cent of the design strength.

***Superimposed Load***

5. Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

***Removal of Hole Formers***

## C271.27 TREATMENT OF FORMED SURFACES

1. All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result. **Quality of Surfaces**
2. As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float. **Repair of Defects**
3. Where the use of tie wires or other fitments is permitted by the Superintendent any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above. **Removal of the Wires**
4. The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer. **Coating with Bonding Agent**

## C271.28 JOINTS

1. Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures (other than barriers and footpaths) the joints may be made at the base of walls and at other locations in the walls where approved by the Superintendent. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout. **Horizontal Construction Joint**
2. Retaining walls shall be provided with vertical expansion joints as shown on the Drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete. **Vertical Expansion Joints**
3. Where barriers are extruded or cast in place, narrow transverse vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints, shall be at intervals of 3 metres. **Barrier Contraction**
4. In barriers, unless shown otherwise on the Drawings, expansion joints, 15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding 15m and where the barrier abuts against gully pits. Expansion joints shall consist of a preformed joint filler complying with RTA Specification 3204. **Barrier Expansion**
5. In footpaths, median toppings and driveways, unless otherwise shown on the Drawings, expansion joints, 15mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of a preformed joint filler complying with RTA Specification 3204.
6. All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep to induce transverse contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form "slabs". The ratio of the longest side to the shortest side shall not exceed 1.6. The shortest side of the "slab" shall be a maximum of 4m.

## C271.29 STRENGTH OF CONCRETE

1. When tested in accordance with AS 1012.9, the concrete shall have a compressive strength not less than that shown on the Drawings or if not shown shall have a compressive strength not less than that specified in Table C271.5 for the particular class of work.

**Strength Requirement**

3. The strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

**Determination of Strength**

3. In general, two pairs of test specimens shall be moulded for each 15 cubic metres of concrete, or part thereof, one pair being intended for the 7 day test if required and the other pair for a 28 day test.

**Moulding of Cylinders**

Use	MPa	Minimum Cement per cu metre	Coarse Aggregate Nominal Size	Maximum Water/Cement Ratio	Cylinder Strength Required	
		Kg	mm		7 days	28 days
					MPa	MPa
Foundations, mass retaining walls	20	330	40	.55	15	20
Mass concrete footings, pitching, linings etc.	20	330	20	.55	15	20
Drainage structures, driveways footpaths, New Jersey barrier, miscellaneous concrete work	20	330	20	.55	15	20
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining walls	32	380	20	.5	24	32
Extruded concrete	20	330	14	.55	15	20

**Table C271.5 - Concrete Strength Requirements**

4. The strengths specified at 28 days shall be increased as shown in Table C271.6 for tests at ages in excess of 28 days.

**Strength Age Factor**



*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25
*For intermediate ages the factor shall be determined on a pro-rata basis	

**Table C271.6 - Concrete Age Conversion Factors**

5. If the test specimens fail to achieve the specified strength, the Contractor may, with the approval of the Superintendent, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements, the concrete will be accepted.

**Cores and Test Acceptance**

6. If cores taken fail to satisfy the strength requirements, the concrete shall be removed.

**Failure of Cores**

### **C271.30 SAMPLING CONCRETE**

1. Equipment and facilities shall be provided by the Contractor for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work.

**Contractor's Responsibility**

2. Concrete test specimens shall be either cylinders 200mm long and 100mm diameter or 300mm long and 150mm diameter, moulded concurrently in the presence of the Superintendent or his representative, in accordance with AS 1012.8, from samples taken in accordance with AS 1 012.1.

**Moulding of Test Cylinders**

## **STEEL REINFORCEMENT FOR CONCRETE**

### **C271.31 MATERIAL**

1. Steel reinforcement shall comply with the requirements of the appropriate following Australian Standards:-

**Standards**

- (a) AS 1302 Steel Reinforcing Bars for Concrete.
- (b) AS 1303 Steel Reinforcing Wire for Concrete.
- (c) AS 1304 Welded Wire Reinforcing Fabric for Concrete.

2. The type and size of bars shall be as shown on the Drawings.

**Type and Size**

3. Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.

**Quality**

4. The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS 1302, AS 1303 or AS 1304, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis. *Documentary Evidence*

5. Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length. The cost of all samples and tests shall be borne by the Contractor. *Further Sampling Contractor's Cost*

6. Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at  $23 \pm 5^{\circ}\text{C}$  without being pierced by the wire. The Contractor shall demonstrate that the proposed chairs conform with these requirements. *Wire Chairs*

## **C271.32 BENDING**

1. Reinforcement shall be formed to the dimensions and shapes shown on the Drawings. It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the drawings will not be accepted. Heating of reinforcement for purposes of bending will not be permitted. Where the radius of a bend or hook is not stated on the drawings, it shall be made around a pin having a diameter of not less than four times the diameter of the bar bent. *Cutting and Bending*

## **C271.33 SPLICING**

### **(a) General**

1. All reinforcement shall be furnished in the lengths indicated on the Drawings. If splicing is required, this to be in accordance with the provisions of AS 1302. *Plan Lengths*

2. The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor. *Contractor's Cost*

## **C271.34 MARKING**

1. Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire. Each bundle shall have a stout metal label of not less than 40mm diameter attached to it. Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings. If called for on the Drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately. *Marking Details*

## **C271.35 STORAGE**

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure. *Protection of Reinforcement*

## **C271.36 DELIVERY AND RECEIPT OF REINFORCEMENT**

The Reinforcement will be inspected and samples taken at the worksite from the actual reinforcement delivered, in which case the Contractor must accept all risks of rejection if the reinforcement is found to be unsatisfactory and must in any case replace the bars from which the test pieces are taken.

**C271.37 PLACING**

1. Reinforcement shall be accurately placed as shown on the Drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25mm. Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on the Drawings.

***Reinforcement  
Position***

2. The reinforcement in each section of the work shall be approved by the Superintendent before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours.

***Inspection  
Required***

3. Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

***Splices***

4. Bars forming a lapped splice shall be securely wired together in at least two places.

***Lapped Splice***

5. The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the Drawings. Where not so indicated it shall be in accordance with the Australian standard and as stated below:

***Bar Cover***

- (a) Concrete normally in contact only with air
  - (i) Slabs: 40mm
  - (ii) Other than slabs: 45mm
- (b) Concrete in contact with earth or fresh water
  - (i) Slabs of box culverts: 50mm
  - (ii) Other than culverts: 50mm
- (c) Concrete to be 32MPa

In no cases shall the cover be less than 1½ times the diameter of the bar.

**BACKFILLING****C271.38 GENERAL**

1. Backfilling at barriers, paving, etc, and concrete works shall not commence until after the concrete has hardened and the removal of forms in accordance with C271.26. If required by the Superintendent testing prior to backfilling may be required. and not earlier than three days after placing.

2. Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 1289.3.3.1. The material shall be placed in layers not exceeding 150mm and shall be compacted to provide a relative compaction of not less than 98 per cent in accordance with AS 1289.5.1.1.

***Selected  
Backfill***

## C271.39 TREATMENT AT WEEPHOLES

- |   |   |
|---|---|
| <p>1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:</p> <p>(a) The maximum particle dimension shall not exceed 50mm</p> <p>(b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.</p> | <p><b><i>Size &amp; Type of Backfill Material</i></b></p> |
| <p>2. The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.</p>  | <p><b><i>Extent of Material</i></b></p>                   |
| <p>3. Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.</p>                     | <p><b><i>Synthetic Membrane</i></b></p>                   |

## SPRAYED CONCRETE

### C271.40 GENERAL

- |  |  |
|--|--|
| <p>1. Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.</p>  | <p><b><i>Definition</i></b></p>                  |
| <p>2. The minimum depth of sprayed concrete to be applied shall be 75mm.</p>   | <p><b><i>Depth</i></b></p>                       |
| <p>3. Sprayed concrete shall have a minimum cement content of 380 kg/m<sup>3</sup> as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete.</p>  | <p><b><i>Strength</i></b></p>                    |
| <p>4. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.9 and AS 1012.14. Equipment and facilities shall be provided by the Contractor for the taking of cores from the work. The Contractor shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the Superintendent.</p> | <p><b><i>Test Cores</i></b></p>                  |
| <p>5. The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.</p>  | <p><b><i>Contractor's Cost</i></b></p>           |
| <p>6. At least 14 days prior to applying any sprayed concrete the Contractor shall submit to the Superintendent details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS 3600.</p>  | <p><b><i>Contractor's Responsibility</i></b></p> |

### C271.41 TEST PANELS

The Superintendent may require the following Test Steps prior to the application of sprayed concrete:

- |  |                                  |
|--|----------------------------------|
| <p>1. Not less than 10 days before applying concrete, the Contractor shall prepare at least 3 test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent. The test panels shall be made by applying a 75mm thickness of sprayed concrete to a hardboard panel approximately 750mm square. The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works. The panels shall be submitted to the Superintendent for examination.</p> | <p><b><i>Test Panels</i></b></p> |
|--|----------------------------------|

- |   |                       |
|---|-----------------------|
| 2. The Contractor shall cut four 75mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed. The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days. | <b>Cores</b>          |
| 3. Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.                                 | <b>Defective Core</b> |
| 4. Sprayed concrete shall not be applied to the Works until the Contractor produces test panels to the satisfaction of the Superintendent.  | <b>Approval</b>       |

#### **C271.42 SURFACE PREPARATION**

- |  |                    |
|--|--------------------|
| 1. Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.    | <b>Earth</b>       |
| 2. Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete. | <b>Rock</b>        |
| 3. Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.  | <b>Steel Pipes</b> |
| 4. The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.  | <b>Water Flow</b>  |

#### **C271.43 APPLICATION OF SPRAYED CONCRETE**

- |   |   |
|---|---|
| 1. Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed by air jet or other suitable means from the surface as work proceeds and disposed of. | <b>Procedure</b>                        |
| 2. Spraying shall be discontinued if wind causes separation of the nozzle stream.   | <b>Wind Problem</b>                     |
| 3. Concrete shall not be sprayed in air temperatures less than 5°C.   | <b>Air Temperature</b>                  |
| 4. Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.  | <b>Construction Joints</b>              |
| 5. When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.  | <b>Spraying around Reinforcement</b>    |
| 6. Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.   | <b>Protection of Adjoining Surfaces</b> |

**C271.44 CURING**

1. Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied at 0.2 litres per square metre.

***Commence-  
ment***

2. In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days.

***Water Curing***

## LIMITS AND TOLERANCES

### C271.45 SUMMARY OF LIMITS AND TOLERANCES

1. The tolerances applicable to the various clauses in this Specification are summarized in Table C271.7 below:

Item	Activity	Tolerances	Spec Clause
1.	<b>Subgrade</b>		
	(a) Relative Compaction	≥95% (standard compactive effort)	C271.03
2.	<b>Barriers, Footpaths etc.</b>		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 12mm under a straight-edge 3 metres long.	C271.04
	(b) Relative Compaction of Subbase	≥98% (modified compactive effort) ≥100% (standard compactive effort)	C271.04
3.	<b>Formwork</b>		C271.11
	(a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the Drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	
4.	<b>Fine Aggregate</b>		
	(a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table C271.1.	C271.14
5.	<b>Coarse Aggregate</b>		
	(a) Percentage of wear	Loss of weight shall not exceed 30%	C271.15
	(b) Crushing Value	Crushing value shall not exceed 25%	C271.15
	(c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	C271.15
	(d) Particle Shape	The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35%	C271.15
	(e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table C271.2.	C271.15
6.	<b>Aggregate Moisture Content</b>	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	C271.19

Item	Activity	Tolerances	Spec Clause
7.	<b>Consistency</b>	In accordance with AS 1012.3, Method 1 the slump shall not exceed the nominated slump $\pm 15\text{mm}$ .	C271.21
		In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm.	C271.21
8.	<b>Ready-Mixed Concrete</b>		
	(a) Mixing & Delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours.	C271.22
		Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	C271.22
9.	<b>Placing &amp; Compacting of Concrete</b>	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below $5^{\circ}\text{C}$ or the shade temperature is likely to exceed $38^{\circ}\text{C}$ .	C271.23
10.	<b>Finishing of Unformed Concrete Surfaces</b>		
	(a) Wearing Surface	To be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3 metre length.	C271.24
	(b) Finished Level	The finished levels of concrete structures not adjacent to road pavements shall not vary more than 10mm from the specified levels.	C271.24

**Table C271.7 - Summary of Limits and Tolerances**



**SPECIAL REQUIREMENTS**

**C271.46    RESERVED**

**C271.47    RESERVED**

**C271.48    RESERVED**

**C271.49    RESERVED**

**C271.50    RESERVED**

**C271.51    RESERVED**

# DEVELOPMENT CONSTRUCTION SPECIFICATION

**C273**

Modified 3

## **LANDSCAPING**



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## SPECIFICATION C273 : LANDSCAPING

### GENERAL

#### C273.01 SCOPE

1. The work to be executed under this Specification consists of:
  - (a) The vegetation of cut and fill batters, median areas, open drains, gardens, turfed areas, carpark landscapes and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection works, hydroseeding, hydromulching and straw mulching.
  - (b) The supply of plants, planting at locations as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

#### C273.02 REFERENCE DOCUMENTS

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

**(a) Council Specifications**

- C211 - Control of Erosion and Sedimentation.
- C213 - Earthworks.
- Singleton Shire Council "Policy for Urban Street Trees"

**(b) Australian Standards**

- AS 1160 - Bitumen emulsion for construction and maintenance of pavements.
- AS 4419 - Soils for landscaping and garden use.

**(c) Other**

Upper Hunter Weeds Authority

### VEGETATION OF SLOPES AND DRAINS

#### C273.03 PROTECTION OF EXISTING VEGETATION

**a. Execution and Timing of Work**

1. In association with the work to be executed under this Specification, the Contractor shall implement effective erosion and sedimentation control measures in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION.
2. The work to be executed under this Vegetation of Slopes and Drains includes the vegetation of cut and fill batters, footpaths, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the Drawings.
3. Exposed ground shall be vegetated before the area exceeds one hectare.

***Contractor's  
Responsibility***

***Vegetation***

***Exposed  
Ground***

**b. Existing Vegetation**

All existing trees with a trunk diameter >150mm or height >5m must be identified on the drawings

**1. Trees to be retained**

Trees to be retained as indicated in the landscape drawings. To restrict movement, construction and storage of materials near trees with heritage or cultural significance, protective fencing shall be installed as indicated on drawings.

If it is necessary to perform any work on trees to be retained, apply for permission and await instructions.

If trees are damaged during construction, repair trees by minor trimming, staking, tying etc.

If repair work is impractical, or is attempted and is rejected, remove the tree and root system, if directed, make good and either replace the tree with a tree of the same species and similar size, or pay damages.

**2. Work near trees**

Protect trees specified or shown to be retained from damages by groundworks. Take necessary precautions, including the following:

- i. Harmful materials: Do not store or otherwise place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks. Prevent windblown materials such as cement from harming trees and plants.
- ii. Damage: prevent damage to tree bark. Do not attach stays, guys and the like to trees.
- iii. Work under trees: Do not add or remove topsoil within the drip line of trees. If it is necessary to excavate within the drip line, use hand methods such that root systems are preserved intact and undamaged. Open up excavations under tree canopies for as short as period as possible.
- iv. Roots: Do not cut tree roots exceeding 50mm diameter unless permitted. Where it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, apply a bituminous fungicidal sealant to the cut surface to prevent the incursion of rot or disease.
- v. Backfilling: Backfill to excavations around tree roots with a mixture consisting of three parts by volume of topsoil and one part of well rotted compost with a neutral Ph value, free from weed growth and harmful materials. Place the backfill layers, each of 300mm maximum depth, compacted to a dry density similar to that of the original surrounding soil. Do not backfill around tree trunks to a height greater than 300mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.
- vi. Compacted ground: Avoid compaction of the ground under trees. If compaction nevertheless occurs, for example from the operation of heavy constructional plant, notify the superintendent and obtain his instructions, for aeration once construction commences.

**C273.04 MATERIALS****(a) Topsoil**

1. The Contractor shall use topsoil stockpiled on site under the Specification for EARTHWORKS. Where imported topsoil is required it shall comply with AS 4419 and shall:-

**Quality**

- be of a friable, porous nature;
- be free of weeds and weed seeds, bulbs, corms and vegetable propagules;
- contain no refuse or materials toxic to plant growth;
- contain no stumps, roots, clay lumps or stones larger than 50mm in size;
- have an organic content of at least 3 per cent by mass;
- have a pH neither less than 5.5 nor more than 7.5;
- have a soluble salt content not exceeding 600 ppm.

**(b) Herbicide**

1. Herbicide used shall be a glyphosate based herbicide such as 'Roundup'. Other glyphosate based herbicides may be approved by the Superintendent provided that an equivalent concentration of the active ingredient glyphosate is applied.

**(c) Seed****Seed Type and Supplier**

1. All seed used shall be of the species and varieties listed in Annexure C273A and shall be sown at the application rates shown therein. The Contractor shall submit to the Superintendent the name/s of the proposed seed supplier/s within two weeks of the acceptance of the tender.

2. The Contractor's attention is drawn to the lead time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

**Lead Time for Native Seed**

3. All seed must be accompanied by a "Certificate of Authenticity" which shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

**Certification**

4. The Contractor shall not take possession of the seed more than seven days before sowing is to occur. The seed shall be stored in clean, air tight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

**Storage**

5. The Contractor shall replace at his own expense any exotic seed batch found not true to type.

**Contractor's Cost****(d) Turf**

1. Turf shall consist of 25mm depth of dense, well rooted, vigorous grass growth with 25mm depth of topsoil. The type of grass turf to be used will be indicated on the Drawings. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300mm, and shall be in sound unbroken condition.

- All turfed areas to have a minimum of 150mm of good quality topsoil placed prior to turfing, cultivated to a fine tilth and even grade.
- Turf Types - kikuyu, couch or buffalo to be used. Runs of turf must butt hard against each other and be placed perpendicular to the direction of surface water flow.

- Turfed areas to be separated from gardens by means of a concrete, brick or securely fixed treated hardwood mowing strip
- All turf areas are to be kept back for a radius of a minimum of 300mm from trunks of trees.
- Four to six weeks after placement, the turf shall be lightly topdressed with sandy loam to correct any unevenness in the turf. If the time for topdressing falls in winter, topdressing may be deferred until Spring.
- Design of Turfed Areas:
  - i. All turf areas to be maintained by mowing must be slopes of 4:1 or flatter.
  - ii. All turfed areas on Council land must be designed to facilitate easy and efficient mowing by mowers 1.8m wide or wider.

**(e) Fertiliser**

1. Fertiliser used shall be an organic type such as 'Dynamic Lifter-Nitro' with Nitrogen:Phosphorus: Potassium (N:P:K) ratios of 8 : 3.6 : 2 or an equivalent fertiliser approved by the Superintendent.

**Type****(f) Vegetable Mulch**

1. Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded (pass a 50mm  $\phi$  screen). Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50 per cent by mass of the total mulch.

**Composition****(g) Water**

1. Water used shall be potable.

**Quality****(h) Binder**

1. The binder used in hydromulching and strawmulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

**Type****(i) Wetting Agent**

1. The soil wetting agent added in hydromulching or hydroseeding shall be 'Aquasoil' applied at a rate of one litre per 1,000 litres of mix water or an equivalent soil wetting agent approved by the Superintendent.

**Application Rate****(j) Insecticide**

1. Insecticide used shall be Lorsban 500EC or Lorsban 250W or an equivalent insecticide approved by the Superintendent.

**Type****C273.05 VEGETATION OF SLOPES 3 TO 1 OR FLATTER****(a) Preparation of Surface**

1. Slopes shall be sprayed with the glyphosate based herbicide 'Roundup' applied at a rate of 9 litres of Roundup diluted in 200 litres of water per hectare of surface sprayed to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks. If woody weeds exist the use of other herbicides may be required.

**Herbicide Treatment**



2. The surface shall then be tined to a depth of 100 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling. **Preparation**

**(b) Topsoiling**

1. Topsoil shall be uniformly applied to provide an average compacted thickness of 50mm with a minimum compacted thickness of 30mm at any location. The topsoiled area shall be cultivated to a depth of 50mm to provide a roughened surface with soil lumps not exceeding 50mm dimension. **Application**

**(c) Mixing of Seed**

1. The Contractor shall give the Superintendent two days' notice before each sowing operation. Seed shall be sown on the day of mixing with insecticide. **Notice**

**(d) Incorporation of Insecticide**

1. Immediately before sowing, all grass and native seed shall be treated with insecticide. The insecticide shall be thoroughly mixed as a dry powder with the seed at a rate of 10 kilograms of insecticide to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with Annexure C273A. **Application Rate**

**(e) Sowing**

1. Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5mm or shall be raked or harrowed to provide 5mm cover. **Seeder**
2. Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in Annexure C273A. Fertiliser shall be applied concurrently with the seeding operation. **Sowing Rate**

**(f) Turfing**

1. Turf shall be placed on the prepared topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of surface water flow. **Placing**
2. Four to six weeks after placement, the turf shall be lightly topdressed with sandy loam to correct any undulations or unevenness in the turf. **Topdressing**
3. Turfed areas to be maintained by mowing must be 4:1 or flatter

**(g) Watering**

1. The Contractor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by the Superintendent, to promote and maintain growth.

**C273.06 VEGETATION OF SLOPES STEEPER THAN 3 TO 1**

**(a) General**

1. Where shown on the Drawings or directed by the Superintendent, slopes shall be vegetated by one of the following methods: **Method**
- (i) Topsoiling and hydromulching;
  - (ii) Topsoiling, hydroseeding and straw mulching;
  - (iii) Hydroseeding.

**i) Preparation of Surface**

- |   |                            |
|---|----------------------------|
| 1. Weeds shall be killed by spraying with herbicides as specified under Clause C273.05(a).  | <b>Herbicide Treatment</b> |
| 2. No more than seven days before seeding all loose material shall be removed from fill batters and cut batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by the Superintendent. | <b>Preparation</b>         |

**(c) Topsoiling**

- |   |                         |
|---|-------------------------|
| 1. Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50mm with a minimum compacted thickness of 30mm at any location. | <b>Application Rate</b> |
|---|-------------------------|

**(d) Hydromulching or Hydroseeding**

- |   |                           |
|---|---------------------------|
| 1. The hydromulch or hydroseed shall comprise the materials shown in Table C273.1. The materials shall be applied at the application rates shown in Table C273.1.   | <b>Application Rate</b>   |
| 2. Dry surfaces shall be watered by a fine spray before the application of the hydromulch.  | <b>Watering</b>           |
| 3. The mixing and treatment of seed shall be carried out in accordance with Clause C273.05(c).  | <b>Treatment of Seed</b>  |
| 4. During preparation of the hydromulch or hydroseed slurry, 'Lorsban 500EC' insecticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of insecticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table C273.1.   | <b>Insecticide</b>        |
| 5. Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.   | <b>Equipment</b>          |
| 6. A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface.   | <b>Uniform Mix</b>        |
| 7. Hydromulch or hydroseed shall not be applied under the following weather conditions at the site: <ul style="list-style-type: none"> <li>- when temperature is higher than 35°C</li> <li>- when winds exceed 15 km/hr;</li> <li>- where, in the opinion of the Superintendent, the surface is too wet or</li> <li>- during rain periods or when rain appears imminent.</li> </ul> | <b>Weather Conditions</b> |
| 8. Application rates shall be in accordance with Table C273.1   |                           |

Material	Application Rate per Hectare	
	Hydro-Mulching	Hydro-Seeding
i) Vegetable Mulch (kg)	2,500	Nil
ii) Water (l)	35,000	20,000
iii) Binder (l)	700	Nil
iv) Fertiliser	See Annexure C273A	
v) Seed	See Annexure C273A	
vi) Wetting Agent (l)	35	20
vii) Insecticide (l)	5	5

**Table C273.1 - MATERIALS AND APPLICATION RATES**

**(e) Straw Mulching**

1. The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20 mm at any location.

**Method**

**C273.07 VEGETATION OF OPEN DRAINS**

**(a) Preparation of Surface**

1. The Contractor shall so execute the work that the excavation of open drains to the specified profiles is followed within seven days by the vegetation of the surface as specified in this Clause. Topsoil shall be spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

**Profile and Topsoil**

**(b) Sowing**

1. Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in Annexure C273A by one of the following procedures as directed by the Superintendent:

**Procedure**

- (i) Mechanical sowing.
- (ii) Hydromulching or hydroseeding.
- (iii) By hand.

**(c) Surface Protection**

1. Where shown on the Drawings or directed by the Superintendent, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

**Methods**

- (i) Spraying with Bitumen Emulsion

An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of 1 litre of bitumen emulsion per square metre of surface.

**Application Rate**

(ii) Lining with Organic Fibre Mat

The channel surface shall be lined with an organic fibre mat such as 'Sta-Firma (light grade)' or an equivalent organic fibre mat approved by the Superintendent. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched.

**Quality**

The upstream end of the matting shall be slotted into a trench 150mm wide by 150mm deep and pinned to the base of the trench at 200mm centres. The trench shall be backfilled with soil and compacted by foot.

**Anchorage**

The pins shall be 'U' shaped, 4mm gauge wire, 50mm wide and 150mm long legs.

**Pins**

Adjacent runs of matting shall be overlapped 100mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500mm centres and along the middle of each run at 1 m centres. End overlaps shall be 150mm wide with the higher run end lapped over the start of the lower run and pinned at 200mm centres.

**Lapping**

(iii) Turfing

Turf shall be as specified under Clause C273.04(d).

**Quality**

Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain, and pinned into position at 500mm centres.

**Placing**

Seams of turf shall be topdressed with topsoil.

**Topdressing**

All other turfed areas to be maintained by mowing must be slopes of 4:1 or flatter.

**Slopes**

(iv) Watering

**Water**

1. The Contractor shall water treated areas in order to promote and maintain growth as specified under Clause C273.05(g).

## LANDSCAPE PLANTING

### C273.08 EXECUTION AND TIMING OF WORK

1. The work to be executed includes the ground preparation, the supply of plants, planting as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

**Extent of Work**

2. The Contractor shall give the Superintendent a minimum of two days' notice of commencement of planting. Landscape planting shall not be carried out in extreme summer conditions (above 35°C).

**Notice of Commencement**

### C273.09 MATERIALS

(a) Topsoil

1. Topsoil shall comply with the requirements of Clause C273.04(a).

(b) Herbicide

1. Herbicide shall comply with the requirements of Clause C273.04(b).

**(c) Fertiliser**

1. Fertiliser shall be a slow-release type in pellet form with a nine months' release period and having Nitrogen:Phosphorus: Potassium (N:P:K) ratios of 6.3 : 1.8 : 2.8. 'Kokei' fertiliser pellets or an equivalent fertiliser approved by the Superintendent shall be used. **Quality**

**(d) Mulch**

1. Mulch used for landscape planting shall comply with the following requirements: **Quality**
- (i) the material shall comprise hardwood chips;
  - (ii) fines shall not exceed 5 per cent by volume;
  - (iii) the average size of the woodchip shall be approximately 20 mm wide by 5 mm thick by 30 mm long and the maximum length of chip shall not exceed 50 mm; and
  - (iv) the material shall be free of soil, weeds, stones and other foreign material.
2. A 10 kilogram sample of mulch proposed by the Contractor shall be submitted for approval to the Superintendent two weeks before its intended use. The mulch subsequently used shall be consistent in every respect with the sample approved by the Superintendent. **Sample**

	Type or Stock				
	50mm Tube	Gro-Tube	Semi Advanced	Advanced Stock	Super Advanced
Plant Container: dia (mm) depth (mm)	50 75	75 100	150 150	200 200	300 300
Plant Height (mm) * (leaf & stem) *	200 min 400 max	300 min 500 max	300 min 400 max	300 min 500 max	500 min 750 max
Planting Holes: side (mm) depth (mm)	300 300 or ripline	300 300 or ripline	300 300	400 400	600 600
Number of Fertilizer Pellets	2	3	5	5	7

\*Not applicable for dwarf or prostrate species

**Table C273.2 - PLANT STOCK**

**(e) Plant Material**

1. The Contractor shall obtain all plants from a nursery located in an area having a similar climate to the site of the Works. **Source**

2. There shall be no substitution of any species without the Superintendent's approval. All plant material shall be true to species and sizes. Plants shall be healthy, of good form, not soft or forced and with large robust root systems. They shall not be rootbound and shall be free from disease and insect pests. All container soil mix shall contain between 20 per cent and 25 per cent clay by volume. Trees shall have a single leading shoot. **Quality**

For hardening off purposes, all plants shall be delivered to a site within the locality of the Subdivision at least four weeks before planting out. Plant root systems shall be maintained moist at all times with particular attention being paid to watering during the on-site period before and during planting. Plant stock shall be classified as indicated in Table C273.2, and planted in accordance with the Drawings.

**(f) Stakes****Size**

1. All stakes shall be:

<b>Plant size</b>	<b>Qty/plant</b>	<b>Material</b>	<b>Stake Size</b>
Tubes/grow tubes	3	bamboo or hardwood	600mm
150,200 or 300mm pots	1	hardwood	38x38x1500

**C273.10 PLANTING****(a) Mass Planting in Mulched Bed**

1. The mulched area shall be sprayed with herbicide, as specified under Clause C273.05(a), to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks. **Herbicide Treatment**
2. The surface shall be ripped at 500mm centres to a depth of 300mm and the top 200mm of the planting bed broken up by cultivation to a maximum size of 50mm. Mulch, 100mm thick, shall be spread over the planting bed. After removal of the localised mulch, planting holes shall be excavated to the square dimensions and depths as shown in Table C273.2 and the material removed. **Surface Preparation**
3. The specified number of fertilizer pellets as shown in Table C273.2 shall be placed beside the rootball of each plant. **Fertilizer Pellets**
4. The planting hole shall be backfilled with topsoil complying with Clause C273.04(a) and compacted by foot up to surface level, care being taken to avoid mixing mulch with topsoil. A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing. **Backfill and Staking**
5. Each backfilled hole shall receive 10 litres of water before the mulch is respread over the disturbed area. The mulch shall be left just clear of the plant stem. **Watering and Mulching**

**(b) Individual Planting**

1. A planting area 600 mm square shall be loosened to a depth of 400 mm. Planting holes shall be excavated to dimensions and depths as shown in Table C273.2 and the material spread evenly around each hole. See annexure C273B **Planting Holes**
2. The specified number of fertiliser pellets, as shown in Table C273.2, shall be placed beside the rootball of each plant. **Fertilizer Pellets**
3. The planting hole shall be backfilled with topsoil complying with Clause C273.04(a) and compacted by foot up to surface level. A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing. **Backfill and Staking**
4. Each backfilled hole shall receive 10 litres of water. **Watering**
5. Weed infestation for a distance of 800 mm surrounding each proposed planting shall be killed by spraying with a herbicide as specified in Clause C273.05(a). All due care shall be taken to avoid damage caused by contact between herbicide and the plant by means of spray drift etc. **Herbicide Spray**
6. Immediately after planting, mulch 100 mm thick, starting just clear of the plant stem, shall be spread over an area of 600 mm radius surrounding the plant. **Mulch**
7. Trees planted on the naturestrip must comply with Council's Street Tree Planting Policy.

### C273.11 CARE OF LANDSCAPE PLANTING

1. All landscape planting will have a minimum 6 weeks maintenance period after practical completion.

2. The Contractor shall water all plants, from the time of planting, so as to maintain the good health of the plants and vigorous growth during the maintenance period.

***Watering***

3. Missing plants, dead plants and plants nominated by the Superintendent as unhealthy shall be replaced by the Contractor at monthly intervals. Replacement plants shall be of similar size and quality and of identical species and variety to the plant being replaced. The cost of replacement shall be borne by the Contractor.

***Replacement  
Plants  
Contractor's  
Cost***

4. Weed and grass growth in mulched areas shall be killed by treatment with 'Roundup' or other herbicide approved by the Superintendent, in accordance with the manufacturer's instructions at monthly intervals during the construction period and contract maintenance period. Contact of the herbicide with the new plants shall be avoided and any damage repaired or damaged plant material replaced by the Contractor at no cost to the Principal.

***Weed Control***

***Contractor's  
Cost***

5. Turf must be mowed, weeded and watered to maintain healthy turf and vigorous growth during the maintenance period. Turf should be fertilized and topdressed. Failed turf must be replaced.

6. The Contractor shall remove any rubbish from any area in the landscape work site.

7. The Contractor shall maintain staking and tying of plants as necessary.

8. The Contractor shall maintain the irrigation system in full working order.

## SPECIAL REQUIREMENTS

### C273.12 NOXIOUS WEEDS

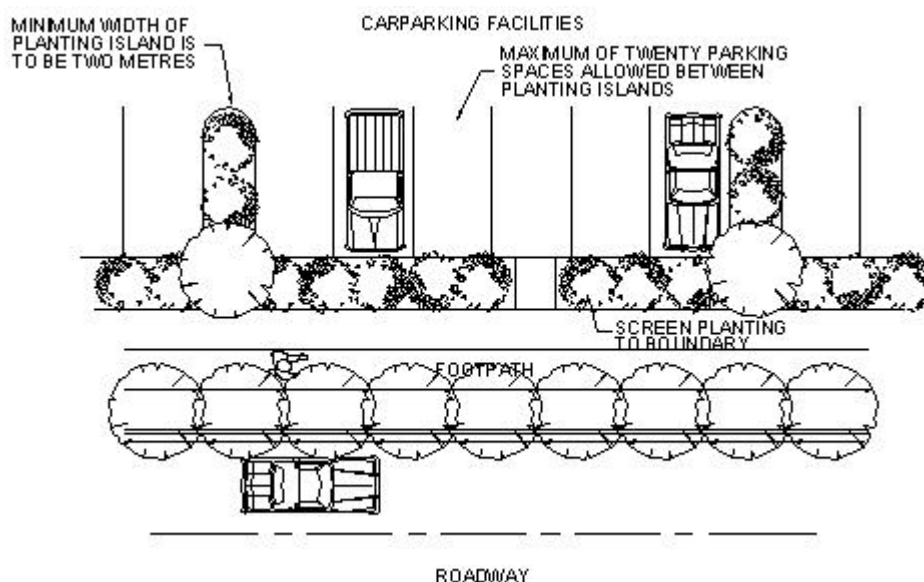
In Singleton Shire the control of noxious weeds is vested with the Upper Hunter Weeds Authority. The responsibility for eradication of noxious plants on private land is that of the land holder.

### C273.13 CARPARKING LANDSCAPING

1. The landscaping of carparking areas is to reduce the visual impact of large open spaces and maintain a human scale. To encourage this carparking areas are to include tree planting with massed shrubs and or groundcovers.

2. For the protection of this plant material all vehicles are to be separated from the landscape areas by means of a concrete kerb or dwarf wall.

3. Carparking spaces, as determined by Council are to be separated every twenty (20) parking (car) spaces wide, as depicted in Drawing below:



**FIGURE C273 –1  
CARPARKING SPACES**

4. Plant selection in the carpark should consider the requirement for:
  - a. hardiness
  - b. vigorous growth
  - c. longevity
  - d. ample shade
  - e. to minimise accident potential
  - f. whether plant (tree) drops sap onto parked cars.
5. The screening of the carpark should serve to enhance views from key viewing points. Screening does not imply the excessive use of shrubs to achieve a mass of plant material.
6. Carpark landscape proposals must identify the need for:
  - a. pedestrian and vehicular movement
  - b. reduction of accident potential
  - c. security of pedestrians and vehicles, and
  - d. the provision of drainage from garden areas.
7. The use of a different surface material should be considered to delineate the pedestrian areas.
8. Plant selection should be such that minimal maintenance will be required at maturity. In particular planting should not overgrow paths or cause restrictions to pedestrian and vehicular movement.
9. The landscape design is to consider Council's Carparking Development Control Plan.



**C273.14 IRRIGATION**

Council's climate requires irrigation to establish vigorous growth of landscape planting. The following shows levels of irrigation required for various work

Type of Development	Minimal Standard of Irrigation Required
Road works/batter stabilisation/drains	Nil
Residential – single dwelling	Hose cocks (within 15m of pedestrian access)
Dual occupancy	“ “ “ “ “
Common area Units/ townhouses	Manual dripline, soaker, micro sprinkler or sprinkler system
Industrial	Manual dripline, soaker, micro sprinkler Or sprinkler system
Commercial	“ “ “ “ ”

Automatic irrigation systems are defined as having means of automatically applying irrigation water at preprogrammed times.

Irrigation systems must have a method of preventing backflow and cross connection with the Council potable water supply.

Irrigation systems must be shown on landscape drawings and specifications.

Minimum cover over trenched irrigation pipework is to be 300mm

In ground valves must be housed in valve boxes. Typical 300x 450 pvc valve boxes must be finished flush with finished ground surface.

Pop-up sprinklers must be mounted on adjustable swing arms to facilitate adjusting level of sprinklers.

**C273.15 RESERVED****C273.16 RESERVED**

## LIMITS AND TOLERANCES

## C273.17 SUMMARY OF TOLERANCES

Item	Activity	Tolerances	Spec Clause
1.	<b>Topsoil</b>		
	a) Organic Content	>5% by mass	C273.04a
	b) pH	>5.0 <6.5	C273.04a
	c) Soluble Salt	<0.06% by mass	C273.04a
2.	<b>Topsoiling</b>	For Slopes – Minimum compacted thickness at any location of 30mm – For turfed areas – Minimum thickness 150mm cultivated to a fine tilth, even grade. For Open drains – Minimum compacted thickness 30mm at any location.	C273.05b C273.06c C273.04d C273.07a
3.	<b>Straw Mulching</b>		
	a) Bitumen Emulsion	Incorporated as a spray at a rate >2500 litres of bitumen emulsion per hectare of surface.	C273.06e
	b) Straw Mat	Finished thickness >20mm.	C273.06e
4.	<b>Vegetation of Open Drains</b>		
	a) Turfing	Widths >300mm.	C273.07c
5.	<b>Landscape Planting</b>		
	a) Temperature	Planting not to be undertaken when temperatures >35°C.	C273.08
6.	<b>Mulch</b>		
	a) Fines	Shall not exceed 5% by volume.	C273.09d
	b) Woodchip	Maximum size <50mm.	C273.09d
7.	<b>Plant Material</b>		
	a) Container Soil Mix	Contain >20% <25% by volume of clay.	C273.09e

Table C273.3 - LIMITS AND TOLERANCES

## ANNEXURES

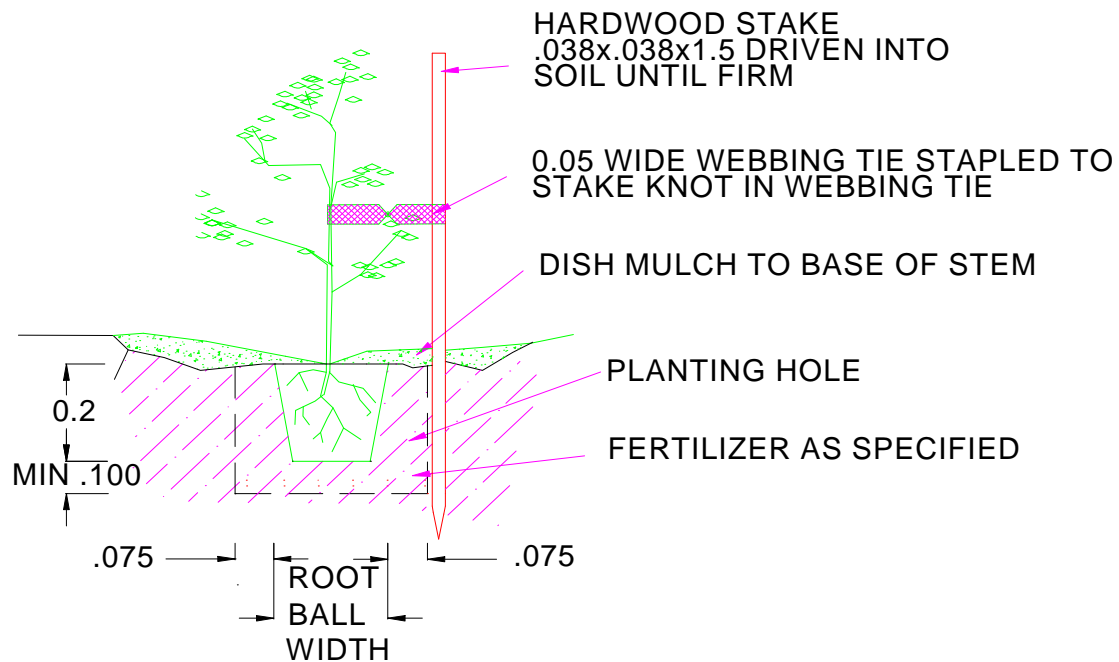
### ANNEXURE C273A

#### GRASS AND NATIVE SEED MIXTURES FOR SEEDING AND FERTILISING OF MEDIAN AND ROADSIDE AREAS

		<b>MINIMUM APPLICATION RATE</b> <b>(Kilograms or grams of seed or fertiliser per hectare of surface)</b>
GRASS SEED	Rye Corn (April-August) or	60 kg/ha
	Japanese Millet (Sept-March)	60 kg/ha
	Hulled Couch	5 kg/ha
	Red Clover (Inoculated)	5 kg/ha
	White Clover (Inoculated)	5 kg/ha
	'Elka' Perennial Rye	5 kg/ha
NATIVE SEED	Acacia dealbata	4 kg/ha
	Acacia buxifolia	1 kg/ha
	Acacia decurrens	1 kg/ha
	Acacia pravissima	1 kg/ha
	Leptospermum lanigerum	1 kg/ha
	Hardenbergia violacea	500 g/ha
	Kennedia prostrata	500 g/ha
	Acacia implexa	200 g/ha
	Banksia marginata	200 g/ha
	Bursaria spinosa	200 g/ha
	Callistemon pallidus	200 g/ha
	Dodonaea viscosa	200 g/ha
ORGANIC FERTILISER	Dynamic Lifter 'Nitro' or Equivalent	1000 kg/ha

## ANNEXURE C273B

## PLANTING &amp; STAKING DETAIL

**NOTE:**

- THIS DETAIL IS TO BE READ IN CONJUNCTION WITH SPECIFICATION AND DRAWINGS.
- ERADICATE ALL WEED GROWTH PRIOR TO PLANTING

DEVELOPMENT  
CONSTRUCTION  
SPECIFICATION

C501

Modified 3

**BUSHFIRE PROTECTION**  
**(Perimeter Tracks)**



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**SPECIFICATION C501  
BUSHFIRE PROTECTION (Perimeter Tracks)**

**GENERAL**

**C501.01 SCOPE**

1. The work to be constructed under this Specification consists of perimeter tracks for fire protection. These tracks shall be constructed in accordance with the requirements as prescribed in the Soil Conservation Service Publication, Guidelines for the Planning, Construction and Maintenance of Tracks.

2. Perimeter tracks with the subdivision shall be connected by suitable intersections with existing access tracks.

***Access Tracks***

3. The track surface shall be constructed with outfall drainage and trafficable cross banks, so as to reduce erosion damage and maintenance needs. Establishing and maintaining vegetation on the tracks can further reduce erosion and may be deemed necessary in some areas.

***Construction***

4. This specification states the requirements for constructing and maintaining tracks to minimise soil erosion.

***Principles***

**C501.02 OBJECTIVE**

1. The aim of this specification is to prescribe requirements in order that bushfire protection provided by perimeter tracks is effective and is undertaken in a manner to minimise disturbance of the natural surroundings and the need for future maintenance.

**C501.03 REFERENCE DOCUMENTS**

1. Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

***Documents  
Standards Test  
Methods***

**(a) Council Specifications**

- C220 - Stormwater Drainage - General
- C221 - Pipe Drainage
- C223 - Drainage Structures
- C273 - Landscaping

**(b) NSW Government Legislation**

- Soil Conservation Act, 1938.

**(c) NSW Government Department Publications.**

- Department of Land and Water Conservation (formerly Conservation and Land Management) - Soil Conservation Service 1983. - Guidelines for the Planning, Construction and Maintenance of Tracks.



**C501.04 DEFINITIONS****Batter**

The face of an embankment or cutting, produced as a result of earthmoving operations involving cutting and filling.

**Cross Bank**

A hump of earth constructed across a track so that runoff is effectively diverted from it.

Cross banks are designed to handle larger flows than cross drains.

**Cross Drains**

Drains of various forms that baulks the flow of water down a track and divert it across the track's surface. The capacity of the drain is defined by its cross-section.

Cross drains are designed to handle smaller flows than cross banks but larger flows than can be controlled by crossfall drainage.

**Crossfall Drainage**

Drainage which occurs when the surface of a track has sufficient cross slope to cause water to flow across and off the surface, rather than along it. Where the water flows into the hillside, it is termed 'infall'. Where flow is away from the hillside, it is termed 'outfall'.

**Culvert**

A pipe or similar structure used to direct water under the track.

## **CONSTRUCTION**

**C501.05 CROSS BANKS**

1. Outlet points for cross banks, shall not be blocked by a stump or rock. Outlets shall be sited so that runoff will spill into undisturbed vegetation and cannot flow back onto the track.

***Cross Bank  
Outer Point***

2. The roadline shall be ripped to a depth of 20 to 30 cm for a distance of one or two tractor lengths back from the chosen outlet point. The loose earth shall be pushed down the roadline into a bank, commencing at the uphill side of the road and working across the outlet side. A long, shallow excavation for the cross bank shall be provided (typically 6 metres).

***Construction***

3. Sufficient loose earth shall be used to give the required dimensions after shaping and compaction. Depending on the size of the machine being used, up to eight bladefulls of earth may be required. The crest width dimensions shall be long enough to ensure comfortable vehicle access over the cross bank. The channel depth dimensions shall prevent runoff from overtopping the bank.

***Shaping and  
Compaction***

4. The entire length of the bank shall be track or wheel rolled to obtain maximum compaction and a smooth, even bank with batters no steeper in relation to the track surface than 1:5.

**C501.06 EARTHWORKS**

- |   |                                   |
|---|-----------------------------------|
| 1. When constructing tracks, the soil and vegetation shall be disturbed as little as possible both on and adjacent to the track. The track shall be constructed to follow the contour of the land as much as possible to reduce the amount of cut and fill. For safety reasons, the maximum crossfall used shall generally not exceed 1:10. | <b><i>Minimum Disturbance</i></b> |
| 2. Cut batters to be 1.5:1 maximum.   | <b><i>Cut Batters</i></b>         |
| 3. Fill batters on all soil classes shall be no steeper than 2:1 and flatter where possible to encourage natural revegetation and to effectively accept seed and fertiliser. Batters higher than 1.5 m on Class B, C and D soils may require special stabilisation works such as drop down drains, hay mulching, etc.                       | <b><i>Fill Batters</i></b>        |
| 4. Vegetation debris shall not be incorporated in fill batters.   | <b><i>Debris</i></b>              |
| 5. "Borrow" areas shall not be located near drainage lines or streams because of the danger of sediment polluting the stream. When necessary, "borrow" areas shall be limited in size, worked in such a way to reduce the danger of sediment leaving the borrow pit and revegetated progressively as the pit is worked out.                 | <b><i>Borrow Areas</i></b>        |
| 6. Wherever practicable, topsoil and litter (free of timber debris) shall be stockpiled in a recoverable position for respreading over disturbed areas. This material contains valuable seed and nutrients which will greatly assist revegetation.  | <b><i>Stockpile Topsoil</i></b>   |
| 7. Timber clearing shall be limited to 0.5m on either side of the track. Where extra clearing widths may be needed such as to allow the sun in to keep the trail dry, clear by felling rather than dozing to limit the amount of soil disturbance.  | <b><i>Timber Clearing</i></b>     |

**C501.07 DRAINAGE**

- |   |                           |
|---|---------------------------|
| 1. Drainage lines and streams shall be crossed with fords, culverts or bridges. Log dam crossings shall not be used as they obstruct flood flows and can create turbulent flow and erosion.   | <b><i>Crossings</i></b>   |
| 2. Fords are preferable to culverts or bridges as they cost less and often can be built with little disturbance to the stream bed and banks. Fords shall not be used where the stream has a deep cross-section requiring considerable excavation to provide approaches to the crossing.   | <b><i>Fords</i></b>       |
| 3. Culverts shall not be used where debris blockages are likely.  |                           |
| 4. Where culverts and headwalls are used, they shall be constructed where shown on the Drawings or as directed by the Superintendent in accordance with the Specifications for STORMWATER DRAINAGE - GENERAL, PIPE DRAINAGE and DRAINAGE STRUCTURES. Culverts shall be constructed as close as possible to the natural alignment of the drainage line to avoid diverting the flow into the stream banks or creating scour of the drainage line. | <b><i>Culverts</i></b>    |
| 5. Soil and vegetation disturbance shall be kept to a minimum. Disturbed areas shall be seeded in accordance with the Specification for LANDSCAPING to protect them from erosion.   | <b><i>Disturbance</i></b> |
| 6. Timber, scrub, soil or debris shall not be dumped in drainage lines, but stacked well above flood levels.  | <b><i>No Dumping</i></b>  |

7. Where trees must be destroyed or injured in the bed or within 20m of the banks, of prescribed streams as defined in the Soil Conservation Act, 1938, an authority from the Catchment Areas Protection Board is required.

***Trees in  
Prescribed  
Streams***

#### **C501.08 REVEGETATION**

1. Revegetation shall be in accordance with requirements of the Specification for LANDSCAPING indicated on the development/subdivision plan.

***Amount of  
Revegetation***

2. Where revegetation is required, it must be applied immediately following the disturbance while the soil is still loose, irrespective of the growing seasons.

***Immediate  
Application***

3. A maintenance dressing of appropriate fertiliser and seed shall be applied.

### **SPECIAL REQUIREMENTS**

**C501.09 RESERVED**

**C501.10 RESERVED**

**C501.11 WITHDRAWN**

1

**APPENDIX 1.**

**MINOR RURAL ROAD  
DESIGN AND CONSTRUCTION**

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## MINOR RURAL ROAD CONSTRUCTION A1

### A1.1 GENERAL

1. This section sets out specifications for the construction of rural roads that will not be maintained by Council such as private access roads and rights-of-way. These roads are only to serve a maximum of 4 occupied lots. If it is reasonable to foresee or assume that future expansion in the use of the road is probable, refer to Council's Design Specifications for developments.
2. The aim of this specification is to provide:
  - A convenient and safe access to all rural allotments .
  - Access for emergency and service vehicles.
  - Provide for a quality product that minimises maintenance costs.
  - Have appropriate regard for the climate, geology and topography of the area.

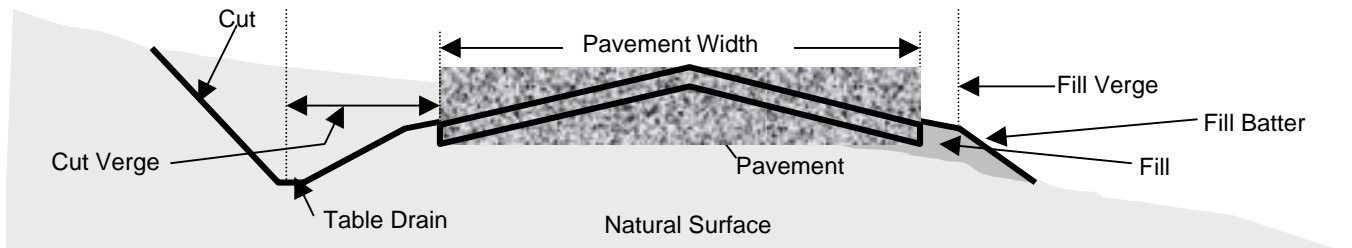
**Scope**

**Aims**

### A1.2 DESIGN CRITERIA

1. The terms referred to in the design standards are illustrated in the diagram below:

**Definitions**



2. The minimum design and construction standards for each classifications is as follows:

**Standards**

Desirable Min Design Speed	Batters		Pavement & Pavement Support				Min Clearing Width	Guideposts		Width of Verge (m)	
	Max Cut Slope	Max Fill Batter Slope	Min Pavement Depth	Min Pavement width on Straights	Min Pavement Width on Curves	Min Subgrade CBR		Min GuidePost Spacing	Other Locations for Guideposts to be Installed		
60km/h	2:1	3:1	200mm (100mm if road serves 1 house)	5m (3m if road only serves 1 house)	5.5m (3.5m if road only serves 1 house)	3	13m	1 set every 200m	1 set at each culvert and on curves	0.5	1.5

3. Where vertical or horizontal curves of low design speed are located in otherwise high speed sections the result is a potentially dangerous section of road. It must be ensured that potentially hazardous features are visible to the driver.
4. A minimum longitudinal gradient of 0.5% is to be adopted. The maximum grade is 11%.
5. Horizontal and vertical curves are to be designed to the requirements of RTA Road Design Guide.

**Low Speeds**

**Grades**

**Alignment**

- |   |                          |
|---|--------------------------|
| 6. Negative crossfall should be limited to 4% on straights and 6% on curves.  | <b>Crossfall</b>         |
| 7. Abrupt changes in crossfall, can cause discomfort in travel and create a visible kink in the road. A rate of change of superelevation of no more than 0.5% relative to the centre line should ensure against this. | <b>Crossfall Changes</b> |
| 8. All intersections should be designed in accordance with the publication AUSTROADS Guide to Traffic Engineering Practice, PART 5, Intersections at Grade.   | <b>Intersections</b>     |

### **A1.3 CONSTRUCTION**

- |  |                                    |
|--|------------------------------------|
| 1. All work shall be carried out in such a manner as to avoid nuisance and/or damage to the environment. The Contractor shall conform with all Acts including but not exclusively, the Environment Protection Authority Act and Protection of the Environment Operations Act 1997.   | <b>Environment</b>                 |
| 2. The developer is responsible for adequate safety precautions during progress of the works, including the erection of any signs, lights and barricades necessary for safety.   | <b>Public Safety</b>               |
| 3. Erosion and sedimentation control measures shall include, but shall not be limited to:<br>(a) The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.<br>(b) The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site. | <b>Erosion &amp; Sedimentation</b> |
| 4. The area within the limits of clearing shall be cleared of all vegetation, plus all minor man-made structures (such as fences and livestock yards) and all rubbish.   | <b>Clearing Operations</b>         |
| 5. All trees and stumps unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing.   | <b>Grubbing</b>                    |
| 6. Holes remaining after trees and stumps have been grubbed shall be excavated to a sound base and backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground.   | <b>Backfill Holes</b>              |
| 7. The topsoil is to be carefully stripped and stockpiled clear of the new work, for final respreading over the exposed clay surfaces of the batters and drains to reduce erosion.   | <b>Removal of Topsoil.</b>         |
| 8. Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching and treatment of cutting floors.   | <b>Cuttings</b>                    |
| 9. In rock cut, faces shall be cleaned of loose material as the excavation proceeds.   | <b>Unstable Material</b>           |
| 10. The floors of cuttings shall be excavated to a designed floor level which shall be at the underside of the pavement. The Contractor shall rip or loosen all material in the floor to a minimum depth of 500mm below the designed floor level for the width of the formation. Unsuitable material shall be excavated and incorporated in embankments or spoiled and replaced with suitable material.  | <b>Floors of cuttings</b>          |
| 11. For embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm.   | <b>Embankment Preparation</b>      |
| 12. Where embankments are to be constructed on or against any slopes that are steeper than 4 horizontal to 1 vertical, the existing slope shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in terraces, at least 1m in width, the terraces to be cut progressively as the embankment is placed.   | <b>Hillside Embankments</b>        |
| 13. The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces.   | <b>Embankment Stability</b>        |
| 14. Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted. The layers shall be of uniform compacted thickness not exceeding 200mm.  | <b>Embankment Layers</b>           |
-

- |  |                                       |
|--|---------------------------------------|
| 15. Spoil shall be disposed of at locations within the specified working area for the Works or be removed and disposed of off site by the Contractor.  | <b><i>Disposal of Spoil</i></b>       |
| 16. All earthworks shall be compacted to provide a relative compaction for standard compactive effort, of not less than 98 per cent standard.  | <b><i>Compaction Requirements</i></b> |
| 17. A multi tyred roller (or another loaded vehicle as approved by the superintendent) shall be used to carry out proof loading by rolling that section of subgrade as directed by the Superintendent. The load on each tyre shall be 1.5 tonne. | <b><i>Proof testing</i></b>           |

**A1.4 DRAINAGE**

- |   |   |
|---|---|
| 1. All drainage structures shall cater for a 1 in 10 year ARI storm event with a minimum pipe size of 450mm and must be designed such that the velocity of stormwater at the outlet does not exceed 2.5m/s.   | <b><i>Design of Structures</i></b>  |
| 2. Table drains of adequate capacity are to be constructed, together with cut-off drains as necessary. Water is to be removed from the table drains at frequent intervals by the use of Mitre drains and disposed of into adjoining properties, but clear of all sites for future dwelling houses.  | <b><i>Table Drains</i></b>  |
| 3. Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed by the Contractor.   | <b><i>Excavation Level</i></b>  |
| 4. Any material at the bottom of the trench or at foundation level deemed to be unsuitable shall be removed and disposed of by the Contractor and replaced with suitable backfill material. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert.   | <b><i>Unsuitable Material</i></b>   |
| 5. All material shall be compacted in layers not exceeding 150mm compacted thickness. At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained. When compacting adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage to any culvert or drainage structure.   | <b><i>Compaction &amp; Moisture Content</i></b>                           |
| 6. The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted.  | <b><i>Excavation Drainage</i></b>   |
| 7. Only reinforced concrete pipes shall be used and these shall comply with AS 4058. Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints. Concrete headwalls are to be affixed to the inlet and outlet of all cross drainage structures. The trench shall not be excavated wider than 1.4 times the external diameter of the pipe plus 300mm. Pipes shall be laid with the socket end placed upstream. No individual length of pipe shall be shorter than 1.2m. The minimum pipe to be used at culvert ends shall be 2.4m. | <b><i>Type of Pipes, Joints and Installation</i></b>                      |
| 8. Bedding material shall be placed and compacted in layers not exceeding 150mm in thickness. Bedding material shall be compacted to a minimum relative compaction of 95 per cent (standard compactive effort).   | <b><i>Compaction of Bedding Materials Inlet &amp; Outlet Channels</i></b> |
| 9. Excavation of inlet and outlet channels shall extend to join the existing stream bed.  |   |

# A1.5 PAVEMENT

1. The acceptable pavement material for Minor Rural Roads are given in the table below:

**Materials**

Test Method	Description	Material Requirements NGS20
AS 1289.3.6.1	Coarse Particle Size Distribution % passing 75.0mm sieve % passing 53.0mm sieve % passing 37.5mm sieve % passing 26.5mm sieve % passing 19.0mm sieve % passing 13.2mm sieve % passing 9.5mm sieve % passing 6.7mm sieve % passing 4.75mm sieve % passing 2.36mm sieve % passing 0.425mm sieve % passing 0.075mm sieve	- - - 100 96-100 - 65-89 - 47-80 32-67 14-42 6-26
AS 1289.3.1.1	Liquid Limit (if non plastic)	max 23
AS 1289.3.3.1	Plastic Limit (if plastic)	max 23
AS 1289.3.3.1	Plasticity Index	max 12
T114	Maximum Dry Compressive Strength on fraction passing 19mm sieve (only applies if Plasticity Index is less than 1)	1.0 Mpa
AS 1289.F1.1	4 day Soaked CBR (98% Modified Compaction)	30
	Relative Compaction	98% standard

## NOTES:

Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75 per cent of the particles larger than 6.70mm.

- ◆ All fractions of the sample specified by AS 1141.22 must be within specification. The fraction with the highest wet/dry strength variation is the value for determining conformance with the specification. The fractions 19.0mm to 13.2mm and 6.7mm to 4.75mm must be tested.

Materials other than that specified above may be used with the approval of Council.

- To avoid materials which lack strength due to the combined effect of high fines and high plasticity the plasticity index multiplied by the % passing the 0.075mm sieve must be 100 or less. **Plasticity Product**
- To enhance stability of the wearing surface and to reduce its permeability the % passing the 0.075mm sieve divided by the % passing the 2.36mm sieve of the pavement material should be greater than 0.2 and less than 0.4. Shoulder and verge material must not be less permeable than the pavement material. **Stability & Permeability**
- The thickness of each compacted layer shall be between 100mm and 200mm. **Layers**
- Each layer of the pavement shall be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction. **Trimming & Compaction**
- Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up shall be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements. **Excessive Moisture Content**
- A multi tyred roller (or another loaded vehicle as approved by the superintendent) shall be used to carry out proof loading by rolling that section of pavement as directed by the Superintendent. The load on each tyre shall be 1.5 tonne. **Proof testing**