Snowy Valleys Council

Road Construction and Subdivision Specifications

Adopted – 27 September 2019

Revision	Date	Approved by

0161 QUALITY (CONSTRUCTION)

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the contractual requirements for the Quality System documentation and operation.

1.2 CONTRACT REQUIREMENT

Standards

The Contractor shall establish, implement and maintain a Quality System in accordance with this worksection and the requirements of AS/NZS ISO 9001.

Applicable to work on and off Site

The Quality System as expressed in the Quality Plan shall be used throughout the course of the Contract to ensure that the quality of the Contractor's and any sub-contractor's work complies with the requirements of the Contract Documents. This shall apply to all work under the Contract, both on site and off site.

Compliance with contract documents

Notwithstanding any statements to the contrary in the Contractor's Quality Manual or Quality Plan, no part of the Quality System shall be used to pre-empt, preclude or otherwise negate the requirements of any part of the Contract Documents.

Quality System requirements shall be used as an aid in achieving compliance with the Contract Documents and documenting such compliance. In no way shall they relieve the Contractor of its responsibility to comply with the Contract Documents.

1.3 REFERENCED DOCUMENTS

Clause references at the end of headings relate to AS/NZS ISO 9001. Additional guidance is provided in SAAHB 90.3.

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

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Standards

SAA HB 90.3	The Construction Industry—Guide to ISO 9001:2000
AS ISO 10013	Guidelines for quality management system documentation
AS/NZS ISO 9000	Quality management systems—Fundamentals and vocabulary
AS/NZS 9001	Quality management systems—Requirements
AS/NZS 19011	Guidelines for quality and/or environmental management systems auditing

1.4 DEFINITIONS

For the purpose of this worksection, the definitions as in AS/NZS ISO 9000 and those below apply:

- Corrective action: Measures, including preventative measures, taken to rectify conditions which have caused or might cause nonconformity.
- Corrective action request (CAR): A formal advice/instruction from the Superintendent regarding departures from the Quality System or Methods as approved in the Quality Plan. Unless specifically noted, it will not require raising of a Nonconformance Report.
- Disposition: Action to be taken to resolve nonconformance. (Lot Specific)
- Hold point: A defined position in the construction/manufacturing stages of the Contract beyond which work shall not proceed without mandatory verification and acceptance by the Superintendent.
- The issue of a Nonconformance Report (NCR) or a Notice of Nonconformance (NNC) automatically creates a Hold Point.
- Inspection and test plan: The working document which identifies the specific inspections and tests to be carried out for works required by the Contract.

- Lot: A lot consists of any part of the works which has been constructed/manufactured under essentially uniform conditions and is essentially homogeneous with respect to material and general appearance.
- The whole of the work included in a lot shall be of a uniform quality without obvious changes in attribute values.
- Method statement (Procedures, Technical procedures, Process descriptions, Specific procedures): A document that specifies the key steps and sequence in the manufacture/construction for an activity; what, how and by whom it shall be done; what materials and equipment shall be used to achieve the required quality standards.
- Nonconformance report: A mandatory (standard format) report submitted by the Contractor that details the nonconforming work and the Contractor's proposed disposition of the nonconformance.
- Notice of nonconformance: Formal instruction from the Superintendent regarding product nonconformance from that specified. It automatically creates a Hold Point and requires a Nonconformance Report from the Contractor.
- Performance audit (Process audit, Technical procedure audit, Methods audit):
- An examination to evaluate whether established methods and procedures are being adhered to in practice.
- Product audit (Conformance audit, Service audit): An assessment of the conformity of the product with the specified technical requirements.
- Quality assurance: The management actions covering planning, quality control testing, inspection and verification procedures integrated with production to provide a product fit for the purpose.
- Quality assurance representative: Appointed by the Principal for a specific project and responsible for the auditing, review and surveillance of procedures and documentation required by the Contractor's approved Quality Plan.
- Quality check lists: orms completed during the manufacture/construction process verifying key steps, and records required for the Quality Register. Check lists apply to each identified lot of work.
- Quality control: The operational techniques and activities that are used to fulfil the requirements of quality.
- Quality management representative: Appointed by the Contractor for a specific project with the authority and responsibility for the implementation and operation of the Quality Plan, to ensure that Quality System requirements are not subordinated to design and productivity.
- Quality manual: document setting out the general quality policies, procedures and practices of an organisation.
- Quality plan: The Quality Assurance documentation specific to a Contract which comprises of the Corporate Quality Manual with its job specific annexures, method statements, inspection and test plans and check lists.
- Quality register: The files containing all quality control records such as test results, completed check lists, certificates of compliance, consignment dockets for materials procured.
- Quality system: The organisational structure, responsibilities, procedures, processes and resources for implementing quality management.
- Quality system requirements (System requirement, Quality management requirement): The administrative activities affecting quality that need to be implemented and controlled to ensure that the product or a service meets specified quality requirements.
- Special processes: Those processes, the results of which cannot be directly examined to establish full conformance. Assurance of satisfactory conformance depends on evidence generated during the process.
- System audit: An examination of the documented Quality System represented by the Quality Manual, Quality Plan and Quality Register to evaluate their effectiveness in meeting the requirements of Australian Standards and the Specification.
- Traceability: The ability to trace the history, application or location of an item or activity, or similar items or activities, by means of recorded identification.
- Witness Point: A nominated position in the manufacture/construction stages of the Contract where the option of attendance may be exercised by the Superintendent, after notification of the requirement.
- Work instruction: A document that provides detailed guidance for the execution of a particular task.

1.5 ABBREVIATIONS

Abbreviations used in this worksection are:

- CAR: Corrective Action Request
- CQS: Contract Quality System
- HP: Hold Point
- ITP: Inspection and Test Plan
- NAT: National Association of Testing Authorities
- NCR: Nonconformance Report
- NNC: Notice of Nonconformance
- QA: Quality Assurance
- QAR: Quality Assurance Representative (Principal)
- QC: Quality Control
- QM: Quality Manual
- QMR: Quality Management Representative (Contractor)
- QP: Quality Plan
- QR: Quality Register
- QS: Quality System
- SRD: System Requirement Description
- WP: Witness Point

2 QUALITY MANUAL AND QUALITY PLAN

2.1 QUALITY MANUAL

The Company Quality Manual shall cover and include the requirements for Quality System Documentation specified in AS/NZS ISO 9001, with guidance to preparation in AS/NZS ISO 10013.

It shall incorporate all applicable System Requirement Descriptions (SRDs) with reasons for those not regarded as applicable. Additionally it should include standard Method Statements and Inspection and Test Plans for the activities usually undertaken by the Contractor. It would be normal to have these in separate volumes.

2.2 QUALITY PLAN

The Quality System shall be incorporated in the project Quality Plan. The Company Quality Manual with its System Requirement Descriptions, standard Method Statements and Check Lists and the project specific components make up the Quality Plan. This is illustrated conceptually in Figure 2.1.

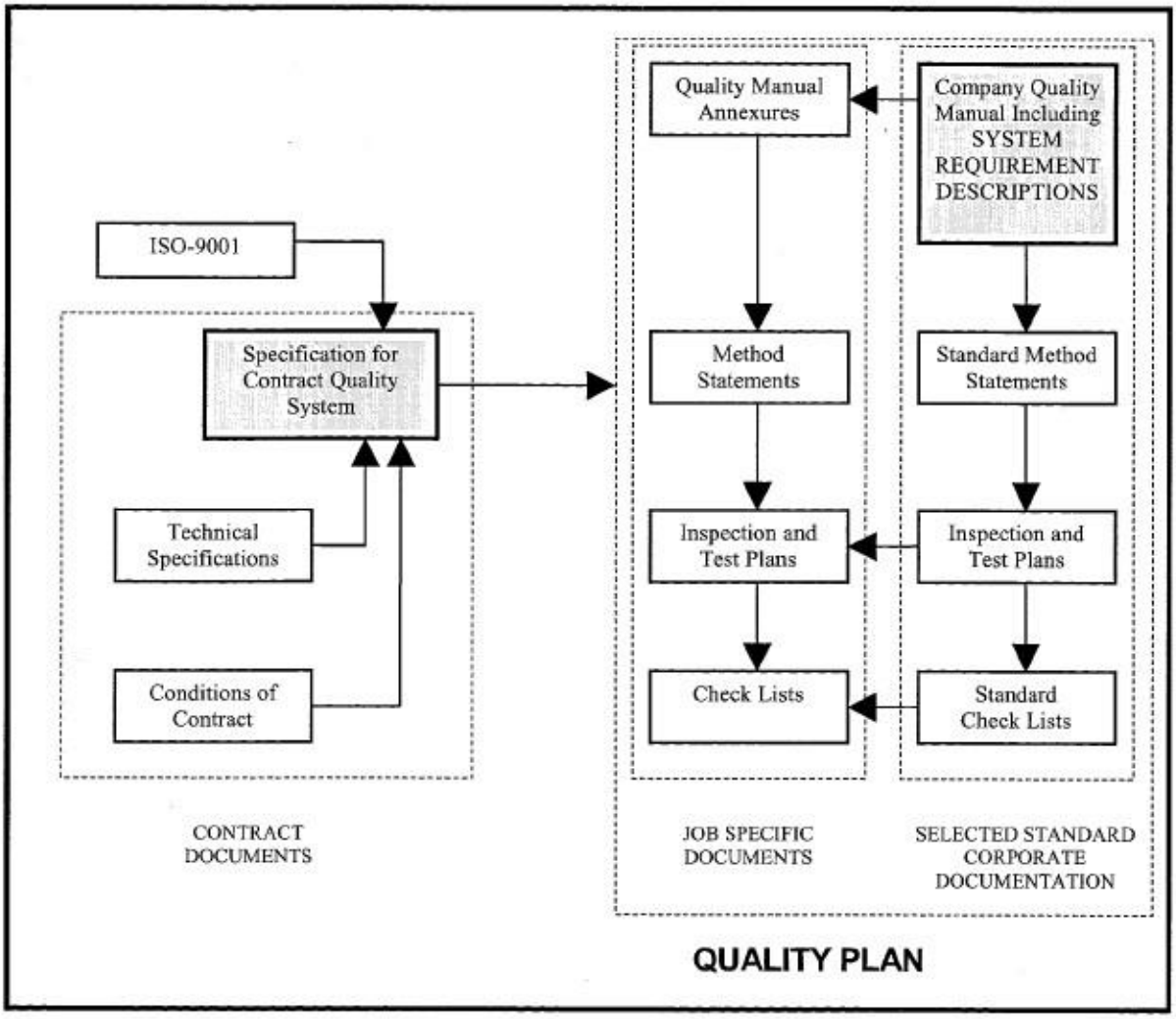


FIGURE 2.1 PROJECT QUALITY SYSTEM DOCUMENTATION

2.3 ANNEXURES TO QUALITY MANUAL

The following details shall be provided by appropriate annexures to the Company Quality Manual:

- Organisation structure—The organisation structure for the management of the project with details of the specific responsibilities and authorities of the nominated key personnel.
- Quality Management Representative. Including this person's qualifications, technical experience and present position together with responsibilities and authorities to resolve quality matters.
- Inspection and test personnel—The personnel or contracted testing organisations who will be conducting each type of compliance inspection of testing of completed works, their experience, qualification and responsibilities.
- Authority for construction process changes—The person authorised to change construction processes on site.

2.4 ADDENDA TO SYSTEM REQUIREMENT DESCRIPTIONS

The System Requirement Descriptions in the Company Quality Manual shall be augmented with suitable addenda to satisfy the requirements of this worksection.

2.5 REGISTER OF METHOD STATEMENTS

A Register of Method Statements giving the title, identifier and revision status, shall be provided. This Register shall list all Method Statements that are to be included in the Quality Plan for the Contract and shall include any suitable Method Statements already incorporated in the Company Quality Manual.

3 JOB SPECIFIC REQUIREMENTS

3.1 GENERAL

In the Quality Plan, the System Requirement Descriptions in the Company Quality Manual may need augmentation to cover the requirements of AS/NZS ISO 9001 and this worksection. This shall be provided in the form of suitable Annexures or where applicable included in the Method Statements or Inspection and Test Plans.

3.2 PROCESS CONTROL—METHOD STATEMENTS

Documentation
Method Statements describing in detail how construction processes are to be carried out shall be provided for all activities scheduled in Annexure B to the joint Annexures. This requirement applies to both contract and subcontracted work. The documentation shall cover, as applicable, planning, methods, verification and control.

Content
Method Statements shall include, as applicable, the following:

- Responsibilities
- Sequence of operations
- Work methods
- Characteristics and tolerances to be met
- Types of equipment
- Materials
- Safety requirements
- Reference documents
- Records produced

Presentation
The presentation of Method Statements may be either descriptive, in the form of flow charts or a combination of both. In either case it must be accompanied by a Check List which shall include the relevant inspection and test points, surveying control points and Hold Points and the officer responsible to verify each check point.

System audit
A system audit of each Method Statement shall be carried out by the Contractor whilst the process is in effect.

3.3 DOCUMENT AND DATA CONTROL

Records
In addition to the requirements of AS/NZS ISO 9001, the Quality Plan shall specify the method of keeping Quality Registers, tracking and handling of NCRs and NNCs and site correspondence.

3.4 CONTROL OF INSPECTION, MEASURING AND TESTING EQUIPMENT

NATA registration
The Quality Plan shall include the latest NATA advice of the terms of registration and current signatories for the laboratories which will be providing the compliance test reports.

Equipment accuracy
Inspection, testing and measuring equipment shall be capable of producing the precision and/or degree of accuracy specified in the referenced Test Methods and this shall be demonstrable by records of calibration.

3.5 PURCHASING

QS to cover all work
Except where the contract documents already stipulate another quality system standard for specific products or services, the quality assurance provisions detailed in this worksection shall apply to all subcontracted products or services which constitute work under the Contract.

Subcontracts
The Contractor shall ensure that the requirements of AS/NZS ISO 9001 and the requirements of this clause are included in all such subcontracts.

3.6 INSPECTION AND TESTING

Documentation
The Quality Plan shall include all inspections, tests and documentation necessary to ensure that the Works comply with Contract Documents.

Sampling and testing
Lots: All compliance inspections and tests shall be based on lots.

Random sampling
The Inspection and Test Plans shall include details of the sampling methods. 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.

Lot sizes frequency of testing
The maximum lot sizes and minimum testing frequencies are listed in the Annexures to the relevant Specifications and/or in Annexure C. Where no minimum frequency of testing, or maximum lot size is stated in the Specification, the Inspection and Test Plan(s) shall nominate appropriate frequencies for the Superintendent's approval.

Time limits
The Inspection and Test Plans shall also uphold any time limits for testing which may be imposed by the Technical Specifications.

Sampling and testing by NATA registered laboratory
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.

Special accreditation
In special circumstances the Principal may accredit a laboratory that is not NATA registered for specific tests or inspection procedures.

Consecutive numbering
Every testing agency or person providing written test reports for any and all testing undertaken shall use unique consecutive project specific serial numbering of the reports for identification and auditing purposes.

Reinstatement
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.

Testing responsibility
The responsibility for completion of inspections, tests and documentation shall be stated in the Quality Plan.

3.7 HOLD POINTS

Superintendent's Approval to Proceed
To assure compliance with the specified standards and requirements, mandatory Hold Points shall apply.

- Hold Points are those stages during the construction/manufacturing process where the Technical Specifications require 'approval by the Superintendent' or where a NCR or NNC has been issued.
- The Contractor shall not proceed past the HP until approval has been received from the Superintendent to proceed. For ease of identification Hold Points may also be annotated on the margins of Technical Specifications.

Requirements for approval to proceed
To obtain the approval to proceed from the Superintendent, the Contractor shall:

provide the information required by the Technical Specifications

ensure and certify that the particular lot/process is conforming;

ensure and certify that all underlying and adjacent lots affected by the lot in question are conforming;

submit the appropriate form (Check List, NCR or NNC) at least 24 hours prior to the time the Contractor wishes to proceed with the placement/construction of the next lot, unless some alternative arrangements have been agreed with the Superintendent.

Witness Point
If the HP has resulted from a NCR or NNC, the Superintendent's approval may be conditional on a Witness Point being included.

3.8 ITP CONTENT

Activities
An Inspection and Test Plan shall break down into distinct activities the process with which it is dealing and for each of those activities identify what inspections or tests, or both, are to be carried out.

Information to be provided
As a minimum, the ITP shall contain the following information:

- item number/lot type reference(s)
- activity description
- who is responsible for carrying out the inspection/test
- specification requirements or where impractical: specification reference
- specification tolerances
- sampling method
- test method
- test frequency
- identification of Hold or Witness Points

Check list for each lot
An ITP shall have a Check List for completion for each particular lot.

3.9 INSPECTIONS

Incoming inspections shall be required for deliveries of materials that will be subsequently included in one or more lots. When completing Check Lists for particular Lots the inspection status shall be cited.

In-process and compliance inspections shall be completed by a responsible officer nominated in the Check List and certified by the Contractor's QMR that the work has been completed in accordance with the Contract Documents.

The Contractor shall establish and maintain a system to ensure and demonstrate that all products or parts of products requiring inspection and/or testing are so inspected and/or tested.

The Contractor shall also establish and maintain a system for identifying the inspection status for all lots of work.

3.10 PRODUCT IDENTIFICATION

Lots
All items of work shall be subdivided into lots as follows:

- Lot size – Lots shall be chosen by the Contractor but shall be within the limits given in Annexure C. In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.
- Lot numbers – Lot numbers shall be used as identifiers on all Quality System data.
- Lot identification – The Contractor shall determine the bounds of each lot before sampling and shall physically identify each lot clearly. The physical identification of a lot shall be maintained until the Contractor has ensured that the lot has achieved the specified quality.

Lot numbering
Each lot shall be given a unique lot number. The allocation of lot numbers shall be carried out by the Contractor to suit the circumstances, provided the lot numbering system complies with the following requirements:

- details of the numbering system are given in the Quality Plan
- the system shall be compatible with any numbering system used in the Contractor's construction programme so that lots are easily identified

- the lot number shall be entered in the Quality Register which shall provide at least the following information:
- three dimensional surveyed location of the lot (chainage of the start and finish points, lateral location and layer location) and/or the particular structure (eg. pier or abutment number, pour number)
- indication of conformance or nonconformance
- summary of test results (eg. characteristic value) and
- location of test sites, test identification numbers and test results
- for nonconforming lots a new number, or numbers, shall be allocated to the resubmitted/subdivided lot(s), but reference shall be maintained to the original lot number.

Lot identification

Field identification: To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor shall implement a field identification system which will clearly identify the bounds of each lot and the lot number. This identification system shall be detailed in the Quality Plan and shall be maintained during all stages of construction of the lot.

Work on a lot shall not commence until the field identification has been established.

Lot boundaries: The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous. This will require appropriate notation in the Quality Register by the QMR.

Sampling and testing

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.

Special accreditation

In special circumstances the Principal may accredit a laboratory that is not NATA registered for specific tests or inspection procedures.

Reinstatement resulting from testing activity

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.

Random sampling

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 A, of the joint Annexures to this specification and AUS-SPEC 7200.C0102 (Quality system), defines the method to be used for determining test locations of random sampling in each lot.

Sampling locations

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.

Test results to meet tolerances for the lot

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.

3.11 TRACEABILITY

Positive identification: The lot identification system, site records and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

Traceability of concrete, asphalt and steel plate: Traceability is required for concrete loads, asphalt loads and steel plate as follows:

- Concrete used in bridge components, cast-in-place box culverts, retaining walls, road pavement subbase and base. Asphalt used in wearing courses, intermediate courses and drainage layers.
- The trace shall start at the batch plant and finish at the location where the concrete or asphalt is incorporated in the Works. Records shall be kept of the batch quantities, mix and dispatch time, testing details and location of placement.

- Steel plate in bridge girders and bridge columns.
- The trace shall start at the steelworks and finish at the location of the plate in the girder or column. Records shall be kept of the steel heat number, testing details and location of the plate in the girder or column.

3.12 SURVEYING CONTROL

Separate system requirement: Surveying Control shall be treated as a separate System Requirement and shall include all measurement, calculation and record procedures necessary to:

set out the Works

verify conformance to the Drawings and Specification in relation to dimensions, tolerances and three dimensional position,

determine lengths, areas or volumes of materials or products, where required for measurement of work.

Method Statement: The Method Statements for Surveying Control shall describe the process control parameters for special processes which cannot be fully verified by subsequent inspection and test.

Surveyor qualifications

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.

Equipment

The procedures and equipment used must be capable of attaining the tolerances nominated in the Specification.

Sampling locations

Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

Conformance verification surveys

Conformance verification survey for concrete base, concrete subbase and bound pavement layers shall be performed as soon as practicable, but in any event not later than one working day after the lot or component has become accessible for survey.

Survey conformance report

The Contractor shall submit a Survey Conformance Report 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.

Work is to be covered up

Where work is to be covered up after conformance has been achieved, a HOLD POINT shall apply until the Survey Conformance Report has been submitted.

Survey records

All survey records shall be included in the Quality Records and recorded in the Quality Register.

Verification field book pages shall be clearly labelled, dated and signed by the surveyor with cross indexed references to equipment used, lot/component identification and associated Survey Conformance Reports.

Where automatic data recording systems are used for verification surveys, a printout of both raw (field) data and reduced data shall be retained in a similar manner as conventional field books.

3.13 CONTROL OF QUALITY RECORDS

Quality register

The Contractor shall keep and maintain all Quality System records as required by AS/NZS ISO 9001 and this worksection. They shall be systematically recorded, indexed and filed so as to be retrievable and accessible to the Superintendent or an appointed Quality Auditor on a job basis within one working day of requisition.

Storage

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.

Superintendent access to records
The Contractor shall make the quality records available to the Superintendent at all reasonable times. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the Principal.

Superintendent copy of the Quality Register
If requested by the Principal, within one month from the date of Practical Completion, the Contractor shall provide the Superintendent with a copy of the Quality Register, or parts thereof.

Finalisation
If requested by the Principal, within one month from the date of Practical Completion, the Contractor shall provide the Superintendent with a copy of the Quality Register, or parts thereof.

W.A.E.
The Contractor shall supply the Superintendent progressively with advice in writing of any amendments to design details for inclusion in Work-As-Executed Drawings (W.A.E).

3.14 NONCONFORMING WORKS

NCR within one day
All nonconforming works detected by the Contractor's Quality System shall be reported to the Superintendent via a Nonconformance Report within one working day of being detected. Nonconformance Reports shall be submitted with all records which indicate a departure from the requirements of the Contract Documents. The NCR shall indicate the proposed disposition.

If the disposition of the nonconformance cannot be determined within one working day, the Contractor shall submit a partially completed NCR identifying the nonconformance.

Disposition
The nonconforming product shall not be covered up unless a disposition has been accepted/approved by the Superintendent and implemented by the Contractor.

Reworking
Where nonconformance can be overcome by simply reworking the lot with the original process, a NCR will be required but a Hold Point will not apply.

NCR automatic Hold Point
With the exception of circumstances described in Clause 3.14.3 above, a NCR will automatically create a HOLD POINT which shall apply until conformance has been achieved and the Superintendent has signed the Authorisation to Proceed.

Corrective Action Request (CARs)
The Superintendent will issue a Corrective Action Request (CAR) when he detects nonconformance to the Contractors Quality System or Methods. Unless specifically stated, this will not create a Hold Point.

Notice of Nonconformance (NNCs)
Where the Superintendent's inspections, surveillance or audits detect product nonconformance, he will issue a Notice of Nonconformance (NNC). This will immediately create a HOLD POINT and the Contractor is required to submit a NCR in accordance with this Clause.

In instances where there is a discrepancy between the test results obtained by the Superintendent and those provided by the Contractor, the results from the Superintendent shall prevail except where the Superintendent may determine a specific audit test procedure to resolve the discrepancy.

Inspection of rectification work
Where required by the Superintendent, a Hold Point shall apply until the Superintendent has inspected the approved rectification work.

Standard NCR form
The Contractor shall prepare a standard form for use as a NCR. This shall include:

- details of nonconformance
- proposed disposition
- provision for attachments
- QAR comment/approval/rejection
- completion of disposition
- release of Hold Point
- corrective action to improve quality
- close out of NCR

All actions shall be signed off by authorised representatives of the Contractor and Superintendent as applicable.

Alternative NCR Form

The Principal retains the right to determine that an alternative NCR form shall be utilised by the Contractor. An example of a NCR form is appended as Annexure D.

Register of NCRs and NNCs

The Contractor shall establish a suitable numbering and registration system for all NCRs and NNCs, including cross referencing as required.

Disposition in five working days

The Contractor shall nominate a proposed disposition for any nonconformance within five working days or shall show cause to the Superintendent for any further delay.

Under no circumstances will the deliberation on disposition of a nonconformance justify an extension of time to the Contract period.

3.15 DISPOSITION OF NONCONFORMANCE

Proposed Disposition

The Contractor shall advise the Superintendent in the NCR of the proposed disposition of the particular nonconformance. This proposed disposition will constitute corrective action for the lot or lots referred to in the NCR and may comprise one of the following:

- propose additional works to bring the lot up to the specified standard; or
- replace all or part of the lot to bring it up to the specified standard; or
- request utilisation of a lot for a reduced level of service if such a clause exists in the relevant Technical Specification; or
- for incidental defects, request that the Superintendent accept the lot without alteration as an exception with or without alteration to the respective unit rates.

Any proposed disposition shall be subject to the approval of the Superintendent. Reworked/replaced lots shall be verified to conform to the specified requirements.

3.16 CORRECTIVE ACTION

The Contractor will be required to indicate, on the NCR, corrective action appropriate to ensure that the Quality Plan is effective in avoiding recurrence of the nonconformance and continues to be effective.

3.17 STATISTICAL TECHNIQUES

Random sampling

Random sampling techniques shall be used for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt.

Test locations

Annexure A, defines the method to be used for determining test locations of random sampling and calculations for the characteristic value for a lot.

Lot sizes test frequencies

Annexure C, lists the maximum lot sizes and minimum test frequencies for the specified activities.

3.18 QUALITY AUDIT SCHEDULE

The Contractor’s Quality Audit Schedule shall be included in the project Quality Plan. Guidance for the requirements of the auditing process is given in AS/NZS ISO 19011.

The Superintendent may require copies of the Audit Reports to be provided.

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all activities associated with the planning, establishment, implementation, operation and maintenance of the Quality System for the project.

These costs shall include all investigation, inspections, testing, rectification and maintenance of the Quality Register.

Cost adjustments, if applicable, will apply the same as to any other Pay Item in the Schedule.

4.2 PAY ITEMS

0161.1 Quality system documents and records

A lump sum for this item shall be provided for all costs associated with the preparation and submission of the Quality Plan, the provision of the QMR on site and the maintenance of the Quality Records during the course of the Contract.

Progress payments shall be calculated on the basis of 30% of the L.S. when the complete Quality Plan is available and the remainder on pro rata based on the monthly value of work done.

0161.2 Quality verification and control

The Lump Sum for this item shall include all costs for inspections, conformance surveys and testing required to verify that all aspects of the work under the Contract comply with the Quality Assurance provisions of the Contract.

Payments shall be made pro rata on the monthly value of work done.

5 ANNEXURE A - RANDOM SAMPLING AND STATISTICAL ANALYSIS

5.1 GENERAL

Statistical techniques shall be used to control relative compaction of each:

- continuous layer of earthworks
- selected subgrade zone
- flexible pavement layers
- asphalt layers
- coring in concrete pavements
- which are generally rectangular in area.

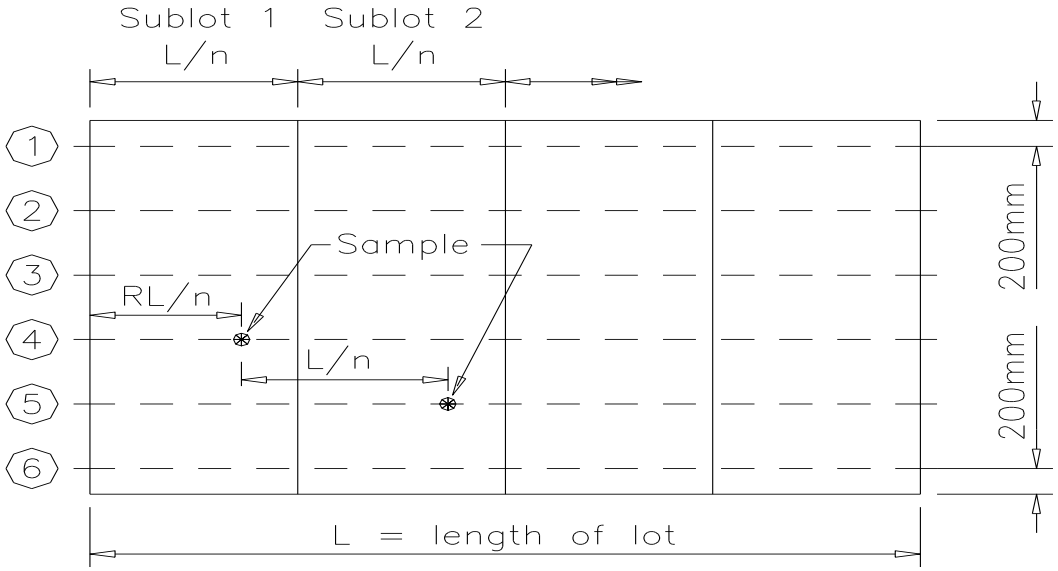
5.2 SAMPLING RATES

The number of samples (n) shall be as indicated in the specific specification which are summarised in the Sub-Annexures to Annexure C.

5.3 RANDOM SAMPLING LOCATIONS

Sampling locations within a lot shall be determined as follows:

- 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);
- Establish six grid lines within the lot, as illustrated in Sampling Locations for Rectangular Lot;
- 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;
- Throw die to select a group (1-6) in Table A1
- Throw die twice to select two random numbers (between 1 and 6) for row and column in Table A1 and obtain random fraction R;
- Length co-ordinate for sample location in Sub-lot 1 = RL/n;
- 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.



Add L/n to previous length co-ordinate.

Add 1(on a cycle of 6) to previous grid line.

Figure A2 SAMPLING LOCATIONS FOR RECTANGULAR LOT

Calculation for statistical conformance of a lot

The calculation of the characteristic value of attribute (Q) for the lot shall be as follows:

$Q = A^m - ks$

where

A^m = arithmetic mean of attribute test results for all sub-lots

k = acceptance constant from **Acceptance Constance** *k* (based on 10% producer's risk)

s = standard deviation of sub-lot attribute test results

$$= \left(\frac{sum\ of \left(x - \bar{x} \right)^2}{n - 1} \right)^{1/2}$$

A lot achieves conformance if Q is equal to or greater than the specified lower limit for characteristic value of the attribute.

If Q is less than the specified lower limit for characteristic value and reworking is subsequently undertaken, the complete lot shall be resampled and retested to verify conformance.

ACCEPTANCE CONSTANT *k*

Sample Size	3	4	5	6	7	8	9	10	15	20
k	0.52	0.62	0.67	0.72	0.75	0.78	0.81	0.83	0.90	0.95

Table A1 - Table of random fractions

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

GROUP	ROW	COLUMN					
		(1)	(2)	(3)	(4)	(5)	(6)
	(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

6 ANNEXURE B - METHOD STATEMENT REQUIREMENTS

6.1 GENERAL

Method Statements are required to describe the key steps and sequence in the construction activities, how and by whom each step shall be undertaken and what materials and equipment shall be used. Method Statements may include a flow chart to clarify the sequence of key steps. One or more Method Statements may address a Construction Activity.

Each Method Statement will be supported by a Check List which shall identify relevant inspections, test points, materials requirements and Hold Points. Each requirement on the Check List will have an officer responsible identified and will require the nominated officer to sign off the requirement so indicating its satisfactory execution.

Method Statements and Check Lists shall be compatible with the appropriate Inspection and Test Plan. Check Lists will be completed for each lot of work during construction and compiled with other documents to comprise the Quality Register.

The Contractor shall submit Method Statements and Check Lists to describe the key steps in those Construction Activities listed below that are identified with a preceding asterisk (*).

Table B1 - Construction activities (insert new numbers)

Item	Enter * here if required	Activity	Specification number
1		Control of traffic	1101
2		Temporary roadways and detours	1101
3		Control of erosion and sedimentation	1102
4		Clearing and grubbing	1111
5		Earthworks—Cut	1112
6		Earthworks—Blasting	1112
7		Earthworks—Unsuitable material	1112
8		Earthworks—Embankment	1112
9		Earthworks—Compaction and quality control	1112

Item	Enter * here if required	Activity	Specification number
10		Siting, excavation, bedding, backfilling and compaction of stormwater drainage	1351
11		Installation of pipe drainage	1352
12		Installation of precast box culverts	1353
13		Siting and installation of drainage structures	1354
14		Installation of lined open drains including kerb and gutter	1121
15		Kerb and gutter replacement	1122
16		Provision of subsurface drainage as subsoil drains, pavement drains or free draining layer	1171, 1172 1173, 1174
17		Stabilisation of pavement or subgrade materials	1113
18		Construction of stabilised pavement layers	1113, 1141
19		Trimming of subgrade and pavement layers	1141
19a		Construction of flexible pavement layers	1141
20		Bituminous cold mix	1142
21		Sprayed bituminous surfacing	1143
22		Construction of asphaltic concrete pavement layers	1144
23		Construction of concrete pavement layers	1131-1135
24		Cold milling of asphalt and base course	1136
25		Segmental paving	1145
26		Bituminous microsurfacing	1146
27		Pavement markings	1191
28		Signposting	1192
29		Guide posts	1193
30		Guardfence	1194
31		Boundary fencing	1195
32		Installation of concrete safety barrier	1163
33		Minor concrete works	0310
34		Landscaping	0250
35		Construction of masonry walls	0292
36		Construction of crib retaining walls	0293
37		Installation of service conduits	1391
38		Trenchless conduit installation	1392
39		Road openings and restorations	1151, 1152
40		Water supply reticulation and pump stations	1341
41		Sewerage system reticulation and pump stations	1361

7 ANNEXURE C - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

7.1 GENERAL

The maximum lot sizes and minimum test frequencies are separately specified for all major activities covered by the worksections as listed hereunder.

The requirements applicable to this Contract are identified in Table C1 with an asterisk indicating that only these details are attached in this Annexure.

Where material/product quality certification can be obtained from the supplier, tests listed per contract/separable part need not be repeated.

On large projects the Superintendent may relax the testing frequency after the Contractor has demonstrated consistent conformance to the quality requirements.

Table C1 Requirements relevant to contract

Item	Sub-annexure	Required (*) for this Contract	Reference Worksection	Sub-annexure heading
1	C1		1112	Earthworks (Roadways)
2	C2		1351, 1352,	Water cycle management—

Item	Sub-annexure	Required (*) for this Contract	Reference Worksection	Sub-annexure heading
			1353, 1354, 1121, 1122	Stormwater drainage, Pipe drainage, Precast box culverts, Drainage structures, open drains including kerb and gutter, Kerb and gutter replacement
3	C3		1171, 1172, 1173, 1174	Pavement moisture control—Subsurface drainage, Subsoil and foundation drains, pavement drains, drainage mats
4	C4		1113	Stabilisation
5	C5		1141	Flexible pavements
6	C6		1142	Bituminous cold mix
7	C7		1143	Sprayed bituminous surfacing
8	C8		1144	Asphaltic concrete
9	C9		1131	Rolled concrete subbase
10	C10		1132	Mass concrete subbase
11	C11		1133	Plain and reinforced concrete base
12	C12		1134	Steel fibre reinforced concrete base
13	C13		1135	Continuously reinforced concrete base
14	C14		1131, 1132, 1133, 1134, 1135, 0310	Ready mixed concrete production and supply
15	C15		1145	Segmental paving
16	C16		1145	Bituminous microsurfacing
17	C17		1191	Pavement markings
18	C18		1192	Signposting
19	C19		0310	Minor concrete works
20	C20		0250	Landscaping
21	C21		0292	Masonry walls
22	C22		0293	Crib retaining walls
23	C23		1341	Water supply reticulation and pump stations
24	C24		1361	Sewerage system reticulation and pump stations

7.2 SUB-ANNEXURE C1

1112 EARTHWORKS (Roadways)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Stripping topsoil	Surface levels	10,000 m²	1 Cross Section per 25 m	Survey
Excavation	Geometry	10,000 m²	1 Cross Section per 25 m	Survey
Floor of cuttings	Material quality—CBR Compaction	5,000 m² 10,000 m²	1 per 1,000 m² * 1 per 500 m²	AS 1289.6.1.1 AS 1289.5.4.1
Blasting	Ground vibration/noise control	1 day's blasting	Continuous monitoring	
Foundation for Embankments	Compaction	5,000 m²	1 per 500 m²	AS 1289.5.4.1
Embankments —General	Geometry Material quality—CBR Compaction/Moisture content	One layer 10,000 m² One layer 5,000 m² One layer 5,000 m²	1 Cross Section per 25 m 1 per 800 m³ 1 per 250 m³	Survey AS 1289.6.1.1 AS 1289.5.1.1 AS 1289.5.4.1 AS 1289.5.7.1
Embankments				

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
—Select zone	Geometry	One layer 10,000 m²	1 Cross Section per 25 m	Survey
	Material quality			
	—Particle size distribution	10,000 m²	1 per 1,000 m³ *	
	—CBR	10,000 m²	1 per 500 m³ *	AS 1289.6.1.1
	Compaction/moisture content	One layer 5,000 m²	1 per 250 m³ *	AS 1289.5.1.1 AS 1289.5.4.1 AS 1289.5.7.1
Fill adjacent to bridges, wingwalls, retaining walls and culverts	Material Quality			
	—Particle size distribution	1 Structure	1 per 200 m³ *	
	—Plasticity index	1 Structure	1 per 200 m³ *	AS 1289.3.3.1
	Compaction/moisture content	1 Structure	1 per layer	AS 1289.5.1.1 AS 1289.5.4.1 AS 1289.5.7.1

* Note: or part thereof, per lot.

7.3 SUB-ANNEXURE C2

WATER CYCLE MANAGEMENT (1351 Stormwater Drainage, 1325 Pipe Drainage, 1353 Precast Box Culverts, 1354 Drainage Structures, 1121 Open Drains Including Kerb And Gutter, 1122 Kerb And (Gutter Replacement))

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 batch	1 per type/size/class per batch	
Siting and Excavation	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Excavation by Blasting	Peak particle velocity	1 drainage line/structure	1 per drainage line/structure	Measure
Foundation	Compaction	1 drainage line/structure	1 per 20 lin m *	AS 1289.5.4.1
Material surrounding steel structures	Material quality —pH/Electrical resistivity	1 drainage line/structure	1 per material	AS 1289.4.3.1 AS 1289.4.4.1
Bedding	Material quality —Particle size distribution Compaction/moisture content	1 contract 1 drainage line/structure	1 per 200 m³ * 1 per layer, per 20 lin m	AS 1141.11 AS 1289.5.4.1 AS 1289.5.7.1
Concrete bedding or lining	Geometry		1 Cross Section per 25 m	Survey and 3 m Straight Edge
Installation of precast units	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Selected backfill	Material quality: —Maximum particle size —Plasticity index Compaction/moisture content	1 contract 1 contract 1 drainage line/structure	1 per 100 m³ * 1 per 100 m³ * 1 per 2 layers per 50 m²	AS 1289.3.3.1 AS 1289.5.4.1 AS 1289.5.7.1
Rock fill for gabions/ wire mattresses	Material quality: —Wet strength —Wet/dry strength variation	1 contract 1 contract	1 per contract 1 per contract	AS 1141.22 AS 1141.22
Kerb and gutter	Geometry	1 contract	1 Cross section per 25 m	Survey and 3 m straight edge

* Note: or part thereof, per lot

7.4 SUB-ANNEXURE C3

Pavement Moisture Control (1171 Subsurface Drainage, 1172 Subsoil And Foundation Drains, 1173 Pavement Drains, 1174 Drainage Mats)

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	1 contract/size	1 per type/size	
	Filter material			
	—Grading (Type A, B, C, D)	1 contract/size	1 per type	AS 1141.11
	—Coefficient of permeability (Type B)	1 contract/size	1 per type	AS 1289.E5.1 ASTM-D2434-68
	—Grading variation after Treatment (Type B)	1 contract/size	1 per type	AS 1141.11
	—Wet Strength (Type C, D)	1 contract/size	1 per type	AS 1141.22
	—10% Fines Wet/Dry (Type C, D)	1 contract/size	1 per type	AS 1141.22
	Geotextile	1 contract	1 per type	
Excavation—Trench base	Line and Grade	1 drainage line	1 per 200 lin m	Survey
	Compaction	1 drainage line	1 per 200 lin m*	AS 1289.5.4.1
Bedding and backfill —Filter material	Compaction	1 drainage line	1 per drainage line	AS 1289.5.4.1
—Selected backfill	Compaction	1 drainage line	1 per 200lin m*	AS 1289.5.4.1
—Earth backfill	Compaction	1 drainage line	1 per 200lin m*	AS 1289.5.4.1
Drainage mat	Geometry	2000m²	1 Cross Section per 25 m	Survey

* Note: or part thereof, per lot

7.5 SUB-ANNEXURE C4

1113 Stabilisation

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Material supply	Material Quality—Supplier's documentary evidence and certification of:			
	—Cement	1 contract	1 per 100t	AS 3972
	—Quicklime			
	Available lime (CaO content)	1 contract	1 per 100t	AS 3583.12
	Slaking rate	1 contract	1 per 100t	T432
	Particle size Dist'n	1 contract	1 per contract	AS 1141.11
	—Hydrated lime			
	Available Lime (CaOH2)	1 contract	1 per 100t	AS 3583.12
	Residue on sieving	1 contract	1 per contract	AS 3583.14
	—Ground blast furnace slag	1 contract	1 per month	AS 3583.2
	—Flyash	1 contract	1 per month	AS 3583.1
	—Blended stabilising agent	1 contract	1 per month	
	—Water			
	Chloride ion content	1 contract	1 per contract	AS 3583.13
	Sulphate ion content	1 contract	1 per contract	AS 1289.4.2.1
	Undissolved solids	1 contract	1 per contract	
Mix design	NATA certification—Supplier's documentary evidence and certification	1 mix	1 per mix	
Stationary mixing plant	Application rate of stabilising agent	1 day's production	1 per 100t	

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	Compressive strength of product	1 day's production	1 per 100t	AS 1289.6.1.1
In-situ spreading	Spread rate	1 layer 1,000 m²	1 per lot or 1 per 500m²	
	Mix uniformity	1 layer 1,000 m²	1 per 500m²	Visual
Trimming and compaction	Geometry	1 layer 2,000 m², max 1 day's placement	One cross section per 25 m	Survey
	Surface quality	"	10 per 200 m lane length *	3 m straight edge
	Average layer thickness	"	1 per lot	
	Average width	"	1 per lot	Measure/survey
	Relative compaction/moisture content	"	3 per lot	AS 1289.5.7.1 AS 1289.5.8.1

* Note: or part thereof, per lot.

7.6 SUB-ANNEXURE C5

1141 Flexible pavements

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Base and subbase supply	Material quality—Supplier's documentary evidence and certification	1 Contract		
	—Particle size distribution		1 per 1,000t	AS 1289.3.6.1
	—Fine particle size distribution ratio		1 per 1,000t	AS 1289.3.6.3
	—Liquid Limit		1 per 1,000t	AS 1289.3.1.1
	—Plastic Limit		1 per 1,000t	AS 1289.3.3.1
	—Plasticity Index		1 per 1,000t	AS 1289.3.3.1
	—Maximum dry compressive strength		1 per 5,000t	T114
	—Particle shape		1 per 1,000t	AS 1141.14
	—Aggregate wet strength		1 per 5,000t	AS 1141.22
	—Wet/Dry strength variation		1 per 5,000t	AS 1141.22
	—Modified Texas Triaxial classification		1 per contract	T171
	—Unconfined compressive strength (Modified)		1 per 5,000t	T116
	—Unconfined compressive strength (Bound)	1 Contract	1 per mix design	T131
Placement	Geometry: Alignment & level	One layer 2,000 m² or max 1 day's placement	1 Cross Section per 15 m	Survey
	—Width & Surface Trim		10 per selected 200 lin. m	Measure & 3m Straight Edge
	Deflection control—Benkelman beam	One layer 5,000 m² or max 1 day's placement	4 per 1,000 m², minimum 10 per lot	T160
	Compaction/moisture content / dry density testing	One layer 5,000 m² or max 1 day's placement	10 per 5,000 m² layer or 3 per lot if less	T130 AS 1289.5.2.1 AS 1289.5.4.1 AS 1289.5.8.1

7.7 SUB-ANNEXURE C6

1142 Bituminous Cold Mix

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material Quality—Supplier's			

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	documentary evidence and certification of:			
	—Coarse aggregates	1 contract or		AS 2758.5
	Grading	1 mth's prod'n	1 per month	AS 1141.11
	Wet strength	1 contract	1 per contract or	AS 1141.22
	Wet/dry strength	"	change in	AS 1141.15
	Flakiness index	"	material	AS 1141.18
	Fractured faces			
	—Fine aggregates	1 contract or		
	Grading	1 mth's prod'n	1 per month	AS 1141.11
	—Mineral filler	1 contract or 1 mth's prod'n	1 per month	AS 2357
	—Class 170 or 320 bitumen binder	1 contract or 1 mth's prod'n	1 per month	AS 2008
	Cutback bitumen	1 delivery/ tanker	1 per delivery/ tanker	AS 2157
	Flux Oil and Cutter Oil	1 delivery/ tanker	1 per delivery/ tanker	AS 3568
Mix design	Approval of mix and NATA documentation. Supplier's documentary evidence and certification.	1 mix per contract (less than 12 months old)	1 per mix	Approval
Production mix	Grading Binder	Each production lot or 1 day's production (whichever is the lesser)	1 per contract or as requested by Superintendent (sampling by production lot)	AS 2891.3.1 AS 2891.3.1

7.8 SUB-ANNEXURE C7

1143 Sprayed bituminious surfacing

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material Quality - Suppliers documentary evidence and certification of:			
	—Class 170 bitumen	1 tanker load	1 per tanker load	
	—Refinery cutback bitumen	1 tanker load	1 per tanker load	
	—Polymer modified binder	1 tanker load	1 per tanker load	
	—Bitumen Adhesion agent	1 delivery	1 per delivery	
	—Cutback oils	1 delivery/ tanker	1 per delivery/tanker	
	—Aggregate precoating agent	1 delivery/ tanker	1 per delivery/ tanker	
	—Aggregate	1 contract	1 per 400 m^3	AS 2758.2
Application rates	Binder	1 day's operation	Calculate per spray run	
	Aggregate	1 day's operation	Calculate per spray run	

* Note: or part thereof, per lot

7.9 SUB-ANNEXURE C8

1144 Asphaltic Concrete (Roadways)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material quality—Supplier's			

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	documentary evidence and certification of:			
	—Coarse & fine aggregates			AS 2758.5
	Grading	1 wk's prod'n	1 per day	AS 1141.11
	Moisture content	1 wk's prod'n	1 per day	AS 1289.2.1.1
	Wet strength	1 contract	)	AS 1141.22
	Wet/dry strength	1 contract	) 1 per	AS 1141.22
	variation	1 contract	) contract	AS 1141.14
	Particle shape	1 contract	) or change in	AS 1141.18
	Fractured faces	1 contract	) material	AS 1141.42
	Polishing agg friction value			
	—Mineral filler	1 contract or 1 month's production	contract or 1 per month's production	AS 2357
	—Bitumen binder	1 refinery batching	1 per tanker load	AS 2008
	—Polymer modified bitumen			
	Elasticity recovery at 60°C	1 production batch by supplier	1 per tanker load	MBT 21
	Viscosity on ER at 60°C			MBT 21
	Torsional recovery at 25°C			MBT 22
	Viscosity at 180°C			MBT 11
	—Bitumen adhesion agent	1 contract	1 per contract or change in material	T230 or nominated equivalent
	Resistance to stripping			
	—Reclaimed asphalt pavement (RAP)	1 stockpile	1 per stockpile	AS 1141.11
	—Bitumen emulsion	1 contract	1 per contract or change in material	AS 1160
Mix design—Nominated mix	Approval of mix and NATA certification. Supplier's documentary evidence and certification	1 mix per contract	1 per mix	
Production mix	Temperature		1 per truck load	Measure
	Moisture content	245.7 from Spec		AS 2891.10
	Grading	245 Asphaltic concrete as included		AS 2891.3.3
	Binder content	as separate table below. Additionally, max lot size one 12 hr shift's production.		AS 2891.3.1
	Resistance to stripping	1 production mix	1 per mix per 5000 t or once per month (whichever is the most frequent)	T640
Laying and compaction	Temperature	1 day's laying per site	1 per truck load	Measure
	Levels	1 day's laying per site	1 cross section per 25 m	Survey
	Shape	1 day's laying	10 per 200 m* lane length	3 m Straight Edge
	Relative compaction/layer thickness	1 day's laying	6 cores per lot 10 nuclear density tests per lot	AS 2891.9.3 or Nuclear Density Meter

* Note: or part thereof, per lot.

Minimum Testing Frequencies For Asphalt Production

Quantity of asphalt in production lot	Minimum frequency of testing
Less than 100 tonnes	One per 50 tonnes or part thereof
101 to 300 tonnes	One per 100 tonnes or part thereof
301 to 600 tonnes	One per 150 tonnes or part thereof
Over 600 tonnes	One per 200 tonnes or part thereof

7.10 SUB-ANNEXURE C9

Placement of 1131 Rolled Concrete Sub-Base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Concrete Supply	Refer Sub-Annexure C14: Ready-mixed concrete production and supply			
	Flyash	Contract	1 per contract	AS 3582.1
	Consistency (Index of compactibility)	1 day's production	1 per day's production per mix type	AS 1012.3.4
	Drying shrinkage	Contract	1 per contract per mix design	AS 1012.13
	Compressive strength of mix designs	Contract	3 per contract per mix design	AS 1012.9
Placement	Compressive strength (7 day and/or 28 day)	1 layer 2000 m² or 1 day's production	1 per 50 tonnes of each mix type	AS 1012.8 AS 1012.9
	Field density	1 layer 2000 m² or 1 day's production	3 per 1000 m² layer or 3 per lot if less	AS 1289.5.8.1
	Thickness and surface level	1 layer 2000 m² or 1 day's production	10 stations per 1000 m² or minimum of 4 for smaller lots	Survey
	Profile factor (straight edge tolerance)	1 layer 2000 m² or 1 day's production	10 stations per 1000 m² or minimum of 4 for smaller lots	3 m straight edge

7.11 SUB-ANNEXURE C10

Placement of 1132 Mass Concrete Sub-Base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Concrete supply	Refer Sub-Annexure C14: Ready-mixed concrete Production and supply			
	Concrete/air temperature	50 m³	1 per 50 m³	Measure
	Air content	50 m³	1 per 50 m³	AS 1012.4 Method 2
	Consistency—Slump	50 m³	1 per load	AS 1012.3.1
	Compressive strength (7 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1021.8 AS 1012.9
	Compressive strength (28 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1021.8 AS 1012.9
Placement	Thickness	50 m³	5 m grid on plan area	Survey and check with subgrade survey
	Geometry	50 m³	1 cross section per 15 m	Survey 3 m straight edge

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Curing	Material quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS 3799 AS 1160
	Application rate	1 day's work	1 per 1000 m²	
Joints	Geometry	50 m³	All joints	Survey

7.12 SUB-ANNEXURE C11

Placement of 1133 Plain Concrete Base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Concrete Supply	Refer Sub-Annexure C14: Ready-Mixed Concrete Production and Supply			
	Concrete/Air Temperature	50 m³	1 per 50 m³	Measure
	Air Content	50 m³	1 per 50 m³	AS 1012.4 Method 2
	Consistency - Slump	50 m³	1 per load	AS 1012.3.1
	Compressive Strength (7 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9
	Compressive Strength (28 day)	50m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9
Placement	Relative Compaction			
	—Machine placed	50 m³	1 per 50 m³*	AS 1012.14
	—Hand placed	Area between 2 consecutive const. joints or 50 m³ (whichever is the lesser)	2 per lot	AS 1012.14
	Thickness	50 m³	5 m grid on plan area	Survey
	Geometry	50 m³	1 cross section per 15 m	Survey and 3 m straight edge
Ride Quality	Profile factor	1000 m²	10/lane/lot	3 m straight edge
Surface Texture	Texture depth	1000 m²	2 per lot	Survey
Curing	Material quality - supplier's documentary evidence and certification	1 contract	1 per production batch	AS 3799 AS 1160
	Application rate	1 day's work	1 per 1000 m²*	
Joints	Sealant material quality supplier's documentary evidence and certification	1 contract	1 per prod'n batch	
	Geometry	50 m³	All joints	Survey

* Note: or part thereof, per lot.

7.13 SUB-ANNEXURE C12

Placement of 1134 Steel Fibre Reinforced Concrete Base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Concrete supply	Refer Sub-Annexure C14: Ready-mixed concrete production and supply			
	Concrete/air temperature	A production lot	As required by Superintendent	Measure
	Air content	1 contract	1 per contract	AS 1012.4 Method 2
	Consistency—Slump	50 m³	1 per load	AS 1012.3.1

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	Compressive strength (7 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9
	Compressive strength (28 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9
	Drying shrinkage	1 day's production or 150 m³ (whichever is the lesser)	3 per lot	AS 1012.13
Placement	Relative compaction			
	—Machine placed	50 m³	1 per 50 m³	AS 1012.14
	—Hand placed	Area between 2 consecutive const. joints	2 per lot	AS 1012.14
	Thickness	50 m³	5 m grid on plan area	Survey
	Geometry	50 m³	1 cross section per 15 m	Survey 3 m straight edge
Ride Quality	Profile factor	50 m³	All lanes	3 m str. edge
Surface Texture	Texture depth	50 m³	2 per 50 m³	Survey
Curing	Material quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS 3799 AS 1160
	Application Rate	1 day's work	1 per 1000 m²	
Joints	Material quality—Sealant supplier's documentary evidence and certification	1 contract	1 per production batch	
	Geometry	50 m³	All joints	Survey and 3 m straight edge
Steel Supply	Material quality—Supplier's documentary evidence and certification	1 Contract	1 per contract	AS 1302 AS 1303 AS 1304
	Steel reinforcement	1 Contract	1 per contract	AS 1302 AS 1303 AS 1304
	Steel fibre	1 Contract	1 per contract	ASTM A 820

7.14 SUB-ANNEXURE C13

Placement of 1135 Continuously Reinforced Concrete Base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Steel supply	Material quality—Supplier's documentary evidence and certification	1 Contract	1 per contract	AS 1302 AS 1303 AS 1304
Concrete supply	Refer Sub-Annexure C14: Ready-mixed concrete production and supply			
	Concrete/air temperature	A production lot	As required by Superintendent	Measure
	Air content	1 Contract	1 per contract	AS 1012.4 Method 2
	Consistency—Slump	50 m³	1 per load	AS 1012.3.1 AS 1012.3.3
	Compressive strength (7 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9
	Compressive strength (28 day)	50 m³	1 pair per 50 m³	AS 1012.1 AS 1012.8 AS 1012.9

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	Drying shrinkage	1 day's production or 150 m³ (whichever is the lesser)	3 per lot	AS 1012.13
Placement	Relative compaction			
	—Machine placed	50 m³	1 per 50 m³	AS 1012.14
	—Hand placed	Area between 2 consecutive const. joints	2 per lot	AS 1012.14
	Thickness	50 m³	5 m grid on plan area	Survey
	Geometry	50 m³	1 cross section per 15 m	Survey 3 m Straight Edge
Ride quality	Profile factor	50 m³	All lanes	3 m Str.Edge
Surface texture	Texture depth	1 day's work	1 per 2000 m²	T240
Curing	Material quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS 3799 AS 1160
	Application rate	1 day's work	1 per 1000 m²	
Joints	Material quality—Sealant supplier's documentary evidence and certification	1 contract	1 per production batch	
	Geometry	1 day's work	All joints	Survey & 3 m Straight edge

7.15 SUB-ANNEXURE C14

Ready-Mixed Concrete Production & Supply (Worksections: 0310 Minor concrete works, 1131 Rolled concrete subbase, 1132 Mass concrete subbase, 1133 Plain and reinforced concrete base, 1134 Steel fibre reinforced concrete base, 1135 Continuously reinforced concrete base)

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	AS 3583.13, AS 1289.4.2.1
	Admixtures	1 mth's prod'n	1 per month	AS 1478
	Fine aggregates			
	—Grading	1 wk's prod'n	1 per 200 m³ concrete*	AS 1141.11
	—Moisture content	N/A	1 per day	
	—Sulphate soundness	1 contract	1 per contract	AS 1141.24
	—Bulk density	1 contract	1 per contract	AS 2758.1
	—Unit mass (Particle density)	1 contract	1 per contract	AS 2758.1
	—Water absorption	1 contract	1 per contract	AS 2758.1
	—Material finer 2 μm	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 200 m³ concrete*	AS 1141.11
	—Moisture content	N/A	1 per day	
	—Wet strength	1 contract	1 per contract	AS 1141.22
	—Wet/dry strength variation	1 contract	1 per contract	AS 1141.22
	—Sulphate soundness	1 contract	1 per contract	AS 1141.24
	—Particle shape	1 contract	1 per contract	AS 1141.14
	—Fractured faces	1 contract	1 per contract	AS 1141.18

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	—Bulk density	1 contract	1 per contract	AS 2758.1
	—Unit mass (Particle density)	1 contract	1 per contract	AS 2758.1
	—Water absorption	1 contract	1 per contract	AS 2758.1
	—Material finer 75 μm	1 contract	1 per contract	AS 2758.1
	—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	AS 1012.9
	Aggregate moisture content	1 contract mix	1 per mix per contract	
	Consistency—Slump	1 contract mix	1 per mix per contract	AS 1012.3.1
	Air content	1 contract mix	1 per mix per contract	AS 1012.4 Method 2
	Shrinkage	1 contract mix	1 per mix per contract	AS 1012.13

* Note: or part thereof, per lot.

7.16 SUB-ANNEXURE C15

1145 Segmental Paving

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material quality—Supplier's documentary evidence and certification of:			
	—Concrete segmental paving units	1 contract	1 per contract	
	—Clay segmental paving units	1 contract	1 per contract	
	—Bedding sand Grading	1 contract	1 per contract or change in material	AS 1141.11
	—Joint filling sand Grading	1 contract	1 per contract or change in material	AS 1141.11
Base	Geometry	One layer 5000 m², max 1 day's placement	One cross section per 25 m	Survey
	Surface quality	"	10 per 200 m² or lot	3 m Straight Edge
Edge restraints	Refer '*Minor concrete works'*	1 day's placement	1 per 10 lin m	Measure/ Survey
Laying paver units	Joint width	1 day's placement	All joints	Measure
	Geometry	1 day's placement	One cross section per 15 m	Survey
	Surface quality	1 day's placement	10 per 200 m² or lot	3 m Straight Edge

7.17 SUB-ANNEXURE C16

1146 Bituminous Microsurfacing

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material Quality—Supplier's			

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	documentary evidence and certification of:			
	—Bitumen (prior to emulsification)	1 contract	1 per contract or change in material	AS 2008
	—Bitumen Emulsion			
	Residual Binder Content (Residue from Evaporation)	1 contract	2 per bulk delivery	AS 1160, App.D
	—Mineral aggregates			
	Degradation factor	1 contract	1 per contract or 6 month period	AS 1141.25
	Los angeles value	1 contract	"	AS 1141.23
	Aggregate wet strength	1 contract	"	AS 1141.22
	Wet/dry strength variation	1 contract	"	AS 1141.22
	Polished aggregate friction value	1 contract	"	AS 1141.42
	Sand equivalent	1 contract	"	AS 1289.3.7.1
	—Mineral filler	1 month's prod'n	"	AS 2357
	—Combined aggregate grading	1 contract	"	AS 1141.11, AS 1141.12
Mix Design - Nominated Mix	Approval of mix and NATA certification —Supplier's documentary evidence and certification	1 contract	1 per mix	
Mix Properties	Wear loss	1 contract	1 per mix	ISSA TB 100
	Traffic time	1 contract	1 per mix	ISSA TB 139
	Adhesion	1 contract	1 per mix	ISSA TB 114 or ISSA TB 144
Production Mix	Grading	1 day's prod'n or 50 m³ (whichever is the lesser)	2 per 50 m³*	AS 2891.3.1
	Residual binder content		2 per 50 m³*	AS 2891.3.1
Laying	Levels	1 layer, max 200 m³	1 cross section per 15 m	Survey
	Surface quality	1 layer, max 200 m³	10 per 100 m* lane length	3 m Straight Edge

* Note: or part thereof, per lot.

7.18 SUB-ANNEXURE C17

1191 Pavement Markings

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	AS 1580.107.3
	Application rate of glass	1 contract	1 per site visit or	7200.C0601

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	beads		change in pressure settings	Annexure A
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	7200.C0601 Annexure A

7.19 SUB-ANNEXURE C18

1192 Signposting

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'			

7.20 SUB-ANNEXURE C19

0310 Minor Concrete Works

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Subgrade	Compaction	1000 lin m or 1000 m²	1 per 200 lin m or 200 m²	AS 1289.5.4.1
Gravel subbase construction	Compaction	1 day's placement	1 per 100 lin m or 100 m²	AS 1289.5.4.1
	Subbase geometry	1 day's placement	1 per 25 lin m	3 m straight edge
Steel supply	Material quality—Suppliers documentary evidence and certification	1 delivery	1 per production batch	
Concrete supply	Refer Sub-Annexure C14: Ready-mixed concrete production and supply			
	Consistency—Slump	15 m³	1 per load	AS 1012.3.1
	Compressive strength (7 and 28 day)	15 m³	2 pairs per 15 m³	AS 1012.1 AS 1012.8 AS 1012.9
Concrete placement	Finished Levels	15 m³	1 cross section per 15 m	Survey and 3 m straight edge
	Surface dimensions	Single fabrication	As required to confirm design dimensions	measure
Backfilling	Material quality			
	—Maximum particle size	1 contract/ material type	1 per 200 m³ or lot	
	—Plasticity index	1 contract/ material type	1 per 200 m³ or lot	AS 289.3.3.1
	Compaction	1 day's work or max 200 m²	1 per 200 m² or lot	AS 1289.5.4.1

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Sprayed concrete	Test panels and cores	1 contract	3 test panels and 4 cores per mix design	AS 1012.4, AS 1012.9 AS 1012.14
	Compressive strength cores	15 m³	2 per 15 m³	AS 012.4, AS 012.9 AS 012.14
	Curing material quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	

7.21 SUB-ANNEXURE C20

0250 Open space - landscaping

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Seed	Certification of authenticity for the prescribed mix	1 contract	Certification for each production batch delivered	
Imported topsoil	Material quality —pH —Organic content —Soluble salt content	 10,000 m² 10,000 m² 10,000 m²	 1 per 500 m³ * 1 per 500 m³ * 1 per 500 m³ *	AS 4419
Mulch for planting	Material quality	1 Contract	1 Contract	AS 4454

* Note: or part thereof, per lot.

7.22 SUB-ANNEXURE C21

0292 Masonry Walls

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Alignment	Set out	Contract	25 m sections	Survey
Footing	Concrete slump	Contract	1 per load	AS 1012.3.1
	Concrete strength	Contract	1 per contract or 100 m³ (whichever is the lesser)	AS 1012.9
Concrete grout	Strength	Contract	As required by Superintendent	AS 1012.9
Backfilling	Drainage layer grading	Contract	1 per contract	AS 1141.11
Foundations and backfill	Compaction	Contract or 200 lineal metres (whichever is the lesser)	3 per 200 lineal metres	AS 1289.5.4.1

7.23 SUB-ANNEXURE C22

0293 Crib Retaining Walls

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Alignment	Set out	Contract	25 m sections	Survey
Footing	Concrete slump Concrete strength	Contract Contract	1 per load 1 per contract or 100 m³ (whichever is the lesser)	AS 1012.3.1 AS 1012.9
Backfilling	Quality and plasticity Drainage layer grading	Contract Concrete	1 per contract 1 per contract	AS 1289.3.3.1 AS 141.11
Foundations and backfill	Compaction	Contract or 200 lineal metres (whichever is the lesser)	3 per 200 lineal metres	AS 1289.5.4.1

7.24 SUB-ANNEXURE C23

1341 Water supply reticulation and pump stations

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	1 contract	1 per contract	AS 2977
	—Ductile iron pipes	1 contract	"	AS 2280 and AS 2129
	—Copper pipe	1 contract	"	AS 1432
	—Polyethylene pipe	1 contract	"	AS 1159
	—Stop valves material	1 contract	"	AS 2638 and AS 2129
	—Non return valves	1 contract	"	AS 3578
	—Spring hydrants	1 contract	1 per contract	AS 2544 or AS 3952
Siting and excavation	Geometry	1 line	1 per line	Survey
Bedding	Material quality —Grading	1 contract	1 per contract per source	AS 2032
Thrust and anchor blocks	Refer sub-annexure C13			
Concrete encasement	Refer sub-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 7200.C0801 Clause 5.1
Backfill and compaction	Compaction	1 line	1 per 2 layers max 100 m²	AS 1289.5.7.1
Switchgear and controlgear assembly	Electrical function	each installation	1 factory test per installation	AS 3439
Commissioning of pumping station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

7.25 SUB-ANNEXURE C24

1361 Sewerage system reticulation and pump station

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	1 contract	1 per contract	AS 1477
	—Ductile iron pipes	1 contract	"	AS 2280 and AS 2129
	—Vitrified clay pipes	1 contract	"	AS 1741
	—Precast access chambers	1 contract	"	AS 4198
Siting and excavation	Geometry	1 line/ structure	1 per line/ structure	Survey
Bedding	Material quality—Grading	1 contract	1 per contract per source	AS 1152
Concrete bedding	Refer Sub-Annexure C13			
Laying and jointing of pipes, access chambers, structures	Geometry	1 line	1 per line	Survey

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Thrust and anchor blocks	Refer Sub-Annexure C13			
Concrete encasement	Refer Sub-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 “ “	 AS 3972 AS 3972 AS 3972
Acceptance test of gravitation mains & access chambers	—Compressed air testing —Hydrostatic testing	1 line 1 per test length Test length = 1370 m pipeline dia.(mm)	1 per line 1 per line	As specified 7200.C1001 Clauses 4.4 and 4.5 7200.C1001 Clause 4.6
Backfill and compaction	Compaction	1 line	1 per 2 layers max 100 m²	AS 1289.5.7.1
Switchgear and controlgear assembly	Electrical compliance	each installation	1 factory test per installation	AS 3439
Commissioning of pumping station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

8 ANNEXURE D - NONCONFORMANCE REPORT

NONCONFORMANCE REPORT NCR No: ……..

EXAMPLE Date: ……..

CONTRACT: ……..

PRODUCT OR SERVICE: ……

SUB-CONTRACTOR (if appropriate): ……

INSPECTION & TEST PLAN No: ……

LOT No AND DESCRIPTION/LOCATION: ……

……

……

DETAILS OF NONCONFORMANCE: ……

……

……

……

PROPOSED DISPOSITION: ……

……

……

……

IS A SUPPLEMENTARY REPORT ATTACHED?: YES □ NO □

CLIENT APPROVED □

COMMENT: ……

REJECTED □

COMMENT:……

……

CLIENT SIGNATURE: …… DATE: ……

DISPOSITION COMPLETED (Contractor) …… DATE: ……
RELEASE OF HOLD POINT (Client) …… DATE: ……
CLOSE OUT OF NONCONFORMANCE REPORT: CONTRACTOR QMR: …….. DATE: ……...

0163 CONTRACTORS QUALITY PLAN

1 SCOPE

This worksection covers the quality requirements for delivery of products for acceptance by the Principal in accordance with AS/NZS ISO 9001. It includes handling, storage, packaging, preservation and delivery.

This worksection details the requirements of the Principal to ensure that products delivered under the contract meet the Principal's requirements at destination.

2 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Standards

AS/NZS ISO 9001Quality management systems - Requirements

3 COMPLIANCE WITH CONTRACT DOCUMENTS

Notwithstanding any statements to the contrary in the Contractor's Quality Manual or Quality Plan, no part of the Quality System shall be used to pre-empt, preclude or otherwise negate the requirements of any part of the Contract Documents.

Quality System elements shall be used as an aid in achieving compliance with the Contract Documents and documenting such compliance.

In no way shall they relieve the Contractor of the responsibility to comply with the Contract Documents.

4 QUALITY PLAN

4.1 PROVISION OF QUALITY PLAN

The Contractor is responsible for the provision of a Quality Plan to cater for the Principal's requirements whether performed by the Contractor or Subcontractors to the Contractor.

4.2 VERIFICATION

The Contractor shall verify the successful operation of a Quality Plan which meets the requirements of AS/NZS ISO 9001.

The Quality Plan shall be available for inspection by the Principal's Representative upon request.

4.3 PERSONNEL

The Contractor's Quality Plan shall verify that all personnel involved with the delivery of product are appropriately and adequately trained.

4.4 DOCUMENTATION

The Contractor's Quality Plan shall include documented procedures for handling, storage, packaging, preservation and delivery of product to destination whether the services are provided by the Contractor or nominated Subcontractors.

The Contractor shall ensure that all dispatch documentation is preserved during delivery and traceability of the product to the dispatch documentation is maintained during handling, storage and packaging.

5 PRESERVATION OF PRODUCT QUALITY DURING DELIVERY

The Contractor shall ensure that due care is taken at all stages of delivery to preserve the quality of the product as manufactured.

The manufacturer's instructions for treatment and handling shall be complied with at all stages.

Additional requirements as instructed in the Technical specification for construction shall be complied with by the Contractor or Subcontractor to the Contractor.

6 ACCESSIBILITY OF DELIVERY RECORDS

Records of delivery, storage and packaging shall be accessible to the Contractor and the Principal upon request.

7 NONCONFORMANCE

7.1 ISSUE OF NCR

The Contractor shall be responsible for issue of a Non Conformance Report (NCR) in the event of noncompliance with any requirements of this worksection.

Issue of an NCR shall constitute a HOLD POINT requiring agreement of the Principal to a disposition before further work proceeds.

7.2 PROPOSED DISPOSITION

The Contractor shall nominate a proposed disposition for any nonconformance at the earliest convenient time and within five working days.

8 ACCESS BY PRINCIPAL TO INSPECT PRODUCT DISPATCHED FOR DELIVERY

The Principal shall have access to inspect all product dispatched for delivery under the Contract whether on the Contractor's premises or premises of Subcontractors to the Contractor. Such access shall be available at 24 hours notice.

9 ACCEPTANCE AT DESTINATION

The Principal's Representative shall have authority to refuse delivery including off-loading of product at the destination should inspection reveal nonconforming product due to manufacture faults or damage in transit.

In such case the Principal shall issue a Notice of Nonconformance (NNC) which shall be dealt with by the Contractor in the same way as an NCR.

10 COSTS OF COMPLIANCE WITH QUALITY REQUIREMENTS

All costs incurred in complying with this Quality System Requirements specification are deemed to be included in the unit price for product delivery.

0179 GENERAL REQUIREMENTS (CONSTRUCTION)

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection sets out the quality system or quality control, set out of works, work as executed drawings, environmental protection, site facilities, meetings, supply by Principal, utilities and authorities requirements and project specific requirements.

1.2 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1102 Control of erosion and sedimentation

1112 Earthworks (Roadways)

1195 Boundary fences for road services

2 PROJECT SPECIFIC INFORMATION

2.1 LOCATION AND DESCRIPTION OF PROJECT

Location

The Works are located: [complete/delete]

Description

The Works comprise of the construction of: [complete/delete]

Site Access

Access to site shall be from (Contractor's and Public): [complete/delete]

Possession

Possession of site shall be given: [complete/delete]

2.2 EXTENT OF WORK

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:

- General
  - . Provision for control, protection and safety of traffic during construction including notifications to and obtaining approvals from Authorities.
  - . Notification of all appropriate property owners adjoining the Works.
  - . Setting out the Works.
  - . Erosion and sedimentation control of the Works, including stockpile areas.
  - . Site clearing and grubbing. Topsoil to stockpile.
  - . Topsoil and hydromulch to disturbed areas.
- Roadworks
  - . Provide provisions for traffic in accordance with the concept illustrated in Reference Drawings, including:
    - * New Jersey type barriers at lead ins to the working area in each direction.
    - * Plastic mesh fencing and warning lamps over the entire working length.
  - . Clearing and grubbing sufficient to allow Works to be undertaken.

. Stripping of topsoil.
. Excavation to windrow.
. Construction of embankment from excavated material and borrow stockpiles.
. Construction of 5 MPa mass concrete subbase.
. Construction of 200 mm 32 MPa concrete base.
. Backfill and topsoiling.
. Hydromulching restored areas.
. Disposal of any excess material remaining in borrow stockpiles.

2.3 WORK BY OTHERS

Liaison
The excluded work will be the responsibility of the Principal and Utility Authorities. Attention is drawn to the Conditions of Contract regarding the obligation of the Contractor to co-ordinate the Works with any simultaneous and/or adjacent work by others. The Contractor shall liaise with these Contractors and Authorities to avoid disruption, delays and possible conflict.

[complete/delete]

Borrow
The borrow material required to complete the Works will be stockpiled by others prior to commencement of this Contract.

Bridge construction
The construction of the bridge within this Contract length will be undertaken concurrently by others. This includes the construction of bridge approach slabs and completion of the guardfence over the length of the approach slabs to join to the bridge.

Utilities
Utility adjustments and relocations by Water and Electricity Authorities.

Construction sequence and staging

Separable parts
The Contractor's programme shall allow to complete Separable Parts of the Works by the times stated in Annexure Part A to the General Conditions of Contract, taking into account and clearly indicating the restrictions imposed by utility relocation.

Refer to Utilities and authorities for timing of utility works.

2.4 SUBSURFACE CONDITIONS

[complete/delete]

Contractor to make assessment
The Contractor's attention is drawn to the General Conditions of Contract Clause 'Site Conditions'. The Contractor should make an assessment of the in-situ moisture content likely to be encountered at the actual time work is to be carried out.

2.5 OTHER PROJECT SPECIFIC ITEMS

[complete/delete]

3 GENERAL

3.1 DRAWINGS

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

3.2 STANDARDS AND TEST METHODS

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

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

Overseas standards
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.

Copies to be kept on site
Copies of any standards quoted or referred to in the Specification shall be kept on the site if so specified.

Test methods other than Australian Standards
Test Methods, other than Australian Standards, specified in the Technical Specifications shall refer to the issue dates current at 14 days prior to the closing date for tenders unless otherwise specified.

3.3 TESTING AND SURVEY

All testing and survey as required by the Technical Specifications shall be arranged and carried out by the Contractor after approval to proceed with testing and survey is obtained from the Superintendent.

All test results and survey records shall be made available to the Superintendent if requested to do so. The cost of all such testing and survey shall be borne by the Contractor.

The minimum frequency of testing and survey shall be in accordance with either 0161 *Quality (Constructions*). The appropriate requirements for this Contract are cited on the Form of Tender.

3.4 WORKING AREAS

Designated sites
Where the Drawings indicate construction working areas and areas for temporary site facilities such as the storing of materials, use of plant and erection of sheds, work shall not be performed nor the site occupied outside of these areas.

Security
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.

Temporary fencing
If existing fencing on the Principal's property is cut or altered by the Contractor, or if there is no existing site fencing, the Contractor shall provide and maintain temporary fencing to the satisfaction of the Superintendent during the Contract to prevent unauthorised entry into the Principal's property, and shall reinstate the fencing and remove temporary fencing on completion of the work.

For fencing of temporary site facilities, refer to Chain wire fence.

Safety signs
The Contractor shall erect appropriate regulatory, hazard, emergency information and fire signs, in accordance with AS 1319 Safety signs for the occupational environment, at prominent locations around the working areas and temporary site facilities. Signs shall include, but are not limited to: mandatory signs for personal protective equipment such as eye, head and foot protection, and DANGER signs such as 'DANGER, Construction Site. No Unauthorised Access'.

All words on word-message signs shall be approved by the Superintendent prior to sign manufacture or purchase.

3.5 SMOOTH JUNCTIONS

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

3.6 SETTING OUT THE WORKS

Provision of marks
The Superintendent will provide Permanent Marks as shown on the Drawings. The Superintendent will also establish bench marks related to the level datum.

Transfer of marks
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.

Relocation of survey control
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.

Recovery pegs

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.

Removal on completion of the works

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

3.7 SITE MEETINGS

Representation

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.

Minutes

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.

3.8 ALTERNATIVE CONSTRUCTION

Detailed working drawings

Should a tender based on the use of alternative material, design or method of construction be accepted, the Contractor shall prepare and submit detailed Working Drawings, design calculations and specifications for the alternative, together with details of necessary alterations to this worksection.

Preparation and submission

The design and construction documents required shall be prepared under the supervision of, and be certified by a Professional Engineer experienced in that type of design.

Documents shall be submitted to the Superintendent at least four weeks before construction of the relevant part of the work is scheduled to commence and no work shall commence on that part until written authority to proceed has been issued by the Superintendent.

Costs of alternative construction

All costs incurred in the preparation of Working Drawings, design calculations, specifications and any variations or supplementary submissions required by the Superintendent shall be borne by the Contractor.

3.9 WORKING DRAWINGS

Submission to superintendent

Where the Contractor is required to provide Working Drawings, two sets of such drawings, together with two sets of supporting calculations, shall be prepared and submitted to the Superintendent not less than the minimum time specified prior to scheduled commencement of the work concerned.

Draftsmanship and legibility

Drawings submitted shall be of a standard of draftsmanship and legibility acceptable to the Superintendent. The Working Drawings and calculations shall be altered or supplemented promptly if so required by the Superintendent and the aforesaid number of sets of revised drawings and calculations shall be resubmitted.

Approval to proceed where working drawings required

The work concerned shall not be initiated until a set of Working Drawings has been returned to the Contractor together with written authorisation to proceed. Upon receipt of this authorisation the Contractor shall revise the Working Drawings to incorporate any conditions attached to such authorisation and shall forward to the Superintendent four additional sets of such revised Working Drawings.

Compliance with contract

The Superintendent's written authorisation to proceed shall not relieve the Contractor of the responsibilities for the design (where applicable) and construction of the Works in accordance with the Contract.

Authorised variations to working drawings

After the Superintendent's authorisation to proceed has been issued, variations to the Working Drawings shall be made only after obtaining a specific written authorisation for the variation from the Superintendent. Four sets of such revised Working Drawings shall then be submitted to the Superintendent.

Cost to prepare and supply working drawings

Costs incurred in the preparation and supply of Working Drawings, supporting calculations and other documents and any variations or supplementary submissions required by the Superintendent shall be borne by the Contractor and shall be considered as incidental to the relevant items of work.

3.10 WORK-AS-EXECUTED DRAWINGS

Submission

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 reproducibles of the Contract Drawings will be supplied by the Principal free of charge for this purpose. Council may also accept WAE Drawings in electronic format with suitable certification.

Roadworks

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.

Bridgeworks

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.

3.11 ITEMS TO BE SUPPLIED BY THE PRINCIPAL

Delivered free of cost to nominated points

Items listed in Annexure A—Schedule of Items to be supplied by the Principal (TBS Items) will be supplied, delivered and unloaded by the Principal free of cost to the Contractor at points to be nominated. The Contractor shall give the Superintendent notice of the time delivery of TBS Items are required in accordance with the Requirements of the Technical Specification or as specified below.

Damaged or defective

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 in the case of a Quality Control Contract, or in accordance with the Disposition of Nonconformance requirements in 0161 *Quality (Construction)* in the case of a Quality Assured Contract.

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

In the case of pipe culverts the Contractor shall give the Superintendent 30 days notice of the time delivery is required.

The Principal shall supply the pipe culverts at no cost to the Contractor for the actual length laid of pipe culvert required under the contract.

Any pipe culverts in addition to the above quantity shall be the responsibility of the Contractor to supply at no cost to the Principal.

4 ENVIRONMENT

4.1 PROTECTION OF THE ENVIRONMENT

Conformance to Acts

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 any Environmental Impact Statement and Assessment Report or Review of Environmental Factors for the project, the conditions of approval imposed by the Environment Protection Authority, the Protection of the Environment Operations Act, the Rural Fires Act and any other Local Council requirements and environmental Act relevant to the project. No variation in costs or extensions of time will be considered due to these requirements.

Erosion control

The Contractor shall plan and carry out the Works to avoid erosion, contamination and sedimentation of the site and its surroundings in accordance with 1102 *Control of erosion and sedimentation.*

No toxic chemicals

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

Noise and smoke

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 in Limits on Noise.

Dust control

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

Details of dust control are to be submitted in writing to the Superintendent two (2) weeks prior to commencing excavation/earthworks operations.

Dilapidation Report

Prior to the commencement of any work the contractor shall if directed by the Superintendent arrange for a dilapidation report to be prepared in accordance with industry best practice. **(HP)**

4.2 DRAINAGE OF WORKS

Stormwater control

The control and management of stormwater drainage through the site will be important during construction of the Works.

Stormwater diversion

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. The flow of stormwater and drainage along existing gutters and water tables shall not be interrupted.

Pumping

The Contractor shall keep trenches and excavations dewatered at all times during construction, and if directed by the Superintendent, shall maintain efficient pumping equipment on site.

All permanent retention basins, and temporary erosion and sedimentation control to be completed prior to commencement of earthworks.

4.3 BLASTING

Blasting shall not be permitted, unless otherwise approved by the Superintendent. If such approval is given then blasting shall be carried out in accordance with 1112 *Earthworks (Roadways)*.

4.4 LIMITS ON NOISE

Plant with silencers

The Contractor shall only use plant that have effective residential class silencers fitted to all engine exhausts, have engine covers fitted, and are maintained in good order.

Working hours

Operational hours of plant, including the entry and/or departure of heavy vehicles, shall be restricted to 7 am to 6 pm Monday to Friday, 7 am to 1 pm on Saturdays and at no times on Sundays or Public Holidays. Work outside of the hours specified shall not be undertaken without the prior approval of the Superintendent.

Maximum noise levels

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's publication Environmental Noise Control Manual, shall not exceed an assigned L10 sound pressure level threshold (noise level exceeded for 10% of the sample time). The intent of this requirement is to avoid excessive noise and long periods of elevated noise that is reasonably anticipated to annoy or adversely effect the adjacent community.

Responsibility for damage

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.

4.5 LIMITS ON GROUND VIBRATION

Levels

It is the intent of this worksection 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.

Practices and vibration thresholds acceptable shall be determined in accordance with the current Statutory Regulation. Where such regulation is not available, or jurisdiction is disputed, the criteria given in this clause shall apply.

Limits

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

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 BS 6472 'Evaluation of Human Exposure to Vibration in Buildings (1 HZ to 80 HZ)' when measured inside nearby residential premises.

Peak particle velocity

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

Responsibility for damage

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.

4.6 OTHER PROJECT SPECIFIC ENVIRONMENTAL REQUIREMENTS

[complete/delete]

5 UTILITIES AND AUTHORITIES

5.1 GENERAL

This section includes the location and protection of utilities and services, programming of the work by other Authorities and the Contractor, and an outline of utility adjustments required during the construction of the Works.

5.2 RELATIONS WITH UTILITY AUTHORITIES AND OTHER AGENCIES

Principal to arrange adjustments to utilities

The Superintendent will arrange for all necessary adjustments to utilities required to conform to the Drawings unless specified otherwise or noted on the Drawings. The Superintendent will make every endeavour to arrange for such adjustments to be performed expeditiously and with a minimum of inconvenience to the Contractor. Work shall comply with the Streets Opening Conference's Information Bulletin on Codes and Practices.

Check on presence

Before proceeding with excavation or other work in any area, the Contractor shall liaise with the utility authorities to ascertain the presence of any utility services and check that all necessary utility relocations have been completed.

The utility authorities contact person/position, telephone and facsimile numbers, (correct at time of advertising of tender) are listed below:

(TO BE COMPLETED BY COMPILER)

Water and sewerage

Name:..... PH:..... FAX:.....

Position.....

Electricity

Name:..... PH:..... FAX:.....

Position.....

Gas

Name:..... PH:..... FAX:.....

Position.....

Telephone

Telstra

Name:..... PH:..... FAX:.....

Position.....

Optus

Name:..... PH:..... FAX:.....

Position.....

Other (as required)

Name:..... PH:..... FAX:.....

Position.....

Other utilities (cables and pipes belonging to road authorities, private companies, universities, schools, etc)

Name:..... PH:..... FAX:.....

Position.....

The 'Dial Before You Dig' Service, telephone 1100, may be contacted to obtain locations of water, sewer, stormwater, gas, electricity and telephone services and some cables and pipes of companies and other organisations.

Additional adjustments

Where the Contractor's method of working results in additional adjustments to their plant being deemed necessary by any other Authority the Contractor will arrange for and bear all costs relevant to those additional adjustments. This applies regardless of any approval to the method of working by the Superintendent.

Minimum interference with services and other contractors

The Contractor shall conduct the operations so as to interfere as little as possible with the operations of other Authorities or their contractors on or near the site of the works. The Principal reserves the right to permit other Authorities and others to work on or near the Works being constructed under the Contract.

Responsibility for maintenance and protection of services

The Contractor will not be responsible for the maintenance of any facilities installed or constructed by the various Authorities or structures and other facilities constructed by others (except where such

structures and facilities form part of the Contract), but will be responsible for the protection of such facilities and structures during the Contract period.

Delays due to works by authorities

In certain instances the Contractor may be required to provide the various Authorities the opportunity to remove, relocate, or work on their facilities before the Contractor proceeds with succeeding construction operations.

Should the Contractor suffer any delay in excess of the times set out in this worksection owing to the moving of any such services, or the operations of any Authority controlling such services, the Contractor may apply to the Superintendent for an extension of time in accordance with the Conditions of Contract.

The Contractor shall have no right to monetary compensation or to any claim for damages because of any loss owing to such delays, nor shall the Contractor stop the Works without the express permission in writing of the Superintendent because of any operation by other Authorities.

5.3 LOCATION AND PROTECTION OF SERVICES AND UTILITIES

Contractor to verify locations

Prior to the commencement of any excavation the Contractor shall verify the location and depth of all Public Utility Mains and Consumer Services and shall be responsible for any damage caused, the repair of the damage, and payment of all charges associated therewith.

Precautions

During the excavation of Works, the Contractor shall take every precaution that is necessary, in the opinion of the Superintendent, to secure existing gas, water or drainage pipes, sewers, electric conduits or other existing works, wherever met with both underground and overhead, or that are adjacent to these Works, from injury and shall maintain the same until in the opinion of the Superintendent, the backfilling of excavation and the general progress of the Works render further precautions unnecessary.

The Contractor shall comply with the Statutory Requirements for maintaining safe working clearance to overhead electrical services.

Repairs to damage caused by contractor

Damage to existing water, gas or drainage pipes, sewers, electric conduit or other existing works or services, shall be repaired by the Contractor to the satisfaction of the Superintendent and the relevant Authority at the Contractor's cost.

Notice to divert services

Where it is found necessary to remove, divert or cut into any existing sewer, drainage pipe, gas or water main, service pipes, electric conduits or other existing works, the Contractor shall give at least 3 days notice of the Contractor's requirements to the Superintendent, who will advise what arrangements should be made for the alteration of such existing works.

Liaison

Where the installation of service mains, pits and consumer service connections is to be carried out by the various Utility Authorities the Contractor shall liaise and co-ordinate with the relevant Authorities for the installation to coincide with the construction work of this Contract.

The Contractor shall be responsible to programme the installation such that all work is completed by the relevant Authorities so as not to hinder or delay the progress of the construction work of this Contract.

Limitations to work methods

Attention is directed to the possible existence of vibration and other working limitations in the vicinity of underground and overhead facilities. The extent of these limitations are liable to the absolute discretion of the Authority concerned.

The Contractor shall be deemed to have included consideration of these potential limitations in the method of construction as proposed for approval by the Superintendent in accordance with the provisions of this worksection.

The cost of such limitations on working methods shall be determined in accordance with the Conditions of Contract.

Disclaimer to information shown on drawings

Information shown on the Drawings concerning utility services has been compiled from information obtained from various Utility Authorities and is not guaranteed correct or complete. Services may exist which are not shown on the Drawings, or which are at locations or elevations different than those shown on the Drawings.

5.4 PROGRAMMING AND DURATION OF UTILITY ADJUSTMENTS

Notice of date of completion of parts of the Works required before utility services can be relocated

The Contractor shall give the Superintendent 21 days' notice in writing of the expected date of completion of each of the necessary parts of the Works required before each of the utility services listed in this worksection can be relocated.

No final trimming or subsequent parts of the Work shall proceed in any area of the Work until the adjustment of all utilities within that area is complete.

Allowance for utility adjustments

The Contractor shall allow in the programming of the Works for the utility adjustments specified in the following clauses. The finish dates given are approximate only. The Contractor shall be entitled to extensions of time if the utilities have not been relocated by these dates and this causes delay to the Contract.

The Contractor shall have no right to monetary compensation or to any claim for damages because of any loss attributable to such delays.

5.5 STREET LIGHTING

Site specific: [complete/delete]

5.6 UTILITY RELOCATIONS

Site specific: [complete/delete]

6 SITE FACILITIES

6.1 GENERAL

Workers' facilities

This section includes the provision, maintenance and removal or restoration on completion of the Work of temporary site facilities for personnel, including the office for the Superintendent, and the necessary temporary utility services required on the site.

Facilities required

The Contractor shall provide, equip and maintain temporary ablution facilities, dressing rooms, tool houses and the like required by any Industrial Ordinance, Award or Agreement for use of workers employed by the Contractor, or the Contractor's sub-contractors, and shall remove them on completion of the Contract.

Latrines

The Contractor shall provide temporary latrine accommodation for use of the workers which shall be suitably enclosed and screened and in accordance with the requirements of the Local Authority, making a temporary connection to an existing sewer where one is available. The Contractor shall maintain such accommodation in a clean condition, pay all relevant fees and remove it on completion of the Work, capping off any temporary sewer connection.

6.2 OFFICE FOR SUPERINTENDENT

The Contractor shall provide, equip, maintain and remove at the completion of the Works an office, including toilet facilities, for the sole use of the Superintendent and Superintendent's staff.

The office shall be comprised of:

- Building:

  A structure of prefabricated construction with minimum inside dimensions of 6 m × 3 m x 2.4 m high exclusive of toilet facilities, weatherproof, adequately insulted and well ventilated.

  The office shall contain 2 opening type windows fitted with insect-proof screens and an external door fitted with a cylinder night lock with 2 keys.

  The floor area shall be covered with an approved vinyl flooring and the walls and ceiling painted to the approval of the Superintendent.

- Furniture and fittings

  The office shall contain:

  . One reference table of minimum size 1.5 m × 0.9 m.

. One desk, with lockable drawers, of minimum size 1.5 m x 0.9 m.
. Three office chairs and one stool all with padded seats, swivel base and adjustable height.
. Two 1.2 m square pin boards fixed to the walls.
. One 0.75 kW reverse cycle air conditioner.

- Toilet facilities

  The toilet facilities shall consist of a prefabricated structure, weatherproof and well ventilated, and connected to the temporary sewerage system and containing:

  . One, minimum, partitioned w.c. cubicle with door and latch.
  . Separate wash area with one, minimum, wash basin connected with hot and cold running water.
  . Lockable external door with 2 keys.

- Electricity

  The office, including toilet facilities, shall be supplied with adequate electric lighting and the office with 2 double power points.

- Telephone

  Two telephone lines shall be connected to the office with one line fitted with a telephone hand set. The second line shall be for a facsimile machine supplied by the Superintendent.

- Charges

  The Contractor shall pay all charges resulting from the supply, erection, installation, maintenance, cleaning and removal of the office, toilet facilities, electricity and telephone services.

6.3 ALTERNATIVE SITE FACILITIES

The Contractor may propose alternative site facilities in existing buildings adjacent to, or in close proximity to, the site of the Works.

Full details of such alternative facilities shall be submitted for consideration by the Superintendent, however, the requirements detailed in Office for Superintendent shall be taken as the minimum acceptable.

6.4 WATER SUPPLY

Temporary water supply
The Contractor shall provide any temporary water supply required for site facilities and for carrying out the Work under the Contract.

Fees and charges
The Contractor shall pay all fees and obtain all approvals in respect of the temporary service and shall pay any charges for the water used. On completion of the Contract the temporary water supply service, except that to the Superintendent’s office, shall be removed by the Contractor.

6.5 ELECTRICAL SERVICE

Temporary electricity supply
The Contractor shall provide any temporary electricity supply required for site facilities and for carrying out the Work under the Contract.

Fees and charges
The Contractor shall pay all fees and charges and shall obtain all approvals in respect of the temporary electricity supply. The temporary electrical installation and the electrical reticulation shall fully comply with and conform to the Service Rules, Regulations and Requirements of the Statutory Authority having jurisdiction. The Contractor shall pay for all electricity consumed.

Removal
The temporary electricity service, reticulation and lighting, except that to the Superintendent’s office, shall be removed by the Contractor on completion of the Contract.

6.6 TELEPHONE

Provision
The Contractor shall arrange for installation of a temporary site telephone for the Contractor’s and Sub-contractor’s use and shall maintain the installation for the period of the Contract.

Charges
All charges for installation, rental, calls and removal on completion shall be borne by the Contractor.

6.7 FIRST AID

The Contractor shall provide, equip and maintain an adequate First Aid Treatment Centre on the site and shall have an experienced First Aid person available at all times when work is in progress.

The First Aid facilities shall be clearly marked and readily accessible to all personnel at all times. The minimum provisions under this Clause shall satisfy the current statutory requirements.

6.8 CHAIN WIRE FENCE

Standard

The Contractor shall provide a 1.83 m high galvanised chain wire mesh perimeter fence, in accordance with the requirements of 1195 *Boundary fences for road reserves*, together with a galvanised tubular steel vehicular access gate, for the temporary site facilities as shown on the Drawings or as directed by the Superintendent.

Hessian covering

The mesh fence shall be covered with a suitable hessian or shadecloth screen for its full height.

Removal

The galvanised fence, screen material and gate shall be removed by the Contractor on completion of the Contract.

Other fencing

If a fence, in accordance with Chain Wire Fence is not required, the Working area including the site facilities shall be fenced off from the public to the satisfaction of the Superintendent and in accordance with any relevant regulations.

7 SPECIAL REQUIREMENTS

7.1 ROAD CLOSURE

7.2 NO PUBLIC ROAD WILL BE CLOSED TO TRAFFIC WITHOUT PRIOR CONSENT OF COUNCIL AND APPROPRIATE PUBLIC NOTIFICATION. PROTECTION AND REPAIR OF DAMAGE TO PROPERTY

The Developer will take adequate precaution to prevent deterioration of or damage to private property, public roads and reserves during construction. The Engineer may direct the provision of temporary works considered necessary to provide such protection.

Adequate access and servicing will be maintained and uninterrupted by development works.

The Contractor is responsible for gaining written consent to enter other properties, where necessary, ensuring any damage is restored to its original condition to the satisfaction of the owner. It would be in the Contractor interest to take photographs prior to the commencement of work to eliminate the possibility of dispute.

The Contractor shall insure himself against damage to other properties, policies for which must be presented to Council for their records.

This is to ensure that damage to neighbouring properties is covered.

7.3 HAULAGE ROUTE

Haulage routes to or from the development will be subject to approval by the Engineer prior to the commencement of work. The Developer will ensure these haulage routes are used. Damage to roads by truck serving the Development will be repaired at the Contractor's cost. A visual assessment will be carried out by Council's Engineer to determine the extent of damage.

7.4 STATE SURVEY MARKS

Adequate precaution is to be taken to protect and preserve any state survey marks relative to or affected by the development. The Contractor will be responsible for the subsequent replacement of marks by a Registered Surveyor. An appropriate plan survey showing the relocated marks will be provided by the surveyor and lodged with the Surveyor General's Office in accordance with the Survey Practice Regulation 1990.

7.5 WORKING HOURS AND SUNDAY WORK

No work will be performed outside the hours that apply under the Noise Control Guideline: Construction Site Noise. No subdivision construction works will be carried out on Sunday or public

holiday, by or on behalf of the developer without the express approval of Council. Inspections outside normal working hours can be arranged, refer to Clause 4.4 for details.

7.6 STORAGE OF MATERIALS

Storage of pipes, gravel and other materials in public roads or reserves will not be permitted unless the express approval of Council is obtained. All materials will be stored in a safe and tidy manner that will not cause a nuisance. It may be necessary to erect signposting, safety barriers and silt fences (refer Appendix A)

7.7 ROAD OPENING PERMITS

Council will reserve the right to decline permission to open roads and request either tunnelling or boring methods.

Road opening permits may be obtained from Council's Asset and Design Department. The cost of the road opening permit will be in accordance with Council's current schedule of fees and will apply to both crossing methods. Trenching, backfilling and boring methods will be in accordance with Council's Specification.

7.8 COUNCIL RESERVES

Reserves dedicated to Council are to be left in a safe and tidy condition, free from all hazard to public safety such as wells, shafts, dangerous ruins, building remnants, spoil etc. Areas should be managed and protected as set out in the Environment Section 3.1 of the Design Manual with Council's specific requirements detailed on the engineering plans.

8 MEASUREMENT AND PAYMENT

8.1 DEDUCTIONS FOR NONCONFORMING WORK

Where deductions for nonconforming work are given in the worksections, the nominated deductions shall be applied to the rates given in the Pay Items for that item of work.

8.2 PAY ITEMS

No separate measurement and payment shall be made for compliance with the requirements of this worksection except as specified in the pay item below.

0179.1 Office for Superintendent
The unit of measurement shall be lump sum and shall include provision of all facilities detailed in Office for Superintendent.

9 ANNEXURE A

9.1 SCHEDULE OF ITEMS TO BE SUPPLIED BY PRINCIPAL

DELIBERATELY LEFT BLANK

1101 CONTROL OF TRAFFIC

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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.

The extent of work includes the design, construction, maintenance and removal of temporary roadways including side-tracks and divided road crossovers 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 worksection except where specified otherwise.

Control of traffic shall be in accordance with AS 1742.3, SAA HB81, this worksection, and the Drawings.

Wherever the word ‘should’ occurs in AS 1742.3 the word ‘shall’ applies and the required action is the Contractor’s responsibility.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in *0161 Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this Worksection shall be deemed as the latest edition of Australian standards including amendments and supplements.

Worksections

0161 Quality (Construction)

1102 Control of erosion and sedimentation

1111 Clearing and grubbing

1112 Earthworks (Roadways)

1121 Open drains, including kerb and channel (gutter)

1141 Flexible pavements

1143 Sprayed bituminous surfacing

1144 Asphaltic concrete (Roadways)

1163 Rigid concrete road safety barrier systems (Public domain)

1194 Non-rigid road safety barrier system (Public domain)

1351 Stormwater drainage (Construction)

1352 Pipe drainage

1354 Drainage structures

Standards

AS 1165	Traffic hazard warning lamps (Withdrawn)
AS 1742	Manual of uniform traffic control devices
AS 1742.3	Traffic control devices for works on roads
AS 1742.14	Traffic signals
AS 1743	Road signs specifications
AS 1744	Forms of letters and numerals for road signs (known as Standard alphabets for road signs)
AS/NZS 1906	Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.1	Retroreflective materials
AS 4191	Portable traffic signal systems
AS/NZS 4192	Illuminated flashing arrow signs

AS/NZS 4602 High visibility safety garments

SAA HB 81 (set) Field guides for traffic control at works on roads

AUSTROADS

Guide to Traffic Engineering Practice—Part 5, Intersections at Grade

Guide to the Geometric Design of Rural Roads

2 TRAFFIC MANAGEMENT PLAN

2.1 REQUIREMENTS

Minimise traffic obstruction

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

Guidance scheme approval

All necessary approvals for temporary traffic arrangements shall be obtained from Council and other authorities.

Two weeks before undertaking work which would involve any obstruction whatsoever to traffic the Contractor shall submit, for the Superintendent's approval, a Traffic Management Plan in accordance with the RTA Traffic Control at Worksites Manual, prepared by a person holding RTA "red" or "orange" card for selection, modification and/or design (if required) of a Scheme.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted Traffic Management Plan is required prior to the release of the **Hold Point**. . The Superintendent may require the modification of the Plan to incorporate additional controls (signage, barriers, etc.) or to meet the requirements of AS 1742.3 in addition to the requirements of the RTA Manual to ensure the site is safe and minimises inconvenience for road users and workers.

Additional notice

Where the Traffic Management Plan involves Regulatory Traffic Control Signs or Devices and/or where in the opinion of the Superintendent the disruption to local traffic is significant, the prior approval of the Council Local Traffic Committee may be sought and obtained prior to the release of the **Hold Point**. In such cases the delay in approval may be up to five weeks in accordance with **Regulatory traffic control signs and devices**.

Guidance scheme contents

The Traffic Management Plan shall include:-

- design drawings for any temporary roadways and detours in accordance with **Design drawings** showing pavement, wearing surface and drainage details,
- details of arrangements for construction under traffic in accordance with SAA HB81, and
- a signpost layout plan showing:
  - . location, size and legend of all temporary signs
  - . temporary regulatory signs and temporary speed zones, and
  - . all traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guardfence and barrier boards.
- Protection measures such as barriers that are required to protect workers
- Protection measures to address hazards associated with excavations (including a note as to the depth of the excavation and offset from the traffic lane) such as barriers
- working times when traffic control measures are in place to minimise disruption to traffic during periods of peak flows.

The Traffic Management Plan shall be in accordance with the requirements of this worksection and the Drawings.

Safety

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

A copy of the approved Traffic Management Plan shall be kept on site at all times and used to check the arrangement and maintenance of traffic control devices in accordance with **Arrangement and placement of traffic control devices** and **Maintenance of traffic control devices**.

2.2 TEMPORARY SPEED ZONING

Where a temporary speed limit has been approved by the Road Authority, the Contractor shall arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection.

The Contractor shall erect these 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 and made available to the Superintendent when requested.

Approval for temporary speed zoning shall be obtained through the Superintendent after submission of an explicit written application 2 weeks in advance of action to employ such zoning.

All costs associated with temporary speed zoning signposting shall be borne by the Contractor.

2.3 SIDE ROADS AND PROPERTY ACCESSES

Access

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.

Notice to property owners

With the prior approval of the Superintendent, vehicular access may need to be denied due to particular construction activities. The Contractor is to keep these interruptions to an absolute minimum and must advise the property owners of such occurrences by way of letter drop at least 48 hours prior to such an interruption. The Contractor shall repeat this advice verbally to the property owner in a courteous manner.

3 PERSONNEL, PLANT AND EQUIPMENT

3.1 TRAFFIC CONTROLLERS

Trained traffic controllers

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 and are the holders of a current RTA “Blue Card”.

Recognition marks

Authorised traffic controllers shall wear a distinguishing mark on their outer garment indicating their authority.

3.2 APPROVED CLOTHING FOR WORK PERSONNEL

Safety clothing

In addition to the requirements of AS 1742.3 and SAA HB81, all personnel shall wear a garment or garments of the classification appropriate for the time of work execution in accordance with AS/NZS 4602 as follows:

- Class D—garments for daytime use only
- Class N—garments for night-time use only
- Class D/N—garments for both day and night use.

For Class D and D/N garments, the colour of the material shall be either red-orange or yellow or as otherwise approved by the Superintendent.

For Class N garments, the colour of the background material is unspecified, however, the retroreflective strips shall be white or yellow or as otherwise approved by the Superintendent.

3.3 PLANT AND EQUIPMENT

Night time clearance
At night, where traffic is permitted to use the whole or portion of the existing road, all plant items and similar obstructions shall be removed from the normal path of vehicles to provide a lateral clearance of at least 6 m where practicable, with a minimum clearance of 1.2 m where the protection of such items has been addressed in the Traffic Management Plan.

4 TEMPORARY ROADWAYS AND DETOURS

4.1 APPROVAL

The Contractor shall submit for the Superintendent's approval the design of all proposed temporary roadways , including side-tracks and divided road crossovers, and detours.

4.2 DESIGN STANDARDS

Alignment, grading, pavement and surfacing
The standard of alignment and grading and surface conditions (pavement and sealing) adopted shall be in accordance with section 4.14 of AS 1742.3 and shall otherwise be in accordance with the AUSTROADS publication '*Guide to the Geometric Design of Rural Roads'.*

Intersections
Intersections shall be designed in accordance with the AUSTROADS publication '*Guide to Traffic Engineering Practice—Part 5, Intersections at Grade'.*

4.3 DESIGN DRAWINGS

Design drawings submitted for approval shall show:

- Alignment and grading at a horizontal scale of 1:2000 for rural roads and 1:500 for urban roads. Where the temporary road rejoins the existing road, levels showing the full cross section shall be extended along the existing road for a minimum length of 200 m.
- A sight distance diagram if opposing traffic is to use a single carriageway.
- Intersections, and any other locations where traffic may be required to make turning, merging or diverging movements, at a scale of 1:500.
- Pavement marking details.
- Sufficient cross-sections to indicate the feasibility of making connections between various parts of the work.
- Sufficient dimensions, especially lane widths, to make clear the geometry and clearances of the proposed Works.
- A north point or some other location method to orientate the plan.

4.4 DRAINAGE

Standard
Drainage structures and drains shall be constructed in accordance with the following worksections:

- *1121 Open drain, including kerbs and channel (gutter)*
- *1351 Stormwater drainage*
- *1352 Pipe drainage*
- *1354 Drainage structures*

Design frequency
Drainage proposed in accordance with **Requirements** shall be able to cope with upstream rainfall run-off resulting from all rainfall intensities up to that expected for a once in five year frequency, without overflow over the road.

Pavement drainage
Pavements shall be designed and constructed to not pond water on the wearing surface or shoulders. Temporary formations to be constructed shall not dam water.

4.5 CONSTRUCTION OF EARTHWORKS AND PAVEMENT

Temporary roadways
Temporary roadways shall be constructed in accordance with the following worksections:

- *1102 Control of erosion and sedimentation*
- *1111 Clearing and grubbing*
- *1112 Earthworks (Roadways)*
- *1141 Flexible pavements*

4.6 SURFACING

Wearing surface
The wearing surface width shall extend across the full width of the traffic lanes plus the width shown in Annexure A for each shoulder, or as shown on the Drawings.

Tie-in to existing work
The wearing surface shall be carried onto any existing connecting roadway so as to finish square to the existing roadway centreline.

Standards
Surfacing shall be constructed in accordance with the worksections:

- *1143 Sprayed bituminous surfacing, and/or*
- *1144 Asphaltic concrete (Roadways)*

4.7 ROAD SAFETY BARRIER

Location
Corrugated steel, water filled or precast concrete safety barrier shall be erected on all temporary embankments where the vertical height between the edge of the shoulder and the intersection of the embankment slope and natural surface exceeds 2 m and as otherwise shown on the Drawings.

Erection
Corrugated steel or precast safety barrier shall be erected in accordance with the worksections:

- *1163 Rigid concrete and road safety barrier systems (Public Domain).*
- *1194 Non-rigid road safety barrier systems (Public Domain).*

4.8 OPENING TO TRAFFIC

Approval to use
Temporary roadways and detours (including portable or temporary traffic signals sites) shall not be open to traffic until they have been inspected and approved.

Signposting
All signposting, pavement marking, guardfence and portable or temporary traffic signals shall be completed before the opening of temporary roadways to traffic.

Existing roadway retained
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 hours in the event of temporary roadway failure and there is a warrant to redirect traffic back onto the existing roadway. The determination to redirect traffic shall be by the Superintendent.

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

Traffic switch
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.

Use of works
The use of the completed Works or part of the Works in providing for traffic shall not be considered as full opening to traffic and shall not be a reason for issuing of a Certificate of Practical Completion for the section so used.

Maintenance
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.

Removal and restoration
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.

5 ARRANGEMENTS FOR TRAFFIC

5.1 CONSTRUCTION UNDER TRAFFIC

Lane width
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.

Carriageway restoration
The carriageway/s shall be restored to a safe and trafficable state for through traffic prior to cessation of work each day in accordance with the approved Traffic Management Plan.

Prior notice of work
At least five working days before undertaking any work which would involve construction under traffic, the Contractor shall notify the Superintendent of the arrangements and methods for traffic control in accordance with the approved Traffic Management Plan.

5.2 OPENING COMPLETED WORK

Written notice
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 Police.

Removal of temporary traffic control devices
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.

Permanent signs and markings
All permanent signposting, pavement markings, guardfence and traffic signals relevant to the completed work under the Contract shall be completed prior to opening completed work to traffic.

6 TRAFFIC CONTROL DEVICES

6.1 ARRANGEMENT AND PLACEMENT OF TRAFFIC CONTROL DEVICES

Arrangement diagrams
The arrangement and placement of traffic control devices shall be carried out in accordance with the approved Traffic Management Plan. Persons erecting signs must carry a current RTA “Yellow Card”.

6.2 MAINTENANCE OF TRAFFIC CONTROL DEVICES

Good order and in the correct positions
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.

Out of hours contact
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 and the local Police, in writing, the names, addresses, and means of communicating with personnel nominated for this purpose.

6.3 INADEQUATE TRAFFIC CONTROL DEVICES

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

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

6.4 ACCIDENTS, INCIDENTS AND COMPLAINTS

Accidents
The Contractor shall immediately notify the Superintendent of any accidents or near misses on the site.

Complaints
The Contractor shall immediately notify the Superintendent of any complaints regarding implementation of any Traffic Management Plan including issues such as inability to access properties etc.

6.5 REGULATORY TRAFFIC CONTROL SIGNS AND DEVICES

A Regulatory Traffic Control Sign or Device shall be in accordance with AS 1742.3, and shall require approval by the Council Local Traffic Committee before its erection. This approval shall be obtained through the Superintendent, refer to **Temporary speed zoning**.

6.6 SIGNS

Specifications
All signs shall comply with the requirements of AS 1742.3 or any other relevant Australian Standard.

6.7 BARRIER BOARDS

Standard
Barrier boards shall comply with the requirements of AS 1742.3.

6.8 HIGH VISIBILITY MESH FENCING

High visibility mesh fencing shall be constructed where shown on the Drawings, Traffic Management Plan or as directed by the Superintendent.

High visibility mesh fencing shall be constructed in accordance with AS 1742.3, Containment fences.

6.9 TEMPORARY POST-MOUNTED DELINEATORS

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.

6.10 CONES AND BOLLARDS

Standard and Placement
Traffic cones and bollards shall comply with the requirements of AS 1742.3 and the Traffic Management Plan.

Conditions of Use
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.

Reflectorised for Night Work
Cones and bollards used under night conditions shall be reflectorised in accordance with AS 1742.3.

6.11 TRAFFIC WARNING LAMPS

Traffic warning lamps shall comply with AS 1165 (withdrawn) 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.

6.12 TEMPORARY PAVEMENT MARKINGS

Reflectorised markings
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.

Adjoining work edgelining
Where the adjoining roadway is edgelined, temporary roadways shall be similarly edgelined.

6.13 TEMPORARY LINEMARKING

On final surface
Where temporary linemarking is required on the final wearing surface, only pavement marking tape shall be used.

Deterioration of pavement linemarking
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.

Pavement arrows
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.

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

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

6.14 RAISED PAVEMENT MARKERS

Ineffective markers
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.

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

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

6.15 BOOM BARRIERS

Where the Contractor proposes to use boom barriers to control traffic they shall be of a type and at locations approved by the Superintendent.

6.16 TRAFFIC SIGNALS

Portable or temporary
Traffic Signals may be either portable or temporary as shown in AS 1742.3.

Portable traffic signals
Portable traffic signals may be used for shuttle control where a single lane has to be used alternately by traffic from opposite directions or at road crossings or intersections. They are intended for relatively short term applications.

Where the Contractor proposes to use portable traffic signals they shall be in accordance with AS 4191.

Approval of the Local Traffic Committee shall be sought prior to implementation. Written application is required through the Superintendent 5 weeks in advance of action to employ such traffic signals.

Temporary fixed traffic signals
Temporary fixed traffic signals may be used in accordance with AS 1742.3 for longer term shuttle operations or for non-shuttle control of intersecting traffic flows.

Where the Contractor proposes to use temporary fixed traffic signals they shall be designed and installed in accordance with AS 1742.14.

Approval of the Local Traffic Committee shall be sought prior to implementation. Written application is required through the Superintendent 5 weeks in advance of action to employ such traffic signals.

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection and shown on the Drawings in accordance with Pay Item 1101.1.

All activities for the construction, maintenance and removal of temporary roadways, including side-tracks and divided road crossovers, and detours detailed in this worksection, to the requirements of specific activity Worksections parts, are measured and paid in accordance with those Worksections parts.

7.2 PAY ITEMS

1101.1 Control of traffic

This shall be a Lump Sum item.

The Lump Sum shall include the design of temporary roadways and detours, traffic switching operations, the provision of traffic controllers (as specified), signposting, roadmarkings, raised pavement markers, lights, barriers and any other traffic control devices required for the safe movement of traffic and the protection of persons and property in accordance with this worksection.

Progress payments shall be made on a pro-rata basis of work done under this item, having due regard to the duration of the Contract.

8 ANNEXURE A

8.1 DESIGN STANDARDS AND SIGN REQUIREMENTS

Design standards (To be completed by Compiler)

Design travel speed

Minimum widths of traffic lanes

Minimum widths of shoulders

Minimum width of shoulder seal

Minimum surface type

Minimum thickness

Base type

Minimum thickness

Sub-base type

Minimum thickness

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1102 CONTROL OF EROSION AND SEDIMENTATION

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the construction of structures and the implementation of measures to control erosion and sedimentation in accordance with the approved Erosion and Sedimentation Control Plan (ESCP) or Soil and Water Management Plan (SWMP) included in the Drawings. These may be temporary or permanent.

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 in compliance with the requirements of the Protection of the Environment Operations Act, the Soil Conservation Act 1938, the Water Act 1912 and Council's Adopted Policies where available.

All measures for erosion and sedimentation control shall be designed, installed and maintained by the Contractor in such a manner so as not to present a potential hazard to any person or property.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction).*

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection are:

Worksections

0161 Quality (Construction)

0250 Open space - landscaping

1102 Control of erosion and sedimentation

1112 Earthworks (Roadways)

1121 Open drains, including kerb and channel (gutter)

Other publications

NSW State Legislation

- Protection of the Environment Operations Act 1997
- Soil Conservation Act, 1938
- Water Act, 1912

Department of Environment and Conservation NSW

- A resource guide for local councils - Erosion and Sediment Control

Landcom

- Managing Urban Stormwater: Soils and Construction, July 2006

Institute of Public Works Engineering Australia (IPWEA)

Local Government Salinity Management Handbook

1.4 ESCP/SWMP

Site sections

For implementation of the Erosion and sedimentation control plan/soil and water management plan (ESCP/SWMP), the site shall be divided 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:

- access and haulage tracks,
- borrow pits, stockpile areas and
- compound areas, such as Contractor's facilities and concrete batching areas.

Section plan

At least seven days before the natural surface is disturbed on each of these sections, the Contractor shall submit to the Superintendent an ESCP/SWMP for that section.

This Plan shall be superimposed on half-sized drainage drawings of the works and shall be detailed for each catchment area of the works and consistent with the approved ESCP/SWMP.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted section ESCP/SWMP is required prior to the release of the **Hold Point**.

Plan inclusions

The Plan shall consist of scale diagrams indicating:

- features of the site including contours and drainage paths,
- relevant construction details of all erosion and sedimentation control structures,
- 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 by *1111 Clearing and grubbing.*
- an order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage, and
- proposed time schedules for construction of structures and implementation of measures to control erosion and sedimentation.

Guidance

The Department of Environment and conservation NSW publication Urban Erosion and Sediment Control and the Landcom publication Managing Urban Stormwater, Soils and Construction provides guidance on typical permanent and temporary erosion and sedimentation control measures which may be required and guidance in the preparation of an ESCP/SWMP.

Salinity prevention

In known salt affected areas, the Contractor shall seek advice from the relevant land and water resource authority to ensure that its Erosion and Sedimentation Control Plan conforms with the current salinity prevention measures outlined in the IPWEA publication, Local Government Salinity Management Handbook.

Effective erosion and sedimentation control at all times

Release of the **Hold Point** approving the section ESCP/SWMP as submitted shall not relieve the Contractor of the full responsibility to provide whatever measures are required for effective erosion and sedimentation control at all times.

Adherence to plan

The Contractor shall adhere to the approved ESCP/SWMP. The Contractor shall submit a revised ESCP/SWMP for approval by the Superintendent seven days in advance of an intended variation from the approved plan.

The cost of preparing, submitting and revising the ESCP/SWMP shall be borne by the Contractor.

Erosion and sedimentation control measures

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

- The installation of permanent drainage structures before the removal of topsoil and commencement of earthworks for formation within the catchment area of each structure.
- The prompt completion of all permanent and temporary drainage works, once commenced, to minimise the period of exposure of disturbed areas.
- 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 approved by the Superintendent, before the adjacent ground is disturbed and the excavation is commenced.
- The passage of uncontaminated water through the site without mixing with contaminated runoff from the site.
- 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.
- The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.

- 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.
- The limitation of areas of erodible material exposed at any time to those areas being actively worked. Any area that is not approved by the Superintendent for clearing or disturbance by the Contractor's activities shall be clearly marked, fenced off or otherwise appropriately protected against any such disturbance.
- 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.
- The progressive revegetation of the site, in accordance with *0250 Open space - landscaping*.
- All stockpile sites shall be situated in areas approved for such use by the Superintendent. A 5 m buffer zone shall exist between stockpile sites and any stream or flow path. All stockpiles shall be adequately protected from erosion and contamination of the surrounding area by use of the measures approved in the Erosion and Sedimentation Control Plan
- Access and exit areas shall include shake-down or other methods approved by the Superintendent for the removal of soil materials from motor vehicles.
- All permanent and temporary erosion and sedimentation control measures shall be constructed in accordance with the construction details in the ESCP/SWMP and the details as shown on the Drawings.

2 PERMANENT EROSION AND SEDIMENTATION CONTROL

2.1 EARTHWORKS FOR PERMANENT EROSION AND SEDIMENTATION CONTROL BASINS

Planned levels

Earthworks for permanent erosion and sedimentation control basins shall be constructed to the planned levels and dimensions shown on the Drawings or such levels and dimensions as determined by the Superintendent.

Site preparation

The entire storage and embankment foundation area of permanent erosion and sedimentation control basins shall be cleared in accordance with *1111 Clearing and grubbing* and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with *1112 Earthworks (Roadways)*.

The embankments shall be constructed in accordance with *1112 Earthworks (Roadways)*.

Survey information for measurement of the works

Where 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.

2.2 INLETS, SPILLWAYS AND LOW FLOW OUTLETS FOR SEDIMENTATION CONTROL BASINS AND SEDIMENT TRAPS

Rock mattresses

Inlets and spillways shall be constructed using rock filled woven galvanised steel mattresses and geotextile, as shown on the Drawings or as directed by the Superintendent. The rock filled mattresses shall be installed in accordance with the requirements for rock filled wire mattress and geotextile in *1121 Open drains, including kerb and channel (gutter*).

Plastic pipe outlet

A low flow outlet consisting of a 150 mm diameter plastic pipe shall be installed as shown in the Drawings. No extra payment shall be made for this work which shall be regarded as part of the construction of the sedimentation control basin.

2.3 DROP INLET SEDIMENT CONTROL

Permanent traps

Permanent drop inlet sediment traps and inlet control banks shall be constructed on completion of gully pits as indicated on the Drawings. These permanent drop inlet sediment traps and inlet control

banks are additional to the temporary sedimentation control measures that may be required under **Temporary sediment traps** during construction of the gully pits.

Purpose

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.

Sediment traps and control banks

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.

2.4 CLEANING SEDIMENTATION CONTROL STRUCTURES

Cleaning

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.

Removal of sediment

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 removed to a nominated soil stockpile site or 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.

3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

3.1 GENERAL

Effective erosion and sedimentation control at all times

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

Runoff pollutant free

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 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.

Maintenance

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 ESCP/SWMP.

3.2 TEMPORARY DRAINS

Control of runoff

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.

Contour drains

Contour drains, which follow points on the natural surface of approximately the same elevation, shall be provided immediately after a construction site is cleared to intercept and divert runoff from the site to nearby stable areas at non-erosive velocities.

Contour drains shall be formed with a grade of neither less than 1 per cent nor more than 1.5 per cent and shall be spaced at intervals of neither less than 20 m nor more than 50 m, depending on the erodibility of the exposed soil.

Contour drains shall be constructed as shown on the Drawings.

Diversion drains

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.

3.3 TEMPORARY SEDIMENT TRAPS

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 stormwater drainage systems, natural watercourses or adjacent land.

3.4 BATTER PROTECTION

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

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

3.5 MUD REMOVAL

The Contractor shall take all necessary action to prevent the carting of mud from construction sites onto the adjoining public roadways at all times whilst the works are taking place. Prior to commencing works the Contractor shall submit to the Superintendent for approval the proposed method for removal of mud from construction vehicles.

3.6 MAINTENANCE AND INSPECTION

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.

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.

3.7 REMOVAL

All temporary erosion and sedimentation control works shall be removed by the Contractor when revegetation is established on formerly exposed areas before the end of the Contract.

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.

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis, in accordance with Pay Items 1102.1 to 1102.5 inclusive.

A lump sum for any item other than Pay Item 1102.1 shall not be accepted.

If any item, for which a quantity of work listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in other items for the cost of the activity which has not been priced.

Clearing and grubbing is measured and paid in accordance with 1111 *Clearing and grubbing*.

Landscaping works are measured and paid in accordance with 0250 *Open space - landscaping*.

Topsoil stripping and removal of unsuitable material are measured and paid in accordance with 1112 *Earthworks (Roadways)*.

4.2 PAY ITEMS (UNITS OF MEASURE)

1102.1 Temporary erosion and sedimentation control

The unit of measurement shall be a lump sum for the installation, maintenance, inspection and removal of the temporary erosion and sedimentation control measures in accordance with **Temporary erosion and sedimentation control** inclusive and the Drawings.

1102.2 Earthworks for permanent erosion and sedimentation control basins

The unit of measurement shall be the cubic metre of compacted volume of embankment constructed in accordance with **Earthworks for permanent erosion and sedimentation control basins** and the Drawings.

The volume shall be determined by calculation using the end area method.

The schedule rate shall cover the excavation of material from within the sedimentation control basin and embankment construction required under **Earthworks for permanent erosion and sedimentation control basins** and shall be an average rate for all types of materials.

The cost of excavating and transporting material for embankment construction and obtained from within cuttings or from borrow shall be included in the schedule rate for General Excavation in 1112 *Earthworks (Roadways)*.

1102.3 Inlets, spillways and low flow outlets for sedimentation control basins

The unit of measurement shall be the square metre of horizontal surface area of rock filled mattress constructed in accordance with **Inlets, spillways and low flow outlets for sedimentation control basins and sediment traps** and the Drawings.

1102.4 Drop inlet sediment traps and inlet control banks

The unit of measurement shall be ‘each’ drop inlet sediment trap including inlet control bank constructed in accordance with **Drop inlet sediment control** and the Drawings.

1102.5 Cleaning of permanent sedimentation structures

The unit of measurement shall be the in-place cubic metre of sediment removed from the structure in accordance with **Cleaning sedimentation control structures**.

The volume of sediment removed shall be determined by survey or by methods approved by the Superintendent.

The schedule quantity is a provisional quantity.

1111 CLEARING AND GRUBBING

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the clearing of all vegetation, both living and dead, all minor structures (such as fences and livestock yards), all rubbish and other materials which, in the opinion of the Superintendent, are unsuitable for use in the Works, the chipping of the crowns of trees and the branches of shrubs and the grubbing of trees and stumps.

The work also includes the disposal of all materials that have been cleared and grubbed.

All natural landscape features, including natural rock outcrops, natural vegetation, soil and watercourses are to remain undisturbed except where affected by the Works as approved by the Superintendent.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection are:

Worksections

0161 Quality (Construction)

0250 Open space - landscaping

1102 Control of erosion and sedimentation

1195 Boundary fences for road reserves

1.4 EROSION CONTROL

In advance of or in conjunction with clearing and grubbing operations, effective erosion and sedimentation control measures shall be implemented in accordance with *1102 Control of erosion and sedimentation*.

1.5 BOUNDARY FENCE LINE

The clearing and grubbing required for boundary fencing is included in *1195 Boundary fences for road reserves* and does not form part of the work under this worksection.

1.6 BLASTING

Explosives shall not be permitted to be used in clearing, grubbing or other demolition activities without the prior written approval of the Superintendent.

2 CONSTRUCTION

2.1 LIMITS OF CLEARING

Unless otherwise shown on the Drawings or directed by the Superintendent, the area to be cleared is that which will be occupied by the completed Works, erosion and sedimentation measures, stockpile sites and borrow areas, plus a clearance of 4 m beyond tops of cuts and toes of embankments where the natural fall of the ground is towards the roadway and 2 m beyond the tops of cuts and toes of embankments where the natural fall of the ground either slopes away from the roadway or is level.

The Contractor shall ensure that only the absolute minimum area for construction is cleared.

The Contractor shall peg out the limits of clearing and present this for approval 7 days prior to any commencement of work.

This action constitutes a **Hold Point**.

The Superintendent shall inspect the proposed area for clearing to confirm the clearing perimeters and shall mark with ribbon markers, or indicate to the Contractor, the trees that shall be preserved.

Upon the agreement of the Contractor to the limits of clearing, tree preservation and removal, the Superintendent will proceed to release the **Hold Point**.

2.2 CLEARING OPERATIONS

Extent

The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor structures (such as fences and livestock yards), all redundant kerb and gutter, bitumen surfacing, footpaths and driveways, and all rubbish and other materials which, in the opinion of the Superintendent, are unsuitable for use in the Works.

The Contractor shall plan clearing operations such that wherever possible, clearing is carried out progressively and only the minimum area of land is left disturbed at any time.

Trees to be preserved

Trees that shall be preserved shall be protected during site works by the erection of solid barricades, as shown on the Drawings and, generally at a distance of 4 m from the trunk of the tree, unless otherwise authorised by the Superintendent.

Trees to be preserved in embankment areas

If any tree, which is to be preserved, is found to be within the area to be covered by embankment, the circumstances shall be brought to the notice of the Superintendent who shall decide whether the tree is to be removed or protected as directed by the Superintendent. Such protective measures shall be paid for as a Variation to the Contract.

Utility services

The Contractor shall take all measures to prevent damage to existing underground and overhead utility services.

Disturbance near trees

The erection of structures, excavation and filling, changes to soil profiles, stockpiling of spoil, storage of other materials and driving or parking of any vehicle or machinery within 4 m of the trunks of trees to be retained shall not be permitted unless part of the Works as approved by the Superintendent.

Damage to trees

Damage to trees shall also include damage to bark and root systems. No tree roots are to be cut without the prior approval of the Superintendent.

Excavation within 4 m of tree trunks

If excavation works are to be carried out within 4 m of the trunk of any tree, the Contractor shall develop appropriate work methods to avoid damage to the tree and its roots system.

Trees outside limits of work

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.

Unsound trees in road reserve

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 **Chipping of cleared vegetation**, subject to prior approval of the Superintendent.

Overhanging branches

If directed by the Superintendent, any branch, which overhangs the road formation, shall be cut back to within 0.5 m of the tree trunk and disposed of in accordance with **Chipping of cleared vegetation**.

Timber falling on private property

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 to the Superintendent the written consent of the property owner to its remaining there.

The cost of disposal of such fallen timber shall be borne by the Contractor.

Prior to entering private property, the Contractor shall obtain consent from the Superintendent and the property owner.

Damage to be made good
Damage of any kind, including damage to trees, fencing, occurring during clearing operations and construction shall be made good by the Contractor. The cost of making good such damage shall be borne by the Contractor.

2.3 GRUBBING

Extent
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.

Depth
Grubbing operations shall be carried out to a depth of 0.5 m below the natural surface or 1.5 m below the finished surface level, whichever is the lower.

Backfill holes
Holes remaining after trees and stumps have been grubbed shall be 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.

2.4 CHIPPING OF CLEARED VEGETATION

Wood-chip mulch
The Contractor shall produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this worksection.

The wood-chip mulch produced shall be stockpiled for subsequent use in landscaping in accordance with 0250 *Open space – landscaping* or for use at other locations by the Principal as appropriate.

Dimensions
The wood-chip mulch shall be produced from branches having a maximum diameter of 100 mm and the chipped material produced shall not have two orthogonal dimensions exceeding 75 mm and 50 mm.

2.5 DISPOSAL OF MATERIALS

Removal from site
Unless otherwise specified elsewhere, all materials cleared and grubbed in accordance with this worksection shall become the property of the Contractor and shall be removed from the site and disposed of legally.

Burning of material
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 Regulations applicable to burning off during the period of the Contract.

Burning hazards
Any 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.

3 MEASUREMENT AND PAYMENT

3.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed under this Worksection on a schedule of rates basis in accordance with Pay Items 1111.1 ,1111.2 and 1111.3.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Erosion and sedimentation control measures are measured and paid in accordance with 1102 *Control of erosion and sedimentation*.

Clearing and grubbing for boundary fencing is measured and paid in accordance with 1195 *Boundary fencing for road reserves*.

3.2 PAY ITEMS

1111.1 Clearing and grubbing

The unit of measurement shall be the hectare of plan area bounded by the limits of clearing specified in **Limits of clearing**.

1111.2 Removal of trees outside limits of clearing

The unit of measurement shall be 'each' tree outside the area bounded by the limits of clearing specified in **Limits of clearing**.

The schedule quantity is a provisional quantity.

1111.3 Wood-chipping

The unit of measurement shall be 'cubic metre' in stockpile.

The schedule quantity is a provisional quantity.

1112 EARTHWORKS (ROADWAYS)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of:

- removal of topsoil,
- 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 worksection,
- removal and replacement of any unsuitable material,
- any spoil or borrow activities associated with earthworks, and
- any additional processing of selected material for the selected material zone.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0250 Open space – landscaping

1101 Control of traffic

1102 Control of erosion and sedimentation

1111 Clearing and grubbing

1113 Stabilisation

1351 Stormwater drainage (Construction)

1352 Pipe drainage

1353 Precast box culverts

1354 Drainage structures

Standards

AS 1289	Methods of testing soils for engineering purposes
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 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
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 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 2187	Explosives—Storage, transport and use
AS 2187.1	Storage
AS 2187.2	Use of explosives

Other publications

AUSTROADS *Explosives in Roadworks, Users Guide 1982*

EPA Environmental Noise guide for local Government *Criteria road traffic noise.*

Department of Transport and Regional Services (DOTARS)
Australian Code for the Transport of Explosives by Road and Rail

2 PRELIMINARIES

2.1 NATURAL SURFACE AND EARTHWORKS MATERIALS

Natural surface
Contractor's survey system: The Contractor shall submit details of the Contractor's proposed survey system to the Superintendent for approval, within 14 days of possession of site being granted and in any case prior to commencement of clearing and grubbing or earthworks.

Verify accuracy of ground model: Computer generated road design data files in the format of the approved software containing the ground model may be supplied to the Contractor, as advised prior to commencement of the Contract.

If desired, the Contractor, may verify the accuracy of the model by field surveys.

If the Contractor considers any areas of the model not to be representative, or submitted plans to be inaccurate, the Contractor shall give not less than seven (7) days notice, prior to commencement of Works, to the Superintendent to allow checking.

If the subsequent check survey reveals the ground model and plans to be correct, then the Contractor shall bear the cost of the check survey.

Earthworks materials
Material characteristics: The Contractor shall be responsible for any assumptions made by the Contractor in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.

Embankment material deficiency: Where material from excavations is acceptable for use in embankments, but the Contractor elects to:

- Spoil it, or
- Use it for the Contractor's own purposes, or
- Use it as a source of pavement materials, or
- Construct embankments with dimensions in excess of those specified,

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in **Benching in cuttings.**

The cost of making good such deficiency of material shall be borne by the Contractor.

2.2 PROTECTION OF EARTHWORKS

Care of the works
The Contractor's responsibility for care of the Works shall include the protection of earthworks.

Erosion and sedimentation control
The Contractor shall install effective erosion and sedimentation control measures in accordance with *1102 Control of erosion and sedimentation* prior to commencing earthworks and shall maintain these control measures for the duration of the contract.

Drainage of working areas
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 an approved erosion and sedimentation control system.

Salinity prevention
In salt affected areas, the Contractor shall take adequate precautions to minimise ingress of surface water into the groundwater table.

Wet weather precautions
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 by adequate compaction to provide a smooth tight surface.

Wet material

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.

2.3 SETTING OUT OF EARTHWORKS

Batter profiles

Before earthworks operations commence and after survey controls are in place, batter profiles shall be established by the Contractor and the necessary pegs driven at 25 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 surface level, shall be clearly marked on each peg.

Profile location

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.

Retention and removal of pegs

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.

Additional pegs

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.

Transitions cuttings/embankments

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 **Transition from cut to fill** and **Foundations for embankments**.

2.4 STOCKPILE SITES

Additional stockpile sites

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.

Clearing and grubbing

Any clearing and grubbing required for these sites shall be carried out in accordance with *1111 Clearing and grubbing*.

Temporary erosion and sedimentation control measures shall be taken in accordance with *1102 Control of erosion and sedimentation*.

Restoration

Restoration of stockpile sites following completion of the work shall be carried out in accordance with *0250 Open space – landscaping*.

3 REMOVAL OF TOPSOIL

3.1 SCOPE

Definition

Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones.

Prerequisites

Removal of topsoil from 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 in accordance with *1102 Control of erosion and sedimentation* and *1111 Clearing and grubbing*.

Extent of work

Topsoil throughout the length of the Work shall be removed and stockpiled separately clear of the work with care taken to avoid contamination by other materials.

The work shall include the following:

- Cuttings
  - . Removal of the topsoil to a depth quoted in Annexure 213A or as directed by the Superintendent.
- Embankments
  - . Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in Annexure A, 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 Annexure A shall be removed to its full depth as directed by the Superintendent.
- Other locations
  - . Removal of topsoil as directed by the Superintendent.

3.2 SURVEY AFTER REMOVAL OF TOPSOIL

Establish surface level

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.

Schedule of these surface levels

A schedule of these surface levels shall be submitted to the Superintendent for approval at least three working days before commencement of any work which will alter the ground surface as surveyed.

This action constitutes a **Hold Point**.

The Superintendent's approval to the submitted schedule of surface levels is required prior to the release of the **Hold Point**.

3.3 TOPSOIL STOCKPILES

Site survey

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.

Height and batter

The maximum height of stockpiles shall not exceed 3.0 m and the maximum batter slope shall not exceed 2 horiz : 1 vert.

Stockpile material and trimming

Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.

Erosion control

To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent.

Seeding stockpile

Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with *0250 Open space – landscaping*.

4 CUTTINGS

4.1 SCOPE

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.

4.2 EXCAVATION

Excavated material prepared for incorporation into the works

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 **Unsuitable material** and **Embankment construction** and **Embankment material**.

Batter slopes

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.

The tops of cuttings shall be neatly rounded to the dimensions shown on the Drawings.

Batters to be even

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

Unstable material

Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds.

Blending material

Where, after the removal of topsoil as specified in **Removal of topsoil**, 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 **Embankment material**.

Variation for batter slopes

Where the Superintendent redetermines the batter slope of any section of a cutting after it has been completed in accordance with this Clause, the Superintendent shall order a Variation to the Contract for the resetting out, removal of additional material and retrimming of the batter.

This Variation shall include all additional costs incurred by the Contractor who shall not have any further claim upon the Principal as a result of the redetermination of the batter slope.

4.3 BATTER TOLERANCES

Batter tolerances

The tolerances for the excavation of batters are given in Table 3.1.

Table 3.1 Excavation tolerances for batters

Location	**Tolerance (mm)**	
	Slope 1:1 or flatter	**'Steeper than 1:1**
Toe of batter and level of table drain	+ 0 –150	+ 0 –200
2 m above table drain and higher	+ 300 –300	+ 300 –600
Between level of table drain and 2 m above table drain	pro rata basis	pro rata basis

Excavation beyond Batter Line

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 redetermination of the batter slope under **Excavation**.

The cost of any increase in excavation quantities resulting from such change in batter slope shall be borne by the Contractor.

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.

Restoration of batter slope

For batters steeper than 1:1, if any section of the batter up to a height of 3 m 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.

The cost of restoring batters shall be borne by the Contractor.

4.4 BENCHING IN CUTTINGS

Cut batters shall be benched as shown on the Drawings to provide drainage and erosion control.

Notwithstanding the tolerances permitted under **Batter tolerances**, bench widths shall not be less than shown on the Drawings.

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

The cost of such maintenance and cleaning of benches shall be borne by the Contractor.

4.5 TREATMENT OF FLOORS OF CUTTINGS

Excavation level

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.

Where the Superintendent considers that any underlying material is unsuitable for pavement support, the Superintendent may direct that it be removed in accordance with **Unsuitable material**.

Floor material ripped

The Contractor shall rip or loosen all material in the floor to a minimum depth of 200 mm 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 150 mm.

CBR testing

Prior to ripping or loosening the cutting floor the Contractor shall determine the CBR of the material in the floor by AS 1289.6.1.1. Sufficient tests shall be taken to represent all the various materials which may exist in the cutting floor. If material in the floors of cuttings has a CBR value less than the value quoted in Annexure A, the Superintendent will direct the action to be taken.

Inspection by Superintendent

Ripped or loosened material shall be made available for inspection by the Superintendent before recompaction commences.

This action constitutes a **Hold Point**.

The Superintendent's approval of the ripped or loosened material is required prior to the release of the **Hold Point**. Ripped or loosened material shall be recompacted in accordance with **Compaction and moisture requirements**. No account shall be taken of the volume involved in loosening when measuring the volume of excavations.

Level tolerances

After recompaction, the floors of cuttings shall be re-trimmed parallel with the finished wearing surface. The tolerances for the trimmed levels are given in Annexure A. Prior to placing any subsequent layers over the completed cutting floor, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection.

This action shall constitute a **Hold Point**.

The Superintendent's approval of the completed cutting floor is required prior to the release of the **Hold Point**.

4.6 TRANSITION FROM CUT TO FILL

Intersection line

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.

Terrace construction

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 900 mm below and parallel to the cutting floor, as shown in Figure 4.1, unless otherwise approved by the Superintendent.

Extent of terrace

The terrace shall extend into the cut to the point where the cutting floor is 900 mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.

Excavated quantity

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.

Quality and compaction

The material placed above the terrace shall satisfy the requirements of **Embankment material** and shall be compacted in accordance with **Compaction and moisture requirements**.

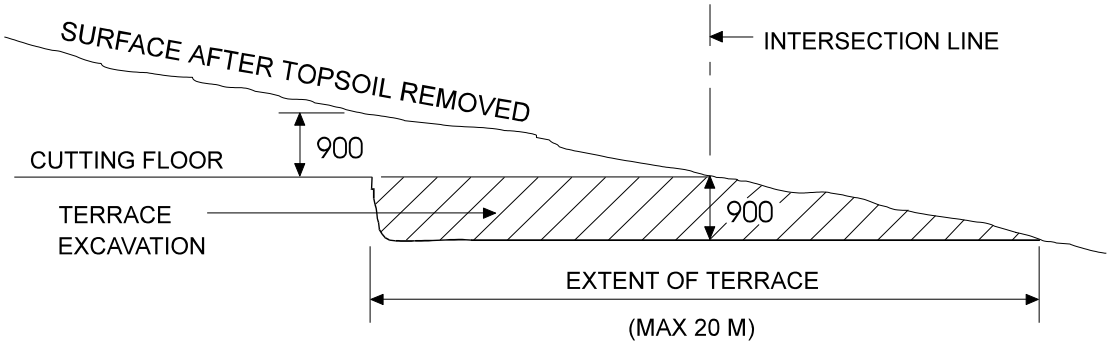

Figure 4.1 Transition from cut to fill

5 BLASTING

5.1 GENERAL

Contractor to obtain licences

When explosives are permitted to be used by the Superintendent and the contractor wishes to undertake blasting, the Contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all Government and Council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS 2187, Parts 1 and 2.

The transport of explosives shall be in accordance with the Australian Code for the Transport of Explosives by Road and Rail.

The requirements of the Environment Protection Authority (EPA) shall be complied with.

The Contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Pre-blast survey

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.

Extent of survey

The survey shall include all structures (including utility services) within 500 m 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 dilapidation 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.

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.

Proposed blasting procedure

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.

This action constitutes a **Hold Point**.

The Superintendent's sighting of the necessary licences and approval to the submitted details of blasting operations is required prior to the release of the **Hold Point**.

Release of the **Hold Point** does not in any way reduce the Contractor's responsibility set out in **Contractor to obtain licences**.

Ground vibration

Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table 5.1.

Table 5.1 Limiting peak particle velocity

Point of Potential Damage (within 1 km of blasting site)	**Peak Particle Velocity**
Completed and cured bridge structures or sub-structures (eg completed abutment)	25 mm/sec
Bridgeworks and structural retaining walls under construction	20 mm/sec
Residential premises, schools, hospitals and other buildings	5 mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance	2 mm/sec

Advice to residents

The Contractor shall advise all residents within a radius of 1 km, 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.

Time limits

Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9 am to 3 pm.

Safety precautions

When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with 1101 *Control of traffic*.

A standard warning procedure in compliance with the NSW Explosives Act 2003 and NSW Explosives Regulations 2005 shall be established and observed at all times.

5.2 PRESPLITTING

Where pre-splitting is carried out the spacing of pre-split drill holes shall not exceed 750 mm centre to centre.

5.3 BLASTING RECORDS

Records to be kept

The Contractor shall maintain accurate records of each blast showing the details listed below:

- Date and time of blast
- Location, number and diameter of holes loaded

- Depth of each hole loaded
- Inclination of holes
- Maximum and minimum burden
- Types of explosives used
- Charge distribution in each hole
- Maximum instantaneous charge
- Delay periods and sequence
- Total amount of charges in the blast
- Length and type of stemming in each hole

Record preparation

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.

5.4 CONTROL OF AIR BLAST OVER-PRESSURE

Application

This Clause shall apply only where a noise sensitive location exists within 1 km of the blasting site.

Noise control manual

The Contractor's attention is drawn to the recommendations given in the EPA Noise Control Manual for the reduction of air blast over-pressure.

Noise limitations

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% of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time.

Monitoring of air blast over-pressure

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 worksection.

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.

Excessive air blast over-pressure

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.

5.5 CONTROL OF GROUND VIBRATION

Monitoring vibrations

The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table 5.1. 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 worksection.

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.

Blasting site relationship

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.

Maximum instantaneous charge

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:

- $MIC = 0.5[D/(PPV/1140)^{-0.625}]^2$

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 5.1.

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

Scaled distance = $D/(MIC)^{0.5}$

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

Adjustment of blast design

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.

6 UNSUITABLE MATERIAL

6.1 DEFINITION

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 for embankment or pavement support in its present position.

6.2 EXTENT OF EXCAVATION

Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable, as directed by the Superintendent, shall be spoiled in accordance with **Spoil**.

6.3 FLOOR INSPECTION

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.

This action constitutes a **Hold Point**.

The Superintendent's approval to the floor of the excavation is required prior to the release of the **Hold Point**.

Prior to placing replacement material the excavated surface shall be compacted in accordance with **Compaction and moisture requirements**.

6.4 REPLACEMENT MATERIAL

The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with **Borrow**, of the quality specified in **Embankment material**. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with **Placing fill for embankment construction** and compacted in accordance with **Compaction and moisture requirements**.

6.5 INAPPROPRIATE CONSTRUCTION ACTIVITIES

All costs associated with reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor.

7 EMBANKMENT CONSTRUCTION

7.1 SCOPE

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 **Unsuitable material**,
- 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.

7.2 EMBANKMENT MATERIAL

Location and quality

Material for embankment construction shall be obtained from the cuttings within the Works in accordance with **Benching in cuttings**, supplemented by borrow in accordance with **Borrow** and from other sources as approved by the Superintendent if necessary.

The material shall be free of tree stumps and roots, topsoil, steel, organic material and other contaminants and shall be capable of being compacted in accordance with **Compaction and moisture requirements**.

Selection of material

The work shall be programmed so that material of the quality specified in **Placing fill for embankment construction** and **Selected material zone** for the upper zones of the formation is available when required.

7.3 FOUNDATIONS FOR EMBANKMENTS

Inspection

Following removal of topsoil in accordance with **Removal of topsoil**, the embankment foundation area shall be made available for inspection by the Superintendent.

Unsuitable material

Where the Superintendent considers that any underlying material is unsuitable, the Superintendent may direct that it be removed and replaced in accordance with **Unsuitable material**.

Foundations for shallow embankments

Shallow embankments: Shallow embankments are those embankments of a depth less than 1.5 metres 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.

Unsuitable material: Material in the foundations for shallow embankments which does not meet the requirements specified in Annexure A, shall be deemed unsuitable in accordance with **Unsuitable material** and shall be replaced by material of the specified quality.

Preparation of foundations: Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200 mm, adjusting the moisture content of the loosened material and compacting as specified in **Compaction and moisture requirements**.

The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

Other embankments

Preparation: 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 200 mm as specified in **Compaction and moisture requirements**.

Bridging layer: 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 with or without geotextile interlayer as specified on the Drawings.

The granular material 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.

The compaction requirements of **Compaction and moisture requirements** 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 **Natural surface and earthworks materials**, the supply and placing of the bridging layer shall be treated as a Variation to the Contract.

Seepage from foundations: 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 **Compaction and moisture requirements**.

A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design.

Working platform: As an alternative to a bridging layer, the Superintendent may approve of a working platform created by the chemical stabilisation of in situ material in accordance with 1113 *Stabilisation*.

7.4 HILLSIDE EMBANKMENTS

Horizontal terraces

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.

Excavated volume

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

7.5 PLACING FILL FOR EMBANKMENT CONSTRUCTION

Uniformity of material

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.

Embankment stability

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 **Compaction and moisture requirements**.

Layer thickness

Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with **Compaction and moisture requirements**.

The layers shall be of uniform compacted thickness not exceeding 200 mm, except that where more than 25% by volume of the filling consists of rock with any dimension larger than 150 mm, the Superintendent may approve an increase in the compacted layer thickness to 300 mm, provided that the relative compaction specified in **Compaction and moisture requirements** is attained.

Maximum size rock pieces

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.

Grading of fill material

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.

Reworking stony patches

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.

Equipment selection for placement

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.

CBR value

After compaction, embankment material in the zone(s) below the selected material zone (or subbase layer, where no selected material zone) shall have a CBR value not less than that quoted in Annexure A for the depth(s) specified in Annexure A.

Test method

The CBR value of the material shall be determined by Test Method AS 1289.6.1.1

Sources of material and processing

The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements.

7.6 EMBANKMENT BATTERS

Batter slopes

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.

Slope tolerances

When completed, the average planes of the batters of embankments shall conform to those shown on the Drawings or as determined by the Superintendent.

For a vertical distance to 1 m below the shoulder, no point on the completed batter shall vary from the specified slope line by more than 150 mm when measured at right angles to the slope line.

At distances greater than 1 m vertically below the shoulder, no point on the completed batter shall vary from the specified slope line by more than 300 mm when measured at right angles to the slope.

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.

Slope undulations

Undulations in the general plane of the batter shall not be permitted.

Slope redetermination

Where the Superintendent redetermines the slope of any section of an embankment batter which has been completed in accordance with this Clause the Superintendent shall order a Variation to the contract for the resetting out and removal or addition of fill material and retrimming of the batter.

7.7 ROCK FACING OF EMBANKMENTS

Location

Where shown on the Drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.

Mechanical interlock

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.

Graded filter

The Contractor shall adjust its 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.

Geotextile

Where shown on the Drawings, or approved by the Superintendent, an appropriate geotextile may be used to prevent the leaching out of fines from the fill material.

Caution in placement

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 and onto the roadway.

The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use.

7.8 TRIMMING TOPS OF EMBANKMENTS

Levels

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 if applicable.

Tolerances

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

Prior to placing any subsequent pavement layers

Prior to placing any subsequent pavement layers over the completed top of embankment filling, the Contractor shall present the completed surface to the Superintendent for inspection.

The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the completed top of the embankment is required prior to the release of the **Hold Point**.

7.9 SELECTED MATERIAL ZONE

Dimension and quality

A selected material zone may be indicated on the Drawings as a zone below the subbase layer and the following quality requirements:

- It shall be free from stone larger than 100 mm maximum dimension,
- The fraction passing 19.0 mm AS sieve shall have a CBR value of not less than that quoted in Annexure A.

When chemical stabilisation is specified these requirements shall apply to the selected material immediately prior to incorporating the stabilising agent.

Winning material

The selected material shall be obtained from cuttings excavated under the Contract or from borrow areas as specified in **Borrow**.

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.

Selection of material

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.

Cost of handling

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.

Placing and compaction of layers

The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150 mm. Compaction shall be as specified in **Compaction and moisture requirements**.

Homogeneous layers

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.

Compact and trim

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 Annexure A.

Inspection prior to placing any subsequent pavement layers

Prior to placing any subsequent pavement layers over the completed select material zone surface, the Contractor shall present the completed surface to the Superintendent for inspection.

The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval to the compacted and trimmed top of selected material zone is required prior to the release of the **Hold Point**.

7.10 FILL ADJACENT TO STRUCTURES

Payment

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

Structure types

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 *1351 Stormwater drainage (Construction), 1352 Pipe drainage, 1353 Precast box culverts* and *1354 Drainage structures.*

Time of placement

No filling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, 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.

7.11 TREATMENT AT WEEPHOLES

Grading

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 50 mm to 10 mm such that:

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

Extent

The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300 mm horizontally into the fill and extend at least 450 mm vertically above the level of the weepholes.

Synthetic membrane

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.

7.12 SELECTED BACKFILL

Selected backfill shall be placed adjacent to structures in accordance with Table 7.1.

The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50 mm and a Plasticity Index, determined by AS 1289.3.3.1, neither less than 2 nor more than 12.

Table 7.1 Selected backfill, width and height

Structure type	**Selected backfill**	
	Width	**Height**
Bridge abutments	2 m	H
Cast-in-place box culverts	H/3	H + 300 mm
Corrugated steel pipes and arches	0.5 m	H + 500 mm
Retaining walls	H/3	H
Where H = height of structure)		

Placement in layers

The selected backfill shall be placed in layers, with a maximum compacted thickness of 150 mm. Layers shall be placed simultaneously on both sides of box culverts and other drainage structures to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of **Compaction and moisture requirements**.

Horizontal terraces

The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 m in width, and the selected backfill shall be placed in accordance with **Placing fill for embankment construction**.

Time of placement against structures, etc.

No selected backfilling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, 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.

Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within 21 days after placing concrete in the bridge deck, unless approved by the Superintendent.

Spill through abutments

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 individual placement around or against such structures.

Framed structures

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 500 mm.

7.13 SPOIL

Definition

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.

Acquisition of planning approval where necessary

The Contractor shall bear all costs associated with the acquisition of planning approval by Council's Town Planning Manager should this be determined as necessary by the Superintendent.

Use in embankments

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 **Placing fill for embankment construction** and **Compaction and moisture requirements** for material in embankments.

Disposal of spoil

Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent. Surplus material so deposited shall be compacted as specified in **Compaction and moisture requirements** for material in embankments or to such lesser extent as may be approved by the Superintendent.

Disposal of spoil up to five kilometres from the point of excavation shall be deemed to be included in General Earthworks.

Where haulage exceeds five kilometres, payment shall be made at the rate nominated in Annexure A for haulage of spoil.

7.14 BORROW

Borrow to be authorised

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 **Embankment material**, **Rock facing of embankments**, **Trimming tops of embankments** or **Fill adjacent to structures**, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Borrow site characteristics

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 **Embankment material**, **Rock facing of embankments**, or **Fill adjacent to structures**, as appropriate.

Planning approval

The Contractor shall bear all costs associated with the acquisition of Planning approval by Council's Town Planning Manager should this be determined as necessary by the Superintendent.

The edges of borrow sites shall be no closer than 3 m from any fence line, road reserve boundary 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 h to 1 v, and shall be left by the Contractor in a tidy and safe condition.

Site preparation and restoration

For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with 1111 *Clearing and grubbing* and **Removal of topsoil**.

Restoration of borrow sites shall be carried out in accordance with 0250 *Open space – landscaping*.

Widening of cutting

If borrow material is obtained by uniformly widening a cutting, the requirements of **Excavation**, **Batter tolerances** and **Treatment of floors of cuttings** as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

Payment

Borrow from within the specified working area shall be deemed to be part of General Earthworks except that additional payment for haulage will be made at the rate nominated in Annexure A for haulage of borrow where the authorised borrow sites are more than five kilometres from the point of delivery.

Borrow obtained from locations outside the specified working area

If the Superintendent accepts that borrow must to be obtained from locations outside the specified working area for the Works, such work shall be treated as a Variation to the Contract.

The Contractor shall be responsible for obtaining any permits required for entry on land and for the payment of any royalty for such borrow material.

The Contractor shall also comply with any requirements of the Environmental Planning and Assessment Act, the Local Council, land owners, the Rural Lands Protection Board and the NSW Soil Conservation Service, as appropriate.

8 COMPACTION AND QUALITY CONTROL

8.1 COMPACTION AND MOISTURE REQUIREMENTS

Trimming and compaction

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.

95% Compaction requirements

The following areas shall be compacted to provide a relative compaction, determined by AS 1289.5.7.1 or AS 1289.5.4.1 for standard compactive effort, of not less than 95%:

- Each layer of material replacing unsuitable material as detailed in **Unsuitable material**.
- Each layer of material placed in embankments, up to 1.5 metres from the top of the pavement.
- Fill placed adjacent to structures up to 1.5 metres from the top of pavement.
- Material in unsealed verges and within medians up to the level at which topsoil is placed.
- Spoil (excluding unsuitable material).
- All other areas except those where higher relative compaction is specified.

Unsuitable material

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

98% Compaction requirements

The following areas shall be compacted to provide a relative compaction of not less than 98% as determined by AS 1289.5.7.1 or AS 1289.5.4.1 for standard compactive effort:

- Foundations for shallow embankments.
- The whole area on the floor of cuttings.
- Each layer of the embankment within 1.5 metres from the top of pavement.
- Each layer of the selected material zone as specified in **Selected material zone**.
- Any areas of material of specified quality which may be shown on the Drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements.
- The fill material placed adjacent to structures as specified in **Fill adjacent to structures** and **Selected backfill** in each layer within 1.5 metres from the top of the pavement.

Shallow cutting definition

Where the vertical alignment design is such that a substantial portion of the road is required to be built at or close to natural surface, the prepared subgrade shall be considered to be in shallow cutting.

Shallow cutting is defined as cutting to a depth below natural surface of less than 0.5 metres.

The floor of shallow cutting shall be treated as specified in **Treatment of floors of cuttings** and **Transition from cut to fill** and shall be compacted to provide a relative compaction determined by AS 1289.5.7.1 or AS 1289.5.4.1, for modified compactive effort, of not less than 97% for a depth of 200 mm.

Cut-fill transition

When shallow cutting conditions occur and with written approval of the Superintendent the requirements specified for transition from cut to fill (**Transition from cut to fill**) may be modified such that the depth of terrace excavation at the transition from cut to fill is reduced from 900 mm to 250 mm.

Proof rolling

Sections of the works where the ripping or loosening of the cutting floor is not required and/or where provision of 'proof-rolling' to the Superintendent's satisfaction is required are indicated in Annexure A.

Proof rolling shall be in accordance with **Deflection monitoring or proof rolling**.

Moisture content and wetting and drying

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 Annexure A of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1.

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.

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 costs of such wetting or drying the material to be compacted shall be borne by the Contractor.

Prompt compaction

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.

Moisture content above optimum

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.

8.2 PROCEDURES FOR DETERMINING TEST LOCATIONS

Test locations

Sampling locations for testing shall be determined as described in *0165 Quality systems and control (Construction)*.

Contractor to prepare area

The specified compaction and moisture tests shall be taken at the determined locations.

Prior to testing the Contractor shall work the lot to ensure uniform moisture content and compaction of all material within the lot.

Test representation

The test/s then taken shall be considered to represent the total volume of material placed within the lot.

Further testing

Where the Superintendent considers that the material which is present has not achieved uniformity required by this Clause or **Placing fill for embankment construction**, the Superintendent may take or direct further testing.

The Superintendent shall nominate the area represented by the additional testing.

Material not conforming

If such testing confirms that material not conforming to the worksection 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 **Compaction and moisture requirements**.

8.3 DEFLECTION MONITORING OR PROOF ROLLING

Formation presented for testing

Following completion of the formation to the underside of the selected material zone in accordance with **Foundations for embankments** and **Placing fill for embankment construction**, and completion of the selected material zone in accordance with **Selected material zone**, the Contractor shall make the work available in lots, for the Superintendent to carry out deflection monitoring or proof rolling

This action constitutes a **Hold Point**.

The Superintendent's approval to the completed formation following deflection monitoring or proof rolling is required prior to the release of the **Hold Point**.

Lot size

A lot for deflection testing shall consist of a continuous length of formation of at least 300 m, or lesser length as approved by the Superintendent, 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 or proof rolling is deemed to be included in the rate for General Earthworks.

8.4 WIDENING OF FORMATION FOR FURNITURE AND SERVICES

Road shoulders and formation shall be widened to accommodate footpaths, guardfence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the Drawings.

8.5 MEDIAN AREAS

Batter slope

The batter slopes for median areas shall conform to those shown on the Drawings and undulations in the general plane of the batter slope shall not be permitted.

Batter tolerances

For a horizontal distance of 2 m from the edge of the shoulder, no point on the completed batter shall vary from the specified slope line by more than 50 mm when measured at right angles to the slope line within 24 hours after compaction.

At distances greater than 2 m horizontally from the edge of the shoulder, no point on the completed batter shall vary from the specified slope line by more than 100 mm when measured at right angles to the slope line within 24 hours after compaction.

Free draining

The medians shall be graded so as not to pond water.

9 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 9.1.

Table 9.1 Summary of limits and tolerances

Activity	Frequency	Limits/Tolerances	Worksection Clause Reference
Batter slopes			
- Excavation	At toe of batter and level of table drain	Batter ≤1:1, +0, –150 mm Batter >1:1, +0, –200 mm	**Batter tolerances (Cuttings) and Table 4.1**
	2 m above table drain and higher	Batter ≤1:1, ±300 mm Batter >1:1, +300, –600 mm	
	Between level of table drain and 2 m above table drain	Pro-rata basis	
- Embankment	1 m below shoulder	± 150 mm	**Slope tolerances**

Activity	**Frequency**	**Limits/Tolerances**	**Worksection Clause Reference**
	At +1 m below shoulder	± 300 mm	**Slope tolerances**
- Median Areas	At 2 m from edge of shoulder	± 50 mm	**Slope tolerances (Compaction and quality control)**
	At distances greater than 2 m from edge of shoulder	± 100 mm	
Floors			
- Floor of cutting	As completed	Annexure A	**Treatment of floors of cuttings**
Tops of Embankments			
- Trimming tops of Embankments	At completion of embankment construction	Parallel to the designed grade line, +10 mm or –40 mm of the levels specified	**Trimming tops of embankments**
- Selected material	As completed	Annexure A	**Selected material zone**
- Selected backfill	Adjacent to structures	Plasticity Index >2, <12	**Selected backfill**
Plus (+) is towards the roadway/surface and minus (–) is away from the roadway/surface. Tolerances are measured at right angles to the slope line.			

10 MEASUREMENT AND PAYMENT

10.1 GENERAL

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1112.1 to 1112.6 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Control measures for erosion and sedimentation are measured and paid in accordance with 1102 *Control of erosion and sedimentation*.

Clearing and grubbing of stockpile sites and borrow areas is measured and paid in accordance with 1111 *Clearing and grubbing*.

Seeding and restoration of stockpile sites and borrow areas is measured and paid in accordance with 0250 *Open space – landscaping*.

Traffic control for blasting operations is measured and paid in accordance with 1101 *Control of traffic*.

Fill adjacent to culverts, other than box culverts, and drainage structures is measured and paid in accordance with 1351 *Stormwater drainage (Construction)*, 1352 *Pipe drainage*.

Selected backfilling to box culverts is measured and paid in accordance with 1353 *Precast box culverts*.

Working platforms created by chemical stabilisation are measured and paid in accordance with 1113 *Stabilisation*.

10.2 PAY ITEMS

C0202.1 Removal and stockpiling of topsoil

The unit of measurement shall be cubic metre as bank volume.

The volume shall be the sum of:

The volume removed from cuttings calculated by multiplying the area of cutting to be stripped as calculated from the plans of natural surface or accepted Ground Model by the depth of topsoil directed to be removed by the Superintendent, plus;

The volume removed from under embankments calculated by multiplying the area to be stripped as calculated from the plans of natural surface or accepted Ground Model by the depth of topsoil stripping as nominated in Annexure A, plus;

The additional volume of topsoil removed from shallow embankments below the depth nominated in Annexure A and calculated on the basis of plan area multiplied by the directed depth of excavation, or as directed.

The schedule rate under this Pay Item includes all activities associated with stripping topsoil, carting and placing into stockpile, then stabilising and trimming the stockpiles.

1112.2 General earthworks

The unit of measurement shall be the cubic metre measured as bank volume of excavation.

The schedule rate for this Pay Item shall be an average rate to cover all types of material encountered during excavation and placed in embankments or spoil stockpiles, including both earth and rock.

Payment for General Earthworks shall include all activities associated with the excavation of material and the construction of embankments, stockpiling of spoil, the haulage of material and any pretreatment such as breaking down or blending material or drying out material containing excess moisture, except that:

- removal of unsuitable material to spoil shall be paid under Pay Item 1112.3;
- extra costs in processing selected material shall be paid under Pay Item 1112.4;
- overhaul of spoil or borrow shall be paid under Pay Items 1112.5 and 1112.6 respectively.

The base of the excavation shall be the designed floor level in accordance with **Treatment of floors of cuttings** and no account shall be taken of level tolerances.

The volume of earthworks in cuttings shall be determined by the surface to surface triangulation method, calculating the volume between the plans of natural surface or accepted Ground Model, the designed batter lines and the base of the excavation; from which shall be deducted the volume of topsoil as calculated under Pay Item 1112.1. No account shall be taken of the allowable batter tolerances or stepping of batters for topsoiling.

Where unsuitable material from the foundations of shallow cuttings or material from cut to fill transitions is excavated and placed into embankments the volume shall be calculated from joint surveys carried out immediately prior to, and after subsequent removal of the unsuitable material, or by other methods which may be approved by the Superintendent.

1112.3 Unsuitable material to spoil

The unit of measurement shall be the cubic metre measured as bank volume of excavation.

This pay item refers only to unsuitable material as defined in **Unsuitable material** which is removed to spoil stockpile.

If the material is such that the bank volume of excavation cannot be measured, the Superintendent shall determine the conversion factors to be applied to the loose volumes measured in haulage units or to the measured stockpile volumes.

The schedule rate(s) under this Pay Item shall include all operations involved in the excavation, haulage, drying out, compaction or other activity required under **Unsuitable material** for its disposal as spoil in accordance with **Spoil**.

When this Pay Item provides for ranges of provisional quantities, the rates shall be applied successively, but not cumulatively, as the volume of unsuitable material increases from one provisional quantity range to the next higher range.

Each rate shall be applied as the sole payment due for all unsuitable material removed within each quantity range, irrespective of the nature or quantity of the material removed.

1112.4 Selected material

The unit of measurement shall be the cubic metre measured as embankment volume in place in the selected material zone. The volume shall be determined by multiplying the theoretical plan area of the top of the selected material zone with its nominated thickness.

This pay item covers any extra costs involved in stockpiling, processing, placing, compaction and trimming of material, including surface preparation for deflection monitoring in the selected material zone over and above those costs allowed for under Pay Item 1112.2.

The width and depth shall be taken as shown on the Drawings or as directed by the Superintendent. No account shall be taken of level tolerances.

1112.5 Haulage of spoil

Where an approved location for spoil disposal is more than five kilometres by road from the point of excavation of material being spoiled, payment shall be made for haulage at the rate nominated in Annexure A per bank cubic metre for each kilometre or part thereof in excess of five kilometres.

1112.6 Haulage of borrow

Where an authorised borrow site that was not nominated in the Contract, is more than five kilometres by road from the point of delivery of borrow material to the Works, payment shall be made for haulage at the rate nominated in Annexure A per bank cubic metre for each kilometre or part thereof in excess of five kilometres.

11 11 ANNEXURE A

11.1 EARTHWORKS INFORMATION

Worksection Clause reference	Description				Value
Removal of topsoil	The depth below natural surface up to which the removal and measurement of top soil shall apply:				
	- Cutting areas				_____mm
	- Embankment areas				_____mm
Treatment of floors of cuttings	Minimum CBR value in cutting floors used for design of pavement				_____%
	Construction tolerances, of the designated grade and crossfall, for floors of cuttings after recompaction				+_____mm –_____mm
Foundations for embankments	Requirements of material in foundations for shallow embankments:				
	- Moisture Content within the range of _____% to _____% of optimum.				
Placing fill for embankment construction, Selected material zone	Upper Zones of Formation (7.5) & Selected Material Zone (7.9)				
	Material within each zone shall have a CBR value of not less than that given in the table below under the nominated test conditions.				
	Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)	
	- Selected Material Zone				
	- Material below Selected Material Zone to 1.5 m from top of pavement.				
Selected material zone	Construction tolerances for Selected Material Zone are: - designed grade and - cross fall				+_____mm +_____mm
Spoil	Haulage of spoil under Pay Item C0202.5 shall be payable at the rate of $_____ per bank cubic metre per kilometre in excess of 5 km.				
Borrow	Haulage of borrow under Pay Item C0202.6 shall be payable at the rate of $_____ per bank cubic metre per kilometre in excess of 5 km.				
Compaction and moisture requirements	Shallow cuttings				
	- Sections of work nominated to be in shallow cutting: ……..…..				
	- Ripping or loosening [is / is not] required in shallow cutting.				
	- Proof rolling of subgrade [is / is not] required.				
Compaction and moisture requirements	Moisture Content of material placed in embankments:				
	- Material in upper zones of formation within the range of ___% to ___% of optimum				
	- All other embankment material within the range of ___% to ___% of optimum				

1113 STABILISATION

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection defines the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

The work to be executed under this worksection 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.

This worksection provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table 1.1.

The pavement course or subgrade zone or layer to be stabilised shall be as specified in 1141 *Flexible pavements*.

Table 1.1 Types of pavement courses, subgrade zones or layers and stabilising binder

Pavement course or subgrade zone or layer	**Stabilising binder**
Pavement course	
Base and subbase	Cement Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ)
Subgrade zone or layer	
Selected Material Zone	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Other Subgrade Layers	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Selected Backfill Zone	Cement Hydrated Lime (pugmill)

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 CONTROL OF TRAFFIC

General

The Contractor shall provide for traffic in accordance with 1101 *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 work has developed sufficient strength to carry normal traffic without damage.

Minimise traffic delays

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.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.**Worksections**

0161 Quality (Construction)

1101 Control of traffic

1112 Earthworks (Roadways)

1141 Flexible pavements

1351 Stormwater drainage (Construction)

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulfate content of a natural soil and the sulfate content of the groundwater—Normal method
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 1289.5.8.1	Soil compaction and density tests—Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge—Direct transmission mode
AS 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 2350	Methods of testing Portland and blended cements
AS 2350.9	Determination of residue on the 45 μm sieve
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3582.2	Slag—Ground granulated iron blast-furnace
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.3	Determination of loss on ignition
AS 3583.6	Determination of relative water requirement and relative strength
AS 3583.12	Determination of available alkali
AS 3583.13	Determination of chloride ion content
AS 3583.14	Determination of insoluble residue content
AS 3972	Portland and blended cements
AS/NZS 2350	Methods of testing Portland and blended cements
AS/NZS 2350.4	Setting time of Portland and blended cements

Other publication

NSW RTA Test Methods T432 Rate of slaking of quicklime

2 INSPECTION, SAMPLING AND TESTING

2.1 MATERIALS PROPOSED FOR USE IN THE WORK

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 A, and that the stabilised material meets the requirements of *1141 Flexible pavements* if incorporated into the works as a pavement layer or, alternatively, *1112 Earthworks (Roadways)* or *1351 Stormwater drainage*.

2.2 MATERIALS USED IN THE WORK

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 worksection.

3 MATERIALS

3.1 CEMENT

Type
The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS 3972.

NSW QA scheme
Cement shall be from a source included in the New South Wales Government Quality Assurance Scheme at time of production.

Nominated brand and source
The Contractor shall nominate the brand and source of all cementitious materials.

Proof of quality
Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any time.

Storage in excess of 3 months
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 AS 3972, 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.

3.2 QUICKLIME

Properties
Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

Available lime The content of calcium oxide, determined by AS 3583.12, shall not be less than 85 per cent.

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.

Particle size
The particle size distribution of the quick lime determined by AS 1141.11 shall comply with the following requirements in Table 3.1.

Table 3.1 Particle size distribution of quicklime

AS Sieve	Per cent passing
13.2 mm	100
9.5 mm	96–100
4.75 mm	70–100
2.36 mm	0–90

3.3 HYDRATED LIME

Properties
Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties:

- Available lime: The content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80 per cent.
- Form: The material shall be in powder form.
- Residue on sieving (Particle Size): The residue on a 300 micron sieve, determined by AS 3583.14, shall not exceed 2 per cent.

The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

- Percentage of calcium hydroxide
- Fineness—Percentage by mass passing the 45 micron sieve (AS 2350.9).
- Source.

3.4 GROUND GRANULATED BLAST FURNACE SLAG

The ground granulated blast furnace slag shall conform to AS 3582.2.

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:

- Fineness—percentage by mass passing the 45 micron sieve (AS 2350.9).
- Relative strength (28 days) (AS 3583.6).
- Source.

3.5 FLYASH

Flyash shall conform to AS 3582.1.

The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are:

- Fineness—percentage by mass passing the 45 micron sieve (AS 2350.9).
- Loss on ignition (AS 3583.3).
- Source.

3.6 BLENDED STABILISING AGENTS

Requirements

The Contractor may utilise a blended stabilising agent.

The Contractor shall obtain mill and batch information which will make the blended stabilising agent traceable to the supplier's test results.

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.

The mass of components of the nominated blended stabilising agent shall not vary by more than ±3 per cent from the blend percentages nominated in the mix design described in Annexure A.

Properties

When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

- Source of each component.
- Fineness—percentage by mass passing the 45 micron sieve (AS 2350.9).
- Setting time (AS 2350.4).

3.7 WATER

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:

- 600 parts per million of chloride ion, determined by AS 3583.13.
- 400 parts per million of sulphate ion, determined by AS 1289.4.2.1.
- 1 per cent by mass of undissolved solids.

Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

4 STABILISATION PROCESSES

4.1 GENERAL

Proposed equipment and procedures

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.

Specification and statutory requirements

Notwithstanding submission to the Superintendent of the Contractor's equipment and stabilisation procedures, the work shall meet all the Worksection 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.

Weather conditions

Stabilisation of pavement materials shall not proceed during wet weather or if rain 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.

4.2 APPLICATION OF STABILISING AGENT

Stationary mixing plant

Application rate: Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the Superintendent.

Measurement: Application rate measured in kilograms per tonne of product shall be monitored and recorded for every 100 tonnes of production. The achieved accuracy of application rate shall be ±10 per cent of the rate nominated in Annexure A.

Excessive application: The application rate shall not be allowed to exceed the nominated rate by more than 10 per cent. The stabilising agent incorporated in excess of the nominated rate shall be at no cost to the Principal.

In-situ

Application process: 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.

Where special processes are proposed by the Contractor involving supply of stabilising agent within the mixing bowl of equipment, the approval of the Superintendent is required and a demonstration of the process at the Contractor's expense may be requested.

Spreading rate: Spreading shall be carried out using the mechanical spreader nominated in the Work Plan and subsequently approved by the Superintendent. Annexure A nominates the spread rate.

Tolerances: The actual spread rate shall be within ±10 per cent of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500 m2 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^2).

Load cells: 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.

Over spread: The actual spread rate shall not exceed the nominated rate by more than 10 per cent.

The stabilising agent spread in excess of the nominated rate shall be at no cost to the Principal.

Wind: Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property.

Construction traffic: 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.

Spillage: 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 the same work shift of such spillage.

4.3 MIXING

Stationary mixing plant

Equipment: 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.

Control of water: The plant shall provide for the controlled and metered inclusion of water into the mix.

Uniform mixture: The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS 1289.6.1.1, with a pair of test specimens tested for each 100 tonnes of production and at full cost to the Contractor.

In-situ

Equipment: 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. As mixing blades or tynes 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.

Uniform mixture: 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.

The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process. The Contractor shall carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Inspection results shall be recorded as cited in the worksection Part for Quality Requirements.

Additional mixing: 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.

4.4 FIELD WORKING PERIOD

Definition

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.

Based on laboratory tests

The nominated Field Working Period shall be provided in Annexure 241A 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 percentage points.

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.

Compaction within field working period

The Contractor will complete the compaction process within the Nominated Field Working Period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions.

4.5 TRIMMING AND COMPACTION

Level tolerance

After mixing the layer shall be trimmed and compacted in accordance with 1141 *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 **Tolerances**.

Secondary trimming

Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and 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 slurrying 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 **Tolerances**.

When required by the Superintendent survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary trimming. This survey will be at no cost to the Principal.

Trimmed material

All trimmed material having been cut to waste shall be used as fill or spoiled as directed by the Superintendent. The material shall be owned by the Principal.

Straight edge test

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 **Tolerances**.

This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

Compaction

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 *1141 Flexible pavements*, *1112 Earthworks (Roadways)* or *1351 Stormwater drainage (Construction),* as appropriate.

Test method

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.

Wet Density

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.

In-situ dry density

The field density may be determined by in-situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS 1289.5.8.1.

4.6 JOINTS

Joint type

Joints are defined in this worksection 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.

A longitudinal joint shall be considered to be a joint generally parallel to the road centreline.

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.

Cutting back

All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections.

A minimum longitudinal overlap of mixing runs shall be 75 mm.

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.

No longitudinal joints shall be allowed within 0.5 metre of the centreline of a typical wheelpath.

Finish

The level and shape of the joints shall be within the limits specified in **Tolerances**.

4.7 TOLERANCES

Levels and surface trim

Primary trimming: The surface level after primary trimming shall be within a tolerance of +30 mm and +10 mm of the levels shown on the Drawings.

Secondary trimming: The surface level after secondary trimming shall be within a tolerance of +15 mm and -15 mm of the levels shown on the Drawings. The pavement surface after secondary trimming

and immediately prior to sealing shall be of a quality such that deviation under a 3 metre straight edge does not exceed 12 mm.

Layer thickness

Minimum thickness: The final thickness of the stabilised layer at any point shall be within a tolerance of +20 mm and -10 mm of the nominated layer thickness.

Average thickness: The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200 m length of a lot. The average thickness shall not be less than that required to meet the specified final thickness tolerances after trimming.

Method of measurement: 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.

Width

Minimum width: 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 50 mm.

Average width: The average width of the layer shall be determined from measurements at 3 sites selected at random by the Superintendent over any 200 m length of a lot and shall be not less than the specified width.

4.8 CURING

Notice

The Contractor shall submit to the Superintendent details of the proposed method of curing as part of the Work Plan.

Water curing

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 prime or primer-seal. 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.

Curing Period

Under this Worksection provision for curing up to the period indicated in Annexure A shall be the responsibility of the Contractor at cost to the Contractor

5 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses of this worksection are summarised in the table below:

Table 5.1 Summary of Limits and Tolerances

Activity	Limits/Tolerances				Worksection Clause reference
Quicklime					
- Available lime	>85% Calcium Oxide content				**Quicklime**
- Slaking rate	Active Slaking time < twenty minutes, and temperature rise on slaking not less than 40oC in six minutes (for an average of four samples).				**Quicklime**
- Particle distribution	Fraction passing AS Sieve:				**Quicklime**
	100%	for	13.2 mm	Sieve	
	96-100%	for	9.5 mm	Sieve	
	70-100%	for	4.75 mm	Sieve	
	0-90%	for	2.36 mm	Sieve	

Activity	Limits/Tolerances	Worksection Clause reference
Hydrated lime		
- Available lime	>80% Calcium Hydroxide	**Hydrated lime**
- Particle size	<2% residue on a 300 micron Sieve	**Hydrated lime**
Blended stabilising agents	Blend percentages shall not vary by more than ±3% from those nominated in Annexure A	**Blended stabilising agents**
Water		
- Chloride ion content	<600 PPM Chloride ion	**Water**
- Sulphate ion content	<400 PPM Sulphate ion	**Water**
- Undissolved solids	<1 percent by mass of undissolved solids	**Water**
Application of stabilising agent		
- Spread rate or incorporation rate for in-situ plant.	Actual spread rate shall be within ± 10% of the nominated rate	**Application of stabilising agent**
Trimming and compaction		
- Surface level	After primary trimming be within +30 mm and +10 mm of levels shown on Drawings After secondary trimming be within ±15 mm of levels shown on Drawings	**Trimming and compaction & Tolerances**
- Layer thickness	Final thickness of layers shall not vary more than +20 mm and -10 mm of required thickness	**Trimming and compaction & Tolerances**
- Shape	Shall not deviate more than 12 mm under a 3 m straight edge immediately prior to first sealing	**Trimming and compaction & Tolerances**
Joints		
- Longitudinal overlap	> 75 mm overlap of mixing runs	**Joints**
- Transverse overlap	> 2 m overlap of transverse joints	**Joints**
- Longitudinal joints	Shall not be allowed within 0.5 m of the centreline of a typical wheelpath	**Joints**
Width		
- Width of stabilised layer	At any point, the width shall be not less than 50 mm short of the width shown on the Drawings with an average width always greater than that shown on the Drawings	**Tolerances**

6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this workstation for on-site stabilisation in accordance with Pay Items 1113.1 to 1113.2 inclusive.

Except that where stabilisation is provided by use of stationary plant the supply of the material including the stabilisation service and stabilising agent is measured and paid in accordance with *1141 Flexible pavements* or *1112 Earthworks (Roadways)*, as appropriate, for supply of the material as a pre-mix product. Supply in these circumstances includes all testing.

A lump sum price for any of these items shall not be accepted.

Supply, spread and compact subbase, or base material is measured and paid in accordance with *1141 Flexible pavements*.

Supply, spread and compact select material is measured and paid in accordance with *1112 Earthworks (Roadways)*.

Control of traffic is measured and paid in accordance with 1101 *Control of traffic*.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

6.2 PAY ITEMS

1113.1 Supply and spread stabilising agent (in situ mixing only)

The unit of measurement shall be the square metre.

The area shall be determined by the length and width of work as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of allowable tolerances.

The schedule rate under this Pay Item shall include all the activities associated with the supply, delivery and spreading of the stabilising agent including testing in accordance with this worksection.

1113.2 Mixing of stabilising agent

The unit of measurement shall be the square metre.

The area shall be determined by the length and width of work as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The schedule rate under this Pay Item shall include all the activities associated with the mixing of the stabilising agent with the designated materials in-situ and to the nominated depth in accordance with this worksection.

7 ANNEXURE A

7.1 STABILISATION MIX DESIGN

Type of stabilising agent …….

…….

…….

…….

Nominal percentage of stabilising agent by mass	……	%
Spread rate of stabilising agent for contractual purposes	……	(kg/m^2)
Depth of compacted layer to be stabilised	……	(mm)
Nominated field working period	……	(hrs)
Nominated target unconfined compressive strength (UCS) (7 day accelerated curing)	……	MPa
Nominated target CBR value (4 day soaked) for stabilised modified subgrade	……	%
Period for contractor's curing	……	(days)
Nominated granular material(s)	……	(type)

Source of nominated granular material ……..……..

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1121 OPEN DRAINS INCLUDING KERB AND GUTTER

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the construction, lining and protection of all types of open drains, including the construction of kerb and/or channel and the construction of rock filled wire mattresses and gabions.

This worksection should be read in conjunction with *1351 Stormwater drainage (Construction)*, *1352 Pipe drainage*, *1353 Precast box culverts* and *1354 Drainage structures* as applicable.

1.2 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0250 Open space – landscaping

0310 Minor concrete work

1102 Control of erosion and sedimentation

1351 Stormwater drainage (Construction)

1352 Pipe drainage

1353 Precast box culverts

1354 Drainage structures

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.22	Wet/dry strength variation
AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 2758	Aggregates and rock for engineering purposes
AS 2758.4	Aggregate for gabion baskets and wire mattresses
AS 2876	Concrete kerbs and channels (gutters)—Manually or machine placed
AS/NZS 4534	Zinc and zinc/aluminium-alloy coatings on steel wire

Other publications

AUSTROADS

AP-3/90 Guide to Geotextiles

1.3 DEFINITION

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, grated drains, channels (gutters) and kerbs and channels (gutters).

1.4 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 016 *Quality (Construction)*.

2 UNLINED OPEN DRAINS

2.1 GENERAL

Shape
Unless shown otherwise on the Drawings, drains shall be vee shaped or of trapezoidal cross section and shall not be less than 300 mm deep and have a minimum waterway area of 0.2 square metres.

Grade
Open drains shall be graded to ensure free flow of water and, unless shown on the Drawings or directed otherwise by the Superintendent, shall not have a grade of less than 1 %.

Trees and rock outcrops

Where trees marked for preservation or rock outcrops occur in the line of a drain, the drain may be neatly diverted if approved by the Superintendent.

Open drains
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 or directed by the Superintendent.

Salinity prevention
Open drains shall be located and constructed so as to avoid recharging groundwater encouraging a shallow water table and creating or worsening salinity degradation of adjacent land.

Control of erosion
All work shall be undertaken in accordance with 1102 *Control of erosion and sedimentation*.

2.2 TYPES

Catch drains
Catch drains shall be provided above the tops of cuttings or along the toes of embankments where shown on the Drawings or as directed by the Superintendent before construction of the adjacent roadway.

The edges of catch drains shall be positioned not less than 2 m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains unless otherwise approved by the Superintendent.

Diversion and contour drains
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.

Table drains
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.

Channels
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, avoiding disturbance in stream flow. 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.

2.3 CONSTRUCTION

Excavated material
Material excavated from drains shall be placed on the lower sides of the drains and formed as banks with side slopes not steeper than 4H:1V on the cross section of the bank to increase the capacity of the drains.

This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 % for standard compactive effort.

No disturbance to waterway outside the site
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.

Excess material

Any excess material shall be disposed of by the Contractor at locations and in a manner approved by the Superintendent.

Revegetation

Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with 0250 *Open space – landscaping*.

3 LINED OPEN DRAINS

3.1 GENERAL

Shape

Lined open drains shall be formed as for unlined open drains with the inclusion of a lined invert in accordance with the Drawings, or as directed by the Superintendent.

Profile

Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.

Compaction of Foundations

Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining.

The relative compaction, as determined by AS 1289.5.7.1 or AS 1289.5.4.1 shall not be less than 95 % for standard compactive effort.

3.2 CONCRETE LINING

Method

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with 0310 *Minor concrete work*.

Weepholes shall be provided in the concrete at intervals of 2 m or as determined by the Superintendent.

Finish

The top of the finished lining shall be true to line and of uniform width, free from humps, sags or other irregularities.

Tolerances

The level at any point on the surface of the lining shall be within ±20 mm of design levels.

When a straight edge 3 m long is laid on top of the lining parallel to the direction of flow, the surface shall not vary more than 10 mm from the edge of the straight edge.

Contraction joints

Unless shown otherwise on the Drawings, contraction joints shall be formed every 3 m of lining length for a minimum of 50 % of cross sectional area.

The joint shall be tooled a minimum of 20 mm in depth to form a neat groove of 5 mm minimum width.

Expansion joints

Unless shown otherwise on the Drawings, expansion joints, 15 mm in width for the full depth of the concrete lining, shall be constructed at intervals not exceeding 15 m.

Expansion joints shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

3.3 STONE PITCHING

Stone pitching shall consist of sound durable rock not less than 100 mm 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 20 mm in width.

3.4 BATTER DRAINS

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

Installation
The units shall be installed in carefully excavated and template controlled trench to produce an even top edge of batter drain of +0 mm to –50 mm from the batter line at the underside of topsoil.

Compaction
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 top edge of the batter drain.

Topsoil and turfing
When topsoil is placed it shall be tapered over a width of 1 m to zero thickness at the rim of the drain.

Both sides of the drain shall then be turfed for minimum width of 600 mm and pinned down as provided in 0250 *Open space – landscaping*.

3.5 PROPRIETARY PRODUCTS

Unless shown on the Drawings, proprietary products may only be used with the approval of the Superintendent.

Where specified, they must be used strictly in accordance with the manufacturer's instructions.

4 KERB AND GUTTER

4.1 GENERAL

Description
Kerb and gutter includes all forms of concrete gutters, dish drains, grated drains, and mountable median and barrier kerbing.

Compaction of foundations
Before placing any kerb and/or gutter, the foundation material shall be shaped and compacted to form a firm base.

Other than for **kerb and gutter** constructed on pavement courses, the relative compaction, shall be in accordance with the requirements of AS 2876.

Where placed on pavement courses, the foundation shall be compacted to the requirements of the respective pavement course.

The foundation material in all cases will be subject to the Superintendent's approval.

This action constitutes a **Hold Point**.

The Superintendent's approval of the foundation materials and its condition is required prior to release of the **Hold Point**.

4.2 CONSTRUCTION

Method
Kerb and/or gutter may be constructed by extrusion or by slip forming in accordance with AS 2876.

Construction Details
The foundation, concrete quality, curing and testing details shall be in accordance with AS 2876. Prior to commencement of pouring the proposed construction levels shall be checked by the Council Engineer for compliance with design.

Grading and Alignment
Kerb and guttering will be graded and aligned in accordance with the approved engineering plan. In cul-de-sacs or internal roads which will not be extended, minor variations of up to 10mm in line and 10mm in level over a distance of 5m will be accepted.

On through roads subject to future extension, variations greater than 10mm in line and level will not be accepted.

Construction works that exhibit ponding will not be accepted.

Placement, Finishing and Concrete Properties

Concrete in kerb and guttering will be placed in accordance with the general requirements for concrete within this specification. The finish is to be a smooth steel trowel type surface.

All concrete in kerb and guttering will have a minimum compressive strength of 28 MPa at 28 days and a slump of 80mm.

Base Material

Kerb and guttering will be laid on the approved DGS 20 base material with no loose material beneath. The base will be at least 150mm thick and extend a minimum of 150mm behind the rear of kerb. The base material is to be thoroughly dampened immediately prior to placement of the kerb.

Alternative construction options will be considered.

Joints

Expansion joints will be provided at junctions with accesses, pits and other structures, and will comprise of approved expansion jointing material placed through the entire cross sectional area of concrete, finishing flush with exposed surfaces. Contraction joints consisting of a vertical cut to within 50mm of base will be formed at 3m intervals. All gutter crossings are to be provided with expansion joints where the layback merges with the kerb.

Gutter Crossings

Gutter crossings are to be placed as shown on the engineering plans, to suit existing requirements, as requested by the Developer or as determined on site during construction.

Where gutter crossings are provided as part of the development a concrete access slab (footpath crossing) to Council's specifications will be constructed. Instances where this may occur or be required are existing driveways, integrated developments where housing locations and designs are known.

Residential Gutter Crossings

Where a domestic footpath crossing is to be provided each gutter crossing will be 3.0m along the flat section with a 500mm kerb wing at each end unless otherwise directed.

Industrial/Commercial Gutter Crossings

Industrial or commercial gutter crossings will be a minimum of 6.0m along the flat section unless otherwise directed, with a 1000mm wing at each end, and are to be a minimum of fully reinforced 30MPa concrete with one layer of F82 mesh.

Footpath Crossings Slabs (Kerb to Boundary)

Residential Standard

a Thickness – Minimum 125mm thick with one layer of F72 mesh with minimum 50mm cover from the bottom – 20 MPa concrete. A minimum compacted depth of 100mm of approved gravel shall be placed under as a base.

b Dimensions – Minimum 3.6m at kerb to 2.5m at boundary.

c Where water mains, sewers etc. are beneath the crossing, a "Construction Joint" shall be placed 0.5m each side of the service centreline.

Industrial/Commercial Standard

a Thickness – Minimum 150mm thick with one layer F82 mesh with minimum 50mm cover from the bottom – 30 MPa concrete. A minimum depth of 150mm of approved compacted gravel shall be placed under as a base.

b Dimensions – Minimum width of 6m but dimensions to suit the widths and turning movements of vehicles using the development is required.

c Where water mains, sewers etc. are beneath the crossing, a "Construction Joint" shall be placed 0.5m each side of the service centreline.

Grade Requirements

The recommended maximum slope for a driveway is 16%.

Driveways up to 14% may be left unconstructed. The developer shall construct and seal any driveway between 14% and 18% to a width of 3.0 metres, with a minimum 150mm pavement depth of road base with a minimum 4 day soak CBR of 25%.

The maximum acceptable slope for a driveway is 25%. For Council to consider such a slope on a driveway the developer shall provide a longitudinal and cross sectional information for the driveway.

The developer shall pave any driveway between 18% and 25% to a width of 3.0 metres, 150mm deep using 20MPa concrete.

Access to Multiple and Battle Axe Lots

Residential Areas

a A full width concrete access slab is required if the access is servicing more than one lot. Minimum width is 2.5m.

b Thickness of all concrete accesses to be minimum of 125mm thick 20MPa. Full width access will require one layer of F72 mesh placed 50mm from the bottom.

Note: In all cases the access slab across the footpath is to be of full width construction.

Industrial/Commercial Areas

a A full width concrete access is required for all industrial/commercial accesses. Minimum width is 6m but should be designed to suit vehicle turning paths.

b The minimum thickness is 150mm 30MPa concrete with one layer F82 mesh placed 50mm from the bottom. Base materials are to be as specified above.

Jointing of Footpaths and Crossings

Grooved "dummy" joints and expansion joints shall be placed in footpaths, cycleways and driveway strips in accordance with the Standard Drawings. Concrete access slabs across footpaths are to have expansion joints at the rear of kerb and at the boundary where the slab is placed separately to the access crossing. Refer

Where access crossings are placed into existing kerb and gutter, the kerb is to be mechanically cut at right angles to the face of kerb along the invert of the gutter; the kerb section is to be completely removed and the slab and access poured integrally.

All expansion jointing material is to be placed to the full depth of the concrete section.

Service Conduits

If the footpath slab is laid before service cables, conduits shall be installed in accordance with requirements of the relevant authorities.

Concrete Footpaths

Concrete footpaths are to be constructed as detailed on the approved engineering plan with due regard to general concrete requirements and finish. Minimum width is 1.2 metres. Minimum thickness is 75mm. Note, isolated thickening, reinforcing and base material (as detailed in this specification) are required at existing/proposed vehicular crossing points.

Cycleways

The minimum width of shared concrete cycleway/pathway is to be 2.5 metres with a minimum thickness of 100mm. Bedding in accordance with the drawings.

The minimum width of a cycleway only will be determined by Council on a merit basis.

Cycleways are to be thickened and reinforced as per industrial footpath crossings where vehicular access is required to reserves, for maintenance or as directed by the engineer.

Bedding

Bedding for concrete footpaths to be a minimum 50mm sand overlying a firm, well compacted natural material. Other bedding/bases to be provided as specified.

Mobility Ramps

Mobility ramps shall be constructed at all street intersections, Public Reserves, pedestrian crossings, in accordance with the approved plans and as directed by the Engineer. Refer to Drawings for location.

Service Locations

Where services cross roads at their intersection with the face of kerb it will be marked as scheduled below.

Service	Mark
Water Main	W
Water Service	W
Telecom	T
Electricity	E
Gas	G
State Survey Marker	SSM
Subsoil flushing point	F
Empty Conduit	O

Marks will be impressions in green concrete kerb, formed with 8mm diameter rod bent to required letter shape.

Kerb and Gutter Additional Requirements

The following general requirements for kerb and guttering will apply.

Type

Only “slurry-less” type machine placed kerb and gutter to RTA or Council standard profiles will be accepted unless otherwise approved by the Engineer.

Joining of Work

The completed section is to be cut off cleanly, the residue concrete removed and expansion jointing placed before recommencement of work, so that the new work will be squarely butted to the existing concrete.

Protection

Newly placed concrete will be protected from rain by PVC sheeting.

Curing

Kerb and gutter concrete will be cured by the use of an approved curing compound. Application will be in accordance with the manufacturers recommendations.

Testing

The Engineer may require slumps be checked and core samples taken as directed and tested for compressive strength by an independent registered NATA Laboratory at to cost to Council.

Stormwater Pipe Outlets

In all kerbs, where connection of roof stormwater to a common drainage line is not provided, an outlet will be provided through the kerb on each side of the lot approximately 1.0 metre in from the boundary. Outlets are to be constructed from nominal 125 x 75 x 4mm RHS hot dip galvanised and cut to the shape of the kerb.

Placement of Kerb on Existing Pavement

Only fixing of barrier kerb (kerb only) and mountable kerb to existing pavement will be permitted by the following means.

a The extraction of 100mm cubes of material from the existing pavement at 1.0m centres located centrally beneath the proposed kerb line. The existing pavement will be cut cleanly with a minimum of disturbance. All loose material to be removed and if required the base material recompacted to the satisfaction of the Engineer.

b 12mm inverted “U” shaped dowels will be inserted a minimum of 150mm each leg into the existing pavement at 600mm centres. The dowels are to be shaped to have approximately 40mm cover. Approved epoxy may be used to fix the dowels into pre-drilled holes or the dowels may be hammered into the existing pavement. Any damaged dowels are to be replaced.

Finish

The top and face of the finished kerb and/or gutter shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and gutter shall have a steel float finish.

Tolerances

The level at any point on the surface of the channels shall be within ±10 mm of design levels.

When a straight edge 3 m long is laid on top of or along the face of the kerb or on the surface of channels, the surface shall not vary more than 5 mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring channel depression.

Contraction joints

Unless shown otherwise on the Drawings, contraction joints shall be formed every 3 m of channel length for a minimum of 50 % of cross sectional area. The joint shall be tooled 20 mm in depth to form a neat groove of 5 mm minimum width.

Adjacent concrete pavement

Where kerbs and/or channels 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 channel.

Stormwater outlets

All house stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe through the kerb as shown on the Drawings. All kerb outlets shall be 10 guage hot-dipped galvanised steel.

Vehicular or pedestrian access

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 the Drawings.

Footpath crossovers shall be constructed to meet the laybacks as shown on the Drawings, or reinstated to match existing materials where not otherwise shown.

Backfill timing

After the new kerb and gutter has been constructed and not earlier than three days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the Drawings, or as instructed by the Superintendent. Within four hours of pouring or prior to leaving the site, whichever occurs first, the site approved erosion protection shall be provided.

Backfill material

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50 mm diameter, or material as approved by the Superintendent.

Behind kerb

Backfill material behind the kerb shall be compacted in layers not greater than 150 mm thick, to a relative compaction of 95 % when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards.

Pavement

Pavement material adjacent to new channel shall be backfilled in accordance with the Drawings or as directed by the Superintendent.

5 ROCK FILLED WIRE MATTRESSES AND GABIONS

5.1 GENERAL

Location and geotextile

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 geotextile, as shown on the Drawings, shall be placed between the wire cage and the material being protected.

Foundation material

Before installation of rock-filled wire mattresses, the foundation material shall be excavated such that the mattresses finish flush with the surrounding ground.

Where mattresses are used to line open drains, the foundation material shall be shaped and compacted, in accordance with AS 1289.5.4.1 and shall not be less than 95 % for standard compactive effort, to form a uniform channel cross-section prior to installation of mattresses.

5.2 MATERIALS

Galvanising

For Wire mattresses and Gabions, the galvanising requirements for wire of circular cross section cited in this clause as 'heavily galvanised' shall comply with the coating mass requirements for round wire, Class W10, in AS/NZS 4534.

Wire mattresses

Mattress dimension: Unless otherwise specified or shown on the Drawings, the wire mattresses shall be supplied in units having dimensions of 6 m $\times$ 2 m $\times$ 230 mm, and shall be cut to suit areas as shown on the Drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600 mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the Drawings.

Wire dimensions: Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

Gabions

Gabion dimensions: The gabions shall be of the sizes shown on the Drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the drawings.

Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100 mm.

Wire dimensions: Gabions shall have a nominal mesh size of 80 mm × 100 mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the drawings.

The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

Geotextile

Type: A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with AUSTROADS Guide to Geotextiles, shall be used.

Sample: Samples, manufacturer's worksection and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile.

Rock fill material

Rock Quality: The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.

For wire mattresses: Rock fill for wire mattresses shall have particle sizes between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser. 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 slightly overfull by 25 mm to 50 mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

For gabions: Rock fill for gabions shall have particle sizes between 100 mm and 250 mm and preferably not greater than 200 mm.

Rock fill material may be placed by hand or suitable mechanical device to ensure fill is tightly packed with a minimum of voids.

Fill material shall be levelled off 25 mm to 50 mm above the top of the mesh to allow for settlement.

5.3 ASSEMBLY AND ERECTION

Before laying out the wire mattresses or gabions, geotextile shall be placed on the founding material.

The edges of wire mattresses shall be firmly tied to galvanised star pickets driven a minimum of 900 mm into the surrounding ground at 1 m maximum intervals and the star pickets cut off level with the top of the mattress.

The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300 mm and filled with rock fill. This edge shall be tied to star pickets.

6 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 6.1.

Table 6.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Worksection Clause Reference
Unlined open drains		
- Grading	Grade >1%	**Unlined open drains**
- Depth	>300 mm	**Unlined open drains**
- Waterway Area	>0.2 sq m	**Unlined open drains**
- Catch Drain Location	>2 m from top of cuttings or toes of embankments	**Types (Unlined catch drains)**
- Compaction	> 95% (standard compaction)	**Construction (Excavated material)**

Activity	Limits/Tolerances	Worksection Clause Reference
Lined open drains		
- Compaction of Foundation	>95% (standard compaction)	**Lined open drains**
- Level of lining surface	Level ±20 mm of design level	**Concrete lining**
- Surface uniformity	Deviation lining surface from 3 m straight edge ≤10 mm	**Concrete lining**
Kerb and channel		
- Compaction of foundation	to AS 2876	**Kerb and gutter**
- Level of channel surface	Level ≤□±10 mm of design level	**Kerb and gutter Construction**
- Surface uniformity	Deviation kerb and channel surface from 3 m straight edge ≤5 mm	**Kerb and gutter**
- Contraction joints		
. Area	≥50% of CS area	**Kerb and gutter**
. Groove width	≥5 mm	**Kerb and gutter**
- Expansion joint interval	≤ 15 m	**Kerb and gutter**
- Backfill behind kerb		
. Layer thickness	≤ 150 mm	**Kerb and gutter**
. Compaction	>95% (standard compaction)	**Kerb and gutter**
Rock fill for gabions and wire mattresses		
- Compaction of foundation	>95% (standard compaction)	**Rock filled wire mattresses and gabions**
- Wet strength	>100kN	**Materials**
- Wet/Dry strength variation	<45%	**Materials**
- Particle size for wire mattresses	>75 mm <150 mm	**Materials**
- Particle size for gabions	>100 mm <250 mm	**Materials**
- Gabion fill level	>25 mm <50 mm above top of mesh	**Materials**
Erection of wire mattresses		
- Star pickets for ties	Depth in ground >900 mm Spacing <1 m	**Assembly and erection**
- Trench depth for upstream edge	>300 mm	**Assembly and erection**

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a Schedule of Rates basis in accordance with Pay Items 1121.1 to 1121.8 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which as not been priced.

Erosion and sedimentation control measures are measured and paid in accordance with *1102 Control of erosion and sedimentation*.

Sprayed concrete lining of open drains is measured and paid in accordance with *0310 Minor concrete work*.

Cast-in-situ concrete or other lining of open drains is measured and paid in accordance with this worksection and not *0310 Minor concrete work*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in *0310 Minor concrete work*.

Topsoiling and turfing to sides of batter drains are measured and paid in accordance with *0250 Open space – landscaping*.

7.2 PAY ITEMS

1121.1 Excavation—catch, contour and minor diversion drains

The unit of measurement shall be the linear metre measured along the invert of the drain.

The placement and compaction of material excavated from the drains on the lower sides of the drains to form banks shall be included in the excavation rates.

The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.

Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

1121.2 Excavation—inlet, outlet and diversion channels

The unit of measurement shall be the cubic metre measured from cross sections on the drawings using the end area method, or as 'each' where minor work is involved.

The disposal of surplus material shall be included in the excavation rates.

The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.

Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

1121.3 Concrete lining of open drains

The unit of measurement shall be the square metre of concrete in place.

The schedule rate under this Pay Item shall include all the operations involved in the surface preparation, supply and placing of concrete, jointing and curing.

1121.4 Stone pitching of open drains

The unit of measurement shall be the square metre of stone pitching in place.

The schedule rate under this Pay Item shall include all the operations in the surface preparation, supply of stone, placing, final trimming and mortar jointing.

1121.5 Batter drains

The unit of measurement shall be linear metre along the length of the drain formed by batter drain units.

The schedule rate shall include supply of the units, excavation, installation, backfilling and compaction.

1121.6 Rock filled gabions

The unit of measurement shall be the cubic metre of rock filling.

The volume shall be taken from the Drawings with appropriate adjustments being made for any authorised changes.

The schedule rate shall include the supply and placement of geotextile material behind the gabions, the supply and assembly of the gabions, the supply and placing of the rock fill in the gabions.

1121.7 Rock filled wire mattresses

The unit of measurement shall be the square metre of rock filled mattress complete.

The area shall be determined from the actual completed work and shall include the area folded into the trench.

The schedule rate shall include the supply and placement of geotextile material, star pickets and ties as specified, together with the supply and assembly of the wire mattresses and the supply and placing of the rock fill.

1121.8 Kerb and gutter

The unit of measurement shall be the linear metre measured along the length of the kerb and/or gutter including kerb laybacks and perambulator ramps.

The schedule rate shall include all operations involved in the forming, compaction of foundations, concreting, expansion and contraction joints, backfilling and compaction adjacent to the completed kerb.

Separate pay items shall be included for each type of kerb and/or gutter specified.

1122 KERB AND GUTTER REPLACEMENT

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection consists of the removal and disposal of existing kerb and gutter and the construction of new kerb and gutter and associated works.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in *0161 Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete work

1101 Control of traffic

1352 Pipe drainage

Standards

AS 2876	Concrete kerbs and gutters—Manually or machine placed
AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

1.4 PROVISION FOR TRAFFIC

The Works shall be constructed with the least possible obstruction to traffic, both vehicular and pedestrian.

A Traffic Management Plan shall be submitted and all activities for controlling traffic, both vehicular and pedestrian shall be carried out in accordance with *1101 Control of traffic*.

1.5 PROPRIETARY PRODUCTS

Unless shown on the Drawings, proprietary products may only be used with the approval of Council. Where specified, they must be used strictly in accordance with the manufacturer's instructions.

2 CONSTRUCTION

2.1 FOOTPATH AND ROAD PAVEMENT PREPARATION

Saw-cutting

Prior to the excavation and removal of existing kerb and gutter, the footpath, driveways and road pavement shall be saw-cut where shown on the Drawings or as directed by Council to provide a neat, straight, clean cut so as to minimise damage and disturbance to the remainder of the footpath and road pavement.

Damage to footpath

Damage or disturbance to the footpath, driveways and/or road pavement resulting from the work shall be restored to the pre-construction condition to the satisfaction of Council. All costs associated with any restoration work shall be borne by the Contractor.

2.2 REMOVAL AND DISPOSAL

Excavation
The Contractor shall demolish and remove the existing redundant kerb and gutter and excavate to the level shown on the drawings in accordance with *0310 Minor concrete work*.

Services
Care shall be exercised in the removal of kerb and gutter so as to prevent damage to any existing services, including existing house stormwater drainage pipes which discharge into the gutter. Damage occurring to stormwater drainage pipes and/or other services shall be restored to the pre-construction condition. All costs associated with the restoration work shall be borne by the Contractor.

Disposal of material
All excavated material and demolished kerb and gutter shall be removed from site and legally disposed of to a site approved by Council.

Unauthorised disposal
Under no circumstances shall excavated material be disposed of privately to any person or to any site not authorised by Council.

2.3 FOUNDATION

Before placing any kerb and/or gutter, the foundation material shall be shaped and compacted to a firm base.

Other than kerb and gutter constructed on pavement courses, the relative compaction shall be in accordance with the requirements of AS 2876. Where placed on pavement courses, the foundation shall be compacted to the requirements of the respective pavement course. The foundation material in all cases will be subject to Council approval.

This action constitutes a **Hold Point**.

Council approval of the foundation material is required prior to the release of the **Hold Point**.

2.4 KERB AND GUTTER

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

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

Finish
The top and face of the finished kerb and/or gutter shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and gutter shall have a steel float finish.

Tolerances
The level at any point on the surface of the gutters shall be within ±10 mm of design levels. When a straight edge 3 m 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 5 mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression.

Contraction joints
Unless shown otherwise on the Drawings, contraction joints, shall be formed every 3 m of gutter length for a minimum of 50 per cent of cross sectional area. The joint shall be tooled 20 mm in depth to form a neat groove of 5 mm minimum width.

Expansion joints
Unless shown otherwise on the Drawings, expansion joints, 15 mm in width for the full depth of the kerb and gutter, shall be constructed at intervals not exceeding 15 m and where the gutter abuts against pits, retaining walls, overbridges and at both sides of kerb laybacks for vehicular or pedestrian access. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard or equivalent approved by Council.

Joints with adjacent concrete pavement
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.

Stormwater outlets

All existing house stormwater outlets shall be reconnected and extended, to match the existing type and size of pipe, where necessary through the new kerb as shown on the Drawings. Pipework shall be in accordance with the requirements for flexible pipes in *1352 Pipe drainage* or as directed by Council for other types of pipe.

Vehicular or pedestrian access

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 the Drawings. Footpath crossovers shall be constructed to meet laybacks as shown on the Drawings, or reinstated to match existing materials where not otherwise shown.

Gully pits

Where applicable the top of gully pits shall be reconstructed, or precast units adjusted, to suit new kerb and gutter profile in accordance with *0310 Minor concrete work*.

2.5 BACKFILLING AND RESTORATION

Material

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50 mm diameter, or material as approved by Council.

Timing

After the new kerb and gutter has been constructed and not earlier than 3 days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the Drawings, or as instructed by Council.

Behind kerb

Backfill material behind the kerb shall be compacted in layers not greater than 150 mm thick, to a relative compaction of 95% when tested in accordance with AS 1289.5.4.1, for standard compactive effort. The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards and in accordance with any surface treatment shown on the Drawings.

Pavement

Pavement material adjacent to new gutter shall be backfilled in accordance with the Drawings or as directed by Council.

2.6 ADJUSTMENT TO GULLY PITS

Standard

In the event that adjustment of line or level of the kerb and gutter requires adjustments in gully pits any necessary partial demolition shall be undertaken and re-construction of such sections of the gully pits as necessary to match the design standard of the existing gully pit.

Fixing to existing works

Any new wall sections in concrete or brick shall be securely fixed to the retained wall section.

The procedure shall be outlined in writing for Council approval 24 hours prior to commencement of demolition work.

Hydraulic capacity

In all cases the hydraulic capacity of the original gully pit shall be retained or improved. Cavity shapes shall be regular and oriented so as not to impede flow into and out of the pit.

3 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1 Summary of limits and tolerances

Activity	**Limits/tolerances**	**Worksection Clause reference**
Kerb and gutter		
- Compaction of foundation	to AS 2876	**Foundation**
- Level of gutter surface	Level ≤±10 mm of design level	**Kerb and gutter**
- Surface uniformity	Deviation kerb and gutter surface from 3 m straight edge ≤5 mm	**Kerb and gutter**
- Contraction joints		
. Area	≥50% of CS area	**Kerb and gutter**
. Groove width	≥5 mm	**Kerb and gutter**
- Expansion joint interval	≤15 m	**Kerb and gutter**
Backfill behind kerb		
- Layer thickness	≤150 mm	**Backfilling and restoration**
- Compaction	>95% (standard compaction)	**Backfilling and restoration**

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a Schedule of Rates basis in accordance with Pay Items 1122.1 and 1122.2.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity.

Excavation, removal and disposal of existing kerb and gutter and the reconstruction of drainage structures is measured and paid in this worksection and not *0310 Minor concrete work*.

Control of pedestrian and vehicular traffic is measured and paid in accordance with *1101 Control of traffic*.

4.2 PAY ITEMS

1122.1 Kerb and channel (gutter)

The unit of measurement shall be the linear metre (m) measured along the length of the kerb and gutter including kerb laybacks and perambulator ramps.

The schedule rate shall include all operations involved in the removal and disposal of existing kerb and gutter, excavation, forming, compaction of foundations, provision of base, concreting, expansion and contraction joints, backfilling and compaction adjacent to the completed kerb, and making good adjacent surfaces as shown on the Drawings.

Separate pay items shall be included for each type of kerb and gutter specified.

1122.2 Adjustments to gully pits

The unit of measurement shall be ‘each’ for the drainage structures scheduled.

The schedule rate shall include all operations involved in cutting back, adjustment, concreting and backfilling.

1131 ROLLED CONCRETE SUBBASE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the supply, delivery, placement, compaction, jointing and curing of a rolled concrete subbase to the dimensions and levels shown on the Drawings and in accordance with the provisions of the contract.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1132 Mass concrete subbase

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling of fresh concrete
AS 1012.3.4	Determination of properties related to the consistency of concrete—Compactibility index
AS 1012.8.1	Method for making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.13	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.14	Particle shape, by proportional calliper
AS 1141.22	Wet/dry strength variation
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulphate content of a natural soil and the sulphate content of the groundwater—Normal method
AS 1289.5.8.1	Soil compaction and density tests—Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge—Direct transmission mode
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	Determination of chloride ion content
AS 3799	Liquid membrane—forming curing compounds for concrete

AS 3972 Portland and blended cements

Other publications

AUSTROADS

AP-3/90 Guide to Geotextiles

2 MATERIALS FOR CONCRETE

2.1 CEMENT

NSW QA scheme

Cement shall be Type GP Portland cement complying with AS 3972. Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

Nominated brand and source

When submitting details of the nominated mix in accordance with **Nominated mixes** the Contractor shall nominate the brand and source of the cement.

On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work.

Proof of quality

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.

Storage time in excess of 3 months

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, as the case may be, before the cement is used in the work.

The cost of retesting cement shall be borne by the Contractor.

Transport and storage

Cement shall be transported in watertight containers and shall be protected from moisture until used.

Caked or lumpy cement shall not be used.

2.2 FLY ASH

NSW QA scheme

Fly ash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

The use and the quality of fly ash shall comply with AS 3582.1—Supplementary Cementitious Materials for use in Portland Cement—Fly ash.

Source

When submitting details of the nominated mix in accordance with **nominated mixes,** the Contractor shall nominate the powerhouse source of the fly ash.

On approval of a nominated mix by the Superintendent, the Contractor shall use only fly ash from the nominated powerhouse.

Documentary evidence

Documentary evidence of the quality and source of the fly ash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

2.3 WATER

Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish. The water shall be free from oil and shall not contain more than:

- 600 parts per million of chloride ion, determined by AS 3583.13;
- 400 parts per million of sulphate ion, determined by AS 1289.4.2.1.

2.4 ADMIXTURES

Quality

Chemical admixtures shall comply with AS 1478.1. 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 without prior written authorisation by the Superintendent.

Variation to mixture

The dosage of chemical admixture shall be varied to account for air temperature and setting time in accordance with the manufacturer's recommendations.

If the Contractor proposes to vary the admixture between warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of **Variations to approved mixes**.

Source and type

When submitting details of the nominated mix in accordance with **Nominated mixes**, the Contractor shall nominate the proprietary source, type, dose rate, name and method of incorporation of 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.

2.5 AGGREGATES

General

Source and type: When submitting details of the nominated mix in accordance with **Nominated mixes,** the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

Quality: Aggregates shall all pass the 37.5 mm AS sieve and shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 %), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS 1141.14 shall not exceed 35 %.

Proposed grading: 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 aggregate proposed to be used. The grading shall be known as the 'Proposed Grading'.

Blending of aggregates: 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. All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

Grading

The grading of the combined aggregate used in the work, determined by AS 1141.11, shall not deviate from that of the Submitted Sample by more than the amounts shown in Table 2.1.

Table 2.1 Aggregate grading deviation limits

Australian standard sieve	Maximum deviation % passing by mass of total sample
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

Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

Wet Strength—AS 1141.22—Shall not be less than 50 kN.

10 % Fines Wet/Dry Variation—AS 1131.22—Shall not exceed 35 %.

Storage

Facilities: Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring. Storage areas shall have a concrete floor.

Introduction of foreign matter: 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.

3 QUALITY REQUIREMENTS

3.1 FLY ASH CONTENT

The fly ash content of the concrete shall exceed 50 % by mass of the total cementitious material (cement and fly ash) and shall comply with the requirements of AS 3582.1.

3.2 COMPRESSIVE STRENGTH

The compressive strength of concrete shall be determined in accordance with AS 1012.9.

The minimum compressive strength at 7 days shall be 4 MPa and at 28 days shall not be less than 5 MPa for flyash blended cement.

The maximum compressive strength at 28 days shall be less than 15 MPa, 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 20 MPa shall be accepted.

3.3 MOISTURE CONTENT

The moisture content at the point of delivery shall be such as to allow the production of a non-segregated concrete mix and shall be determined by trial mix.

3.4 CONSISTENCY

Measurement

The consistence of the concrete shall be measured at the point of discharge from the truck using the test method for Index of Compactibility described in AS 1012.3.4.

Determination

Consistence shall be maintained within a range to permit adequate compaction of the concrete by the paver and rollers.

The nominal consistence shall be determined during placement of the trial pavement and the Index of Compactibility maintained within the range ±0.05 of the nominal consistency where the Compactibility Index, CI, expressed to the nearest whole number, shall be determined as follows:

- C I= (300 – x)/3
- where ‘x’ = mean drop in surface level due to compaction in millimetres.

3.5 DRYING SHRINKAGE

Measurement

The drying shrinkage of the concrete shall be determined from trial mixes in accordance with the requirements of AS 1012.13, except that compaction shall be effected in 2 layers using a vibrating table and hand tamping to ensure full compaction is achieved.

Moulds shall be marked indicating name of sampler, date and representative area within the works.

Moulds shall not be removed until the concrete has gained sufficient strength so as not to damage specimens.

Shrinkage limit

Drying shrinkage determined after 21 days air drying shall not exceed 450 microstrain.

Any sample not complying with this Clause shall be deemed as non-complying product.

The representative area of the works corresponding to the non-complying mould shall be, at the Superintendent’s discretion, removed from the works and replaced in compliance with **Action on rejection** and **Rejected concrete**.

Any costs resulting from the testing, removal or reinstatement of concrete to comply with this specification shall be borne by the Contractor.

4 DESIGN AND CONTROL OF CONCRETE MIXES

4.1 NOMINATED MIXES

Submission for approval by Superintendent
The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, index of compatibility or other consistence measurement value, 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'.

NATA laboratory certificate of compliance
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 worksection.

All phases of any particular test must be performed at one laboratory.

All relevant test results shall accompany the Certificate. The certificate shall confirm that the required testing has been carried out within the twelve month period before the date of submission to the Superintendent.

Compressive strength determination
In the tests supporting the above certification, the compressive strength at age twenty-eight days shall be determined in accordance with AS 1012.9 for 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.

Timing of submission
These details shall be submitted at least 21 days before using the nominated mix in the work.

4.2 VARIATIONS TO APPROVED MIXES

Approval to vary mix
The Contractor shall not make any changes to the approved mix, its method of production or source or supply of constituents without the prior written approval of the Superintendent.

Written details of variations to the nominated mix and materials
Where changes to an approved mix are proposed, the Contractor shall provide written details of the nominated mix and materials, in accordance with Clause 4.1, for the approval of the Superintendent 21 days prior to proposed implementation of change. The Superintendent may direct that an additional trial be carried out. All costs resulting from compliance testing shall be borne by the Contractor.

Change to the approved mix, without prior written approval
Any change to the approved mix, without prior written approval by the Superintendent shall be considered a non-conforming material and is subject to removal from the works in accordance with this worksection.

5 PRODUCTION AND TRANSPORT

5.1 GENERAL

Methods of handling, storing and batching
At least three weeks before commencing work under this Worksection, the Contractor shall submit, in writing, 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 mixing and transport.

Equipment condition
All equipment shall be in sound mechanical condition and the interior of the pugmill and mixing blades shall be kept thoroughly clean and free of hardened material.

5.2 MEASURING OF MATERIALS

Contractor's methods
The Contractor shall supply to the Superintendent details of its proposed means of monitoring and measuring the constituent materials used in the manufacture of the concrete.

Monitoring equipment
All materials shall be measured by adjustable measuring and discharging devices and all such devices shall be fitted with monitoring equipment.

Pugmilled components
The method of measuring the pugmilled components shall be by continuous measurement (volume or weight) except for liquids which may be measured by volume or flow rate meter.

Accuracy
Weighing hoppers, scales and continuous measurement devices shall be capable of measuring to within 1 % accuracy.

Moisture content
The moisture content of the aggregates shall be determined daily and adjustments shall be made to the quantities of all aggregates as well as to the quantity of water used.

5.3 DELIVERY OF MIXED MATERIAL

Segregation
Segregated or non-uniformly mixed material shall not be delivered to the work.

Delivery time
The delivery time to site shall be such that the elapsed time since mixing shall not exceed 45 minutes unless the mix contains approved retarder of the recommended dosage.

If loss of moisture is likely to occur in the delivered mix due to the haul distance from the plant and because of the effects of evaporation, the loads shall be covered to prevent such moisture loss.

Docket information
The Contractor shall make available to the Superintendent all relevant information regarding the delivery of each batch of appropriate mix inclusive of the following details:

- Supplier name and location.
- Volume of material supplied.
- Product constituents.
- Dispatch time and date.

6 CONSTRUCTION PLANT AND EQUIPMENT

6.1 PAVER EQUIPMENT

Paving machines
Pavers shall be required for the placement of rolled concrete and shall be designed to pave dry cement bound aggregates and be heavy duty, self propelled, track driven and have sufficient mass and stability to spread and finish concrete to the specified thickness, smoothness and surfaces texture without segregation.

Paver equipment
Pavers shall be equipped with a hopper, distributing screws, a vibrating screed, or preferably for surface course applications, at least one tamping bar with a minimum amplitude of 5 mm and interchangeable side forms.

Pavers shall have a capacity consistent with the output of the pugmill and the screed shall be adjustable and capable of placing pavement width from 3.0 m to 5.0 m widths.

Level controls
The paver screed shall have automatic and manual level controls separately operating both sides and shall be capable of operating within plus or minus 5 mm relative to the present or established datum. Sensors operating the automatic level control shall be capable of operating from the following:

- A guideline of tensioned string or wire, set to within plus or minus 5 mm of design levels and supported on preset blocks or pegs spaced at intervals not greater than 10 m.
- A levelling beam.
- A matching shoe travelling on a previously laid layer of material. The matching shoe shall provide level control ensuring that the material being laid shall match the level of the previously laid layer, at the junction of the two, after compaction has been completed.
- Computer based levelling system approved by the Superintendent.

Movement
The paver shall be capable of paving at variable speeds and depths and reversing.

6.2 WATER CARTS

Wheel load
The wheel load of watering plant travelling over concrete pavement courses within seven days of placement shall not exceed 2.8 tonnes.

Spraying requirement
Watering plant shall have spray bars capable of uniformly distributing water, and shall be fitted with rapid acting positive shut-off valves controlled from the operator's cabin.

Water shall be applied in such a manner that the surface of the concrete pavement is not slurried or eroded.

6.3 COMPACTION PLANT

Self propelled
Rollers shall be self propelled and preferably with automatic vibration shut off when the progress of the roller stops.

Contact surface of rollers kept damp
General: Rollers shall be fitted with brushes or similar devices to enable the contact surface of each roll or tyre to be kept uniformly damp with a minimum amount of water and free from foreign material. The taps controlling the rate of flow shall be readily accessible to the operator.

Water shall not be allowed to run directly from taps on to the concrete being compacted.

Rollers for initial rolling: Rollers for initial rolling shall be either tandem or single or vibrating smooth drum rollers with a minimum static mass of 8.5 t and a minimum static load intensity of 2.0 tonne per metre width of vibrating drum.

Pneumatic tyred multi-wheeled rollers: Pneumatic tyred multi-wheeled rollers shall have smooth tyres of equal size. The rear wheels shall be offset relative to the front wheels to give overlapping tyre paths and complete coverage for the effective width of the roller. The roller shall be able to be ballasted for loads between 1.5 t and 2.0 t per wheel and the tyre pressure shall be adjustable between 250 kPa and 650 kPa. Combination rollers which conform with the requirements of this Clause shall be permitted.

Finishing rollers: A smooth steel wheeled tandem or single drum roller weighing between 5 t and 10 t shall be used for finishing.

6.4 SPRAYING EQUIPMENT FOR CURING, BONDING OR DE-BONDING COMPOUNDS

The spraying equipment used to apply a curing, bonding or de-bonding compound shall be equipped with spray nozzles capable of covering the full paved width with a uniform cover of curing compound in a single pass.

The equipment shall maintain the compound in suspension, it shall adequately protect the spray from the wind effects and after shut off there shall be no dripping of compound from the spray nozzles.

7 CONCRETE PLACEMENT

7.1 AIR TEMPERATURE LIMITS

Concrete shall not be placed when the shade temperature is below 5°C or above 35°C. Concrete shall not be placed when rain is falling. In the event of light rain falling during placement, paving shall be allowed to continue, at the discretion of the Superintendent, until all truck loads of mix in transit from the pugmill are placed.

7.2 FINISHING TIME

The Concrete shall be placed, compacted and finished within 90 minutes of mixing (unless it contains an approved retarder of the recommended dosage) except that when the shade temperature exceeds 30°C the concrete shall be placed, compacted and finished within 60 minutes of mixing subject to adjustment by the Superintendent when retarder is approved.

7.3 DEBONDING OF A BOUND SUB-BASE

Unless otherwise approved or directed by the Superintendent, a CRS bitumen emulsion shall be sprayed onto the bound subbase at the rate of approximately one litre of residual bitumen per square metre.

Two 0.5 L/m^2 applications may be used where the first application is required as a curing membrane. The final application shall be in the period 24 to 48 hours before the placement of concrete. The surface to be sprayed shall be cleaned of any loose or foreign material.

7.4 USE OF GUIDE LINES (STRINGLINES OR WIRES)

Guide lines which may consist of stringlines or wires, shall be set to within 5 mm of design levels and shall be tensioned across pegs spaced at appropriate intervals to minimise sag.

On all sag vertical curves and on all horizontal curves the wires shall be held in such a way that the design alignment and profile are accurately followed.

7.5 TRIAL ROLLED CONCRETE SUBBASE

Trial section

Prior to the commencement of paving, the Contractor shall construct a trial section of rolled concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with this worksection.

This section shall be constructed so that it may be incorporated in the finished work.

The trial length, of between 100 m and 200 m, or lesser length as approved by the Superintendent, and at the maximum width proposed to be laid, shall be constructed in one continuous operation.

Materials and methods

The trial rolled 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 the application of curing compound and the construction of joints.

Procedure after placement

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this worksection, the Contractor may proceed with placing concrete subbase from a time five 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 the trial subbase is deficient in some way, the Superintendent will 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.

New trial section

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 and jointed does not comply with this worksection.

Trial concrete subbase which does not comply with the worksection shall be rejected by the Superintendent and shall be removed and reinstated by the Contractor in accordance with **Action on rejection** and **Rejected concrete**.

Any damage caused by such removal to the subgrade or subgrade beams shall be made good by the Contractor and brought to the notice of the Superintendent.

Rectification of Works shall be undertaken by the Contractor immediately.

The cost of removal of rejected trial rolled concrete subbase and the cost of making good any damage caused by such removal to the subgrade beams shall be borne by the Contractor.

8 COMPACTION

8.1 UNIFORM COMPACTION

Concrete shall be uniformly compacted during placement and compaction by roller shall commence immediately after paver placement.

8.2 ROLLER OPERATOR RESPONSIBILITY

Any vibratory mechanism of a roller shall be disengaged before stopping or reversing the direction of the roller. Roller wheels shall be kept free from any build-up and surface defects occurring as a result of rolling shall be corrected immediately.

8.3 INITIAL ROLLING

Initial rolling shall be performed with a steel vibrating roller with the driving roll nearer the paver except on steep grades or on sharp curves where the steering roll shall be nearer the paver.

Joints with previously laid material shall be rolled first and then rolling shall continue longitudinally. The roller shall overhang the supported edge of the paver run.

Each longitudinal pass shall overlap the previous pass by at least 600 mm.

8.4 SECONDARY ROLLING

Secondary rolling shall be performed as soon as possible after initial rolling and shall be performed with a self-propelled pneumatic tyred roller with the driving wheels nearer the paver except on steep grades or on sharp curves where the steering wheels shall be nearer the paver.

Rolling shall be carried out longitudinally. Each roller pass shall overlap the previous pass by at least 600 mm and adjacent passes shall be of different lengths.

8.5 FINAL ROLLING

Final rolling is intended to eliminate roller marks and shall be performed with a steel wheeled non-vibrating roller.

9 JOINTS

9.1 SPECIFICATION

Unless otherwise approved or directed by the Superintendent joints shall be constructed as specified on the Drawings. Joints shall be continuous from edge to edge of the pavement.

9.2 CONSTRUCTION JOINTS

General

Construction joints shall be considered to be fresh joints when concrete on either side of the joint has been mixed within a 90 minute interval, or 60 minute interval when the air temperature is over 30°C, (unless the mix contains an approved retarder) and provided the concrete is still green.

All other construction joints shall be considered to be cold joints.

Longitudinal joints shall, where practical, be constructed parallel to the centreline of the pavement.

Fresh construction joints

Longitudinal joint compaction: For longitudinal joints rolling should not be carried out within 0.3 m of the proposed longitudinal joint during the first paver run. This initially uncompacted section shall be compacted together with the adjoining paver run.

Transverse joint compaction: For transverse joints rolling of the initial strip shall be stopped about 0.5 m from the proposed joint and this initially uncompacted section shall be compacted with the beginning of the succeeding run to form the joint.

Full depth compaction: Extra passes of the vibratory roller or other compaction equipment, or hand finishing shall be used as necessary to ensure full depth compaction and the specified surfaced finish at the joint.

Cold construction joints

Minimise length of cold joints: The work shall be organised to minimise the length of cold joints.

A cold joint shall be formed when the adjoining concrete was placed outside the time requirements specified in this Clause or where the adjoining concrete shows signs of setting.

Method of construction: The edge of the previously placed concrete shall be cut back by sawing the concrete, to at least 1/3 the slab depth to expose an even, clean, sound, vertical surface, without disturbing the concrete that is to remain in place. The balance of section shall be removed without undercutting so as to provide a face of full thickness of the pavement.

Location: Cold transverse construction joints shall be constructed either normal to or at 1 in 6 skew to the centre line and shall not be formed within 3.0 m of a planned contraction joint.

Overlap previous run: For cold longitudinal joints the screed of the paver shall overlap the previously placed paver run and shall be sufficiently high so that compaction will produce a smooth, dense joint.

Excess concrete: Any concrete placed by the paver on the edge of a previously placed paver run shall be pushed back by use of a rake to the edge of the paver run being placed. When the quantity of concrete on the edge of the previously placed paver run plus uncompacted material in the paver run being placed exceeds that required to produce a smooth, dense joint, the excess concrete shall be removed from site by approved methods and wasted.

9.3 TRANSVERSE SAWN CONTRACTION JOINTS

General

Transverse contraction joints shall be sawn, at an appropriate time so as to prevent pavement cracking of the concrete.

Joint spacing shall be approximately 10.0 m and the line of a sawn joint shall not deviate from a 3 m straight edge by more than 20 mm.

The joints shall be initially formed as a sawn groove 3 mm wide to a depth approximately 1/3 the slab depth.

Joints shall be generally sawn in the sequence of concrete placement.

Before sawing a joint, the concrete layer shall be examined closely for cracks and the joints shall be sawn within 1 m of any crack.

Cleaning of the joints

Saw debris shall be washed from the joint and pavement after sawing.

The groove shall be cleaned of all debris.

The cleaning method used shall not damage the groove nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants to be used. The method shall incorporate a jetting at an appropriate high pressure.

9.4 PRELIMINARY SEALING

After cleaning a continuous UV-stabilised PVC spline shall be installed at the top of the groove. The maximum increase in length of a preliminary seal after installation shall be 10 % of the original length.

9.5 PERMANENT SEALING

Second cut

After preliminary sealing, or after cleaning following the second sawcut, if the groove is produced by a two-cut operation, the pavement can be permanently sealed.

Timing

Within two days of final sawing and on removal of the temporary seal a permanent seal shall be provided.

Type of sealant

The permanent seal shall be either a neoprene compression seal, a cast in-situ silicone seal, a hot poured rubberised industrial bitumen sealant, a low shrinkage, rubberised rapid set anionic bitumen emulsion, as detailed in Annexure A or other as approved by the Superintendent.

Quality of sealant

When submitting details of the proposed permanent sealant(s) to be used, the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality of the sealant(s).

9.6 TREATMENT FOR ASPHALT OVERLAY

Joint cut

Where asphaltic surfacing over the concrete subbase is specified, the joint shall consist of a 3 mm wide groove to approximately 1/3 the slab depth followed by cleaning and preliminary sealing as specified in **Transverse sawn contraction joints** and **Preliminary sealing**.

Fabric joint seal

Prior to asphalt surfacing, including tack coating, the groove shall be primed then covered by a single sheet of an approved 300 mm minimum width geotextile backed polymer modified bitumen strip (reference AUSTROADS *Guide to Geotextiles*) placed without wrinkles so as to overlap the joint by 150 mm either side.

No neoprene seal is required beneath this fabric; only a preliminary seal as specified in **Preliminary sealing** is required.

9.7 EXPANSION JOINTS

Location

Expansion joints are generally formed around structures and features which project through, into or against the pavement and at other locations as specified or directed. Sawn contraction joints shall not be constructed within 1.5 m of a transverse expansion joint.

Gap

The joint gap shall be 20 mm running vertically for the full depth of the slab.

Sealant

The sealant shall comprise a hot poured joint sealant in combination with a preformed joint filler as detailed in the Drawings.

The top of the sealant shall be between 3 mm and 6 mm below the surface of the pavement.

9.8 ISOLATION JOINTS

Location

Isolation joints shall be provided at the locations and to the details shown on the Drawings.

Tolerances

The line of the 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 straight-edge by more than 10 mm.

Filler and sealant

The joint filler and sealant shall be installed in accordance with the Drawings and in a manner conforming to the manufacturer's recommendations.

10 CURING

10.1 GENERAL

Method

Curing shall commence following the completion of rolling by keeping the surface of the concrete continuously wet by means of a water cart and/or wet hessian.

After the initial 12 hours of curing, the pavement shall be cured for a further 7 days by the use of the application of an approved curing compound.

Compounds

Curing shall be by the use of materials complying with AS 3799 Class B Resin Based Curing compound Type 1D or Type 2 or Class C Chlorinated Rubber Curing Compound Type 1D.

Where an asphalt base is to be applied, Bitumen emulsion Grade CRS/170, complying with AS 1160 may be used.

Efficiency index of curing compound

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian laboratory, approved by the Superintendent showing a non-volatic content and an Efficiency Index of not less than 90 % when tested in accordance with Appendix B, AS 3799.

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/ m^2, whichever rate is the greater.

Bitumen emulsion shall be applied at a minimum rate of 0.5 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25%.

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

The curing compound shall be applied by a mechanical sprayer, spraying transversely or longitudinally, having a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.

The sprayer shall incorporate a device for continuous agitation and mixing of the compound in its container during spraying. After shut-off of the spray nozzles, there shall be no dripping of the curing compound on the concrete surface.

Hand spraying

For small areas where a mechanical means of distribution cannot be used, the compound shall be sprayed by hand lance at a rate 25 higher than that used on the main base.

Curing period

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.

Equipment on site

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

Damaged curing membrane

The cost of making good such damaged curing membrane shall be borne by the Contractor.

11 DETERMINATION OF COMPRESSIVE STRENGTH OF CONCRETE

11.1 TEST SPECIMENS

General

Point of sampling: Test specimens for determining the compressive strength of rolled concrete shall be moulded from samples taken from the delivery vehicles, or from rolled concrete deposited ready for placement, in accordance with AS 1012.1.

Frequency of testing: A sample will be selected by the Superintendent to represent the whole of the concrete being placed at one time or 50 tonnes, whichever is less. At least one pair of compressive strength specimens shall be moulded from the sample to represent any such lot of the work.

Method of moulding: The method of moulding shall be in accordance with AS 1012.8.1 or by an approved equivalent compaction procedure.

Costs of sampling and testing: All costs associated with the sampling and testing of concrete specimens shall be borne by the Contractor.

Curing

Test specimens moulded in accordance with AS 1012.8.1 shall be cured in accordance with the provisions of AS 1012.8.1, except that after initial curing, de-moulding shall be deferred for a further 48 hours during which time the specimens in their moulds shall be prevented from drying.

Testing

Test method: Specimens shall be capped and tested at a nominated NATA registered laboratory in accordance with AS 1012.8.1 and AS 1012.9.

Strength determination: The strength of a pair of specimens made from one sample shall be the average strength of the two specimens. 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.

11.2 SPECIMENS CUT FROM THE WORK

Circumstances

If the strength indicated by test specimens falls below the specified strength, the Superintendent may approve the cutting of specimens from the completed work.

Securing and testing cores
All activities associated with the securing, subsequent testing and reinstatement of the specimens cut from the work shall conform with *1132 Mass concrete subbase*.

Costs of testing specimens cut from the works

All costs associated with procuring and testing of concrete specimens cut from the work shall be borne by the Contractor.

12 ACCEPTANCE OF CONCRETE

12.1 REASONS FOR REJECTION

Concrete not of the mix approved for the specified strength range, and/or not made in accordance with this Worksection, and/or which does not comply with the consistency specified or approved, may be rejected.

12.2 DETERMINATION OF STRENGTH FOR ACCEPTANCE OF CONCRETE

After tests of concrete specimen(s) cut from the work have been made, the Superintendent shall consider the test results and may at the Superintendent's absolute discretion determine the strength of the concrete for acceptance to be taken as one of the following:

- The average strength of the pair(s) of specimens moulded at the time of casting; or
- The equivalent 28 day strength of the specimen(s) cut from the work.

Adjustments for size and age of specimens being made in accordance with 1132 *Mass concrete subbase*.

12.3 FIELD DENSITY

Method
Field density shall be determined using a single probe nuclear densometer. The pavement density shall be tested at the completion of final rolling so as to comply with AS 1289.5.8.1.

Lower limit
The field density shall be greater than 95 % of the maximum wet density.

The Contractor shall repair all probe holes with sand/cement mortar to full layer depth.

12.4 STRAIGHT EDGE TOLERANCE

Straight edge tolerance shall be measured over a 3 metre straight edge.

The deviation from the straight edge over this distance shall be no more than plus or minus 10 mm.

12.5 PAVEMENT THICKNESS TOLERANCE BY LEVELS

Measurement
The pavement thickness shall be assessed by survey level runs before and after placement and thickness dimensions of concrete cores cut from the pavement shall verify the design thickness to ±10 mm.

Sub-base design level
The design level of the top of the sub-base 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 tolerance
The levels of the surface of the subbase course shall not vary from the design by more than +10 or –20 mm.

12.6 ACTION ON REJECTION

Remedial action low sub-base
Where the cause for rejection is due to departures from design level of the sub-base being too far below the design level, the Contractor shall increase the thickness of the base course to make up such deficiency in thickness.

Remedial action high sub-base

Where the cause for rejection is due to departures from design level being too far above the design level of the subbase, to allow for the base design thickness to be laid, the original design level may be adjusted up to a maximum of +20 mm.

Approval of such local regrading of the surface level 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/m.
- The regrading shall not interfere with the proper design functioning of the draining 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.
- The costs associated with surface level regrading required in this Clause shall be borne by the Contractor.

12.7 REJECTED CONCRETE

Method of removal

Any concrete element rejected shall be neatly cut from the surrounding work by means of a suitable sawcut and removed from the site.

Associated costs

The cost of removing and disposal of rejected concrete from the site, and the cost of any rectification required to the subgrade or sub-base shall be borne by the Contractor.

Rejected material

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.

Length to be removed

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.

damage to underlying or abutting layers or structures. Any damage to underlying or abutting layers or structures shall be made good by the Contractor using methods approved by the Superintendent.

Superintendent's discretion

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction. In this case, the new longitudinal cold joint shall be formed and located along the centreline of the road pavement.

Inspection before replacement

After removal of rejected subbase course material, the section shall be presented for inspection by the Superintendent before replacement work is commenced.

Replacement material

Material used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, shall comply with the requirements of this worksection.

Costs associated with removals, replacements and corrections

All costs associated with removals, replacements and corrections of rolled concrete required and the extra costs incurred by the Contractor with respect to delays caused by such removals, replacements and corrections shall be borne by the Contractor.

13 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 13.1.

Table 13.1 Summary of limits and tolerances

Activity	Limits/tolerances	Worksection Clause Reference
Materials for concrete		
-Water		

Activity	**Limits/tolerances**		**Worksection Clause Reference**
. Chloride ion . Sulphate ion	< 600 ppm < 400 ppm		**Water**
- Aggregates Grading	Deviation from submitted sample not greater than Table 2.1		**Aggregates**
- Durability	Wet strength 10% Fines	> 50 kN <35 percent	**Aggregates**
- Misshapen particles	2 : 1 ratio	<35 percent	**Aggregates**
Paver			
- Tamping bar amplitude	> 5 mm		**Paver equipment**
- Adjustable screed pavement width	> 3.0 m and <5.0 m		**Paver equipment**
Concrete			
- Mixing and transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within three quarters of an hour unless mix contains an approved retarder.		**Delivery of mixed material**
- Shrinkage	Drying Shrinkage < 450 microstrain		**Drying shrinkage**
- Placing temperature	Concrete shall not be placed when shade temperature <5°C or >35°C		**Air temperature limits**
- Placing time	Concrete shall be placed, compacted and finished within:		**Finishing time**
	. 90 minutes after mixing unless an approved retarder is used; or		
	. 60 minutes after mixing if shade temperature >30°C unless an approved retarder is used		
- Pavement thickness	±10 mm with level requirements as in Clause		**Pavement thickness tolerance by levels**
- Straight edge thickness	Maximum deviation measured over a 3 m straight edge shall be ±10 mm		**Straight edge tolerance**
- Level at subbase surface	Design level	+10 mm, –20 mm	**Pavement thickness tolerance by levels**
- Strength	. If strength <80% of specified, concrete rejected.		**Determination of strength for acceptance of concrete**
	. If strength >80% and <100% of specified, deduction of 10% of schedule rate for each 0.5 MPa or part thereof below specified strength for quantity represented.		
- Field density	>95% of maximum density		**Field density**
Joints			
- Transverse contraction	Shall not deviate from a 3 m straight edge placed along the joint by more than 10 mm		**Transverse sawn contraction joints**
- Transverse construction	Shall not be formed within 3 m of a planned		**Construction**

Activity	Limits/tolerances	Worksection Clause Reference
	contraction joint	**joints**
-Spline sealer	Maximum increase in length after installation shall be 10% of original length	**Preliminary sealing**

14 MEASUREMENT AND PAYMENT

14.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed under this worksection in accordance with Pay Items 1131.1 to 1131.2 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

The cost of all work, materials and equipment shall be included in the schedule rate for each Pay Item.

14.2 PAY ITEMS

1131.1 Supply and place rolled concrete

The unit of measurement shall be the cubic metre in place.

The width and length shall be as specified on the Drawings or as directed by the Superintendent.

The depths shall be the depths specified or as directed by the Superintendent across each section.

No account shall be taken of the allowable tolerances.

The cost of providing construction joints, contraction joints and expansion joints shall be included in the schedule rate.

1131.2 Finish and cure rolled concrete

The unit of measurement shall be the square metre of rolled concrete.

The width and length shall be taken as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowance tolerances.

The sides of slabs shall not be included in the measurement of surface area.

The schedule rate shall include all operations involved in the finishing and curing of the concrete.

15 ANNEXURE A

15.1 JOINT SEALING REQUIREMENTS FOR ROLLED CONCRETE SUBBASE

Permanent joint sealing types

(a) Transverse contraction joints

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(b) Expansion joints

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(c) Isolation joints

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1132 MASS CONCRETE SUBBASE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the construction, by mechanical or hand placement of mass concrete subbase including trial sections and subgrade beams to the dimensions and levels shown on the Drawings and in accordance with the provisions of the Contract.

1.2 THICKNESS AND LEVELS OF SUBBASE

The subbase thickness and levels shall be as shown on the Drawings.

1.3 PROVISION FOR BASE SLAB ANCHORS

During construction of the subbase, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the Drawings.

Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with 1133 *Plain and reinforced concrete base* as part of the concrete base construction.

1.4 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.5 REFERENCED DOCUMENTS

The following documents referred to in this Worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete work

1133 Plain and reinforced concrete base

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling of fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.4.2	Determination of air content of freshly mixed concrete—Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1	Method for making and curing concrete—Compression and indirect tensile test specimens
AS 1012.8.2	Method for making and curing concrete—Flexure test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012	Methods of testing concrete
AS 1012.13	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
AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.14	Particle shape, by proportional calliper
AS 1141.22	Wet/dry strength variation

AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulfate content of a natural soil and the sulfate content of the groundwater—Normal method
AS 1379	Worksection and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	Determination of chloride ion content
AS 3799	Liquid membrane—forming curing compounds for concrete
AS 3972	Portland and blended cements

Other publications

AUSTROADS

AP-3/90 Guide to Geotextiles

2 MATERIALS FOR CONCRETE

2.1 CEMENT

NSW QA Scheme

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.

Nominated brand and source

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes** the Contractor shall nominate the brand and source of the cement.

On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work.

Proof of quality

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.

Quality confirmation retesting

If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture or if inadequate storage of the cement is such that a reduction in quality is suspected by the Superintendent, 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.

Transport and storage

Cement shall be transported and stored in watertight containers and shall be protected from moisture until used.

Moisture affected cement

Caked or lumpy cement shall not be used.

2.2 FLYASH

NSW QA scheme

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.

Source
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the powerhouse source of the flyash.

On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence
Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

2.3 WATER

Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

Water used in the production of concrete shall contain:

- less than 600 ppm of chloride ion determined by AS 3583.13;
- less than 400 ppm of suphate ion determined by AS 1289.4.2.1.

2.4 ADMIXTURES

Quality
Chemical admixtures and their uses shall comply with AS 1478.1. 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 may be included in the mix. If an air-entrainer is used, the air content of the fresh concrete shall comply with **Air content**.

Excess air content
Fresh concrete with an air content not complying with **Air content** shall be rejected.

Retarder for warm season
During the warm season (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) approved by the Superintendent, shall be used to control slump within the limits stated in **Consistency**.

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 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with **Design and control of concrete mixes**.

Retarder for cool season
During the cool season (April to September inclusive), only a lignin or lignin-based set retarding admixture containing not more than 6 % reducing sugars (Type WRRe complying with AS 1478.1) 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 variation shall constitute a proposed change to an approved mix for the purposes of **Variations to approved mixes**.

Source and type
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the proprietary source, proposed concentration, type and name of 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.

2.5 AGGREGATES

General
Source and type: When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

Quality: Aggregates shall all pass the 37.5 mm AS sieve and shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 %), material finer than 75 micrometres, impurities and

reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS 1141.14 shall not exceed 35 %.

Proposed grading: 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 aggregate proposed to be used. The grading shall be known as the 'Proposed Grading'.

Blending of aggregates: 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.

All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

Grading

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 2.1.

Table 2.1 Aggregate grading deviation limits

Australian Standard sieve	**Maximum deviation % passing by mass of total sample**
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

Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

- Wet Strength in accordance with AS 1141.22, shall not be less than 50 kN.
- 10 % Fines Wet/Dry Variation in accordance with AS 1141.22 shall not exceed 35 %.

Storage and handling

Facilities: Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

Area surrounding the storage facilities and mixing plant

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.

3 QUALITY REQUIREMENTS OF CONCRETE

3.1 CEMENT AND FLYASH CONTENT

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.

3.2 COMPRESSIVE STRENGTH

The compressive strength of concrete shall be determined in accordance with AS 1012.9.

The minimum compressive strength at 7 days shall be 4 MPa and at 28 days shall not be less than 5 MPa for flyash blended cement.

The maximum compressive strength at 28 days shall be less than 15 MPa, 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 20 MPa shall be accepted.

3.3 SHRINKAGE

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 % of the median of the three readings obtained in accordance with AS 1012.13.

3.4 CONSISTENCY

The Contractor's nominated slump, determined in accordance with AS 1012.3.1, shall be neither less than 25 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 50 mm nor more than 65 mm for hand placed concrete.

3.5 AIR CONTENT

If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS 1012.4.2, shall be neither less than 3 % nor more than 7 % when discharged from the transport vehicle ready for placement.

4 DESIGN AND CONTROL OF CONCRETE MIXES

4.1 GENERAL

Nominated mixes

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.

Details shall also include certification from a NATA registered laboratory and test results supporting this certification. Each such mix shall be known as a 'nominated mix'.

Submission of such documentation shall constitute a **Hold Point**.

Superintendent inspection of documentation and approval of specific nominated mixes is required prior to the release of the **Hold Point** for each mix.

Certificate of compliance with worksection

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 worksection. 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.

Compressive strength determination

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 AS 1012.9. 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.

Timing of submission

These details shall be submitted at least 21 days before the intended usage of the mix in the work.

Approved mixes

A nominated mix that meets with Superintendent approval shall henceforth be referred to as the 'approved mix'.

Prior approval

If the Contractor's nominated mix has received prior approval under a separate contract within twelve months before the proposed date of initial delivery under this contract, and where performance is

agreed to be acceptable by the Principal as satisfactory in terms of the requirements of this worksection, then provided that:

- the Contractor produces documentary evidence and full details of the previously approved mix supplied under a worksection which required the same standard of materials and product as this worksection;
- the constituent materials and their quality remain unchanged from that previously approved; and
- the in-service performance of the concrete 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 this Clause at any time during the course of the contract.

4.2 VARIATIONS TO APPROVED MIXES

Approval required to vary mix

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.

Details to be submitted

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with **Design and control of concrete mixes**.

Mix variations not requiring new trials

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 % 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.

Minimum constituent quantities

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. Any change to the approved mix, without prior written approval by the Superintendent shall be considered a non-conforming material and is subject to removal from the works in accordance with this worksection.

5 CONFORMANCE FOR CONCRETE STRENGTH AND THICKNESS

5.1 CONCRETE CYLINDERS

Test specimens

Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8.1.

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.

Sampling

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.

The method of making and curing specimens shall be in accordance with AS 1012.8.1 with compaction by internal vibration.

Marking and transport

The Contractor shall mark the specimens for identification purposes.

Specimens are not to be transported within 3 hours of being cast.

Test method

Specimens shall be inspected, capped and crushed in accordance with AS 1012.8.1 and AS 1012.9.

Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

- 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.
- For the determination of the compressive strength at seven days when required as a condition of mix approval. For each lot of up to 50 cubic metres of concrete placed at the one time—one pair of specimens.
- 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.

Lot size

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

Cost of testing

The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.

5.2 COMPRESSIVE STRENGTH OF CONCRETE

Determination of strength

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.

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.

Adjustment of test compressive strength for age of specimen

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 5.1.

For intermediate ages the factor shall be determined on a pro-rata basis.

Table 5.1 Concrete age conversion factors

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

Conformance for compressive strength

Under-strength results for a lot: If the compressive strength of test cylinders for any lot is less than the criteria specified in **Compressive strength**, the lot represented by the test cylinders shall be removed and replaced in accordance with this worksection.

The cost of removal of rejected concrete, including its disposal from the site, shall be borne by the Contractor.

Non-conformance and coring to test in situ subbase: In case of non-conformance the Contractor may request permission of the Superintendent 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.

5.3 SPECIMENS CUT FROM THE WORK

Test specimens

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.

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.

Test method

Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.14 with the following amendments:

- 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.
- 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.
- When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5 mm from the mean diameter.
- 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 5.2.
- Wet conditioning only shall be used.

Table 5.2 Core strength factor

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
For intermediate form ratios, the factor shall be determined by interpolation.	

Frequency of coring

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.

The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Curing of cores

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.

Restoration

The method of restoration shall be approved by the Superintendent.

Costs

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 cost of core preparation for testing, curing and testing shall be borne by the Contractor.

5.4 ACCEPTANCE OF CORED CONCRETE FOR COMPRESSIVE STRENGTH

Strength requirement

Concrete shall achieve an in situ compressive strength of 5 MPa within 28 days of placement.

Core strength

If the specimen cut from the subbase reaches 4 MPa for in situ compressive strength, base paving may proceed.

Rejected concrete

No payment shall be made for the rejected concrete nor any bond breaker placed.

Removal of rejected concrete

The cost of removal of rejected concrete, including its legal and responsible disposal from the site, shall be borne by the Contractor.

5.5 CONFORMANCE FOR THICKNESS

General

Conforming tolerances: No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in **Alignment and surface tolerances**.

Thickness measurement: If scabbling is required to achieve the level tolerance limits, 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 5 m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. Thickness measurements shall be rounded off to the nearest 5 mm.

Thickness below worksection

More than 20 mm below: After making due allowance for the tolerances, subbase which is more than 20 mm 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.

10 mm or less below: Subbase which is 10 mm 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 5 % of the area of the lot.

6 PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

6.1 INFORMATION OF THE SUPERINTENDENT

At least four weeks before commencing work under this worksection, 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.

6.2 METHODS FOR HANDLING, STORAGE AND BATCHING MATERIALS

The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:

- 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 prior to handling and batching of material.
- Cementatious material shall be weighed in an individual hopper, with the cement weighed first.
- 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.
- 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.
- Storage of materials shall only be allowed on sites specifically designated for the purpose. Use of a new storage site not expressly authorised by the Superintendent shall be prohibited.

6.3 MIXERS AND AGITATION EQUIPMENT

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 10 mm.

6.4 MIXING AND TRANSPORT METHODS

Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:

- The mixer shall be charged in accordance with the manufacturer's instructions.
- 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 % and 85 % along the length of the tray.
- 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.
- 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.
- Any material delivered in excess of these time limitations shall be legally disposed of. The cost of such action shall be borne by the Contractor.
- 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.
- The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 % of the gross volume of the drum of the mixer.

6.5 MAXIMUM TIME BATCH HELD IN MIXER

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.

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.

6.6 CONSISTENCY

Requirements

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.

Testing

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.

Test method

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1.

The test shall be made on concrete samples obtained in accordance with AS 1012.1.

Check tests

Check tests shall be done on each truckload of concrete.

7 PLACING AND FINISHING CONCRETE SUBBASE

7.1 GENERAL

Approval of methods

At least four weeks before commencing work under this worksection, the Contractor shall submit as part of the Quality Plan, for the approval of the Superintendent, 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.

Written notice of intention to commence construction

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 **Trial concrete subbase**.

Surface conditions

The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter, compacted to the satisfaction of the Superintendent, and in damp condition.

Air temperature limits

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

Concrete temperature limits

The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C.

7.2 RATE OF EVAPORATION

Evaporation limit and precautionary measures

When the value of Rate of Evaporation, determined from the graph in Figure 7.1, exceeds 0.50 kg/m^2/hr 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 kg/m^2/hr.

The cost of such precautionary measures shall be borne by the Contractor.

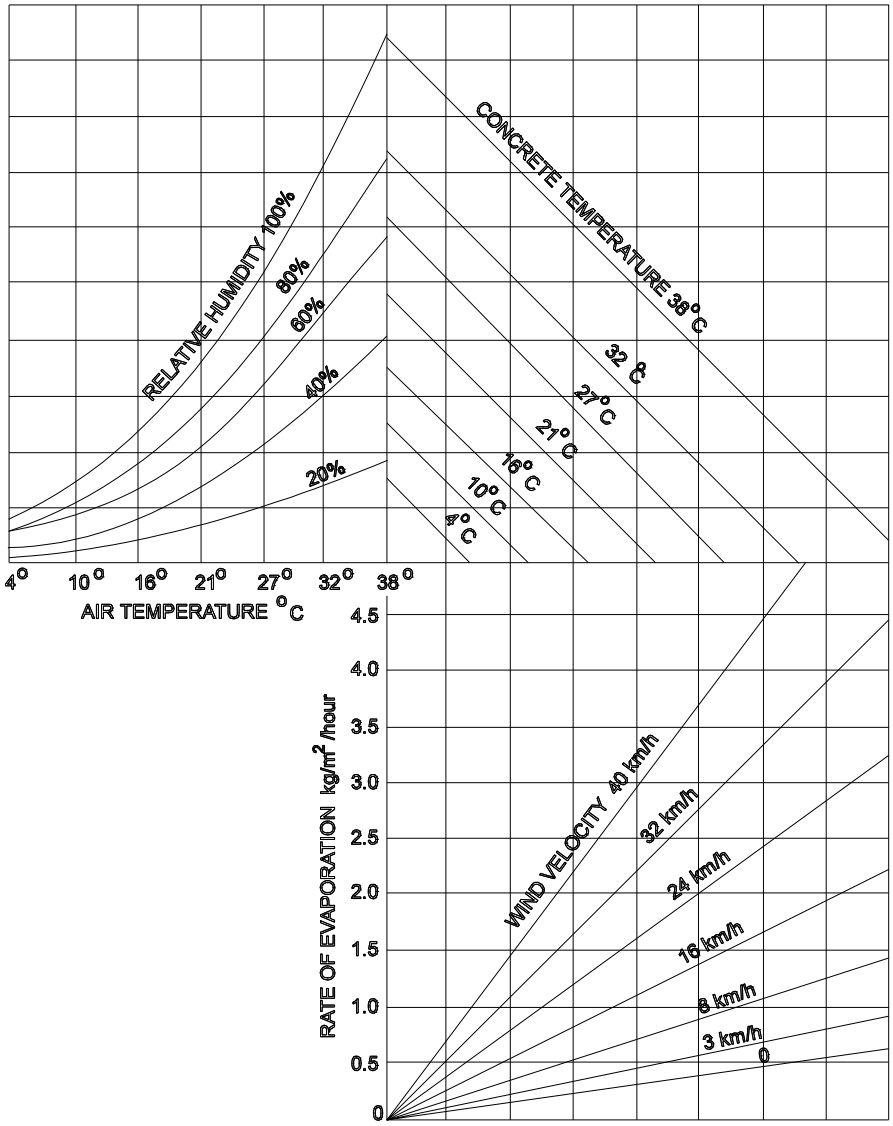

Figure 7.1 Rate of evaporation

Example using rate of evaporation graph

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 using the following data: with air temperature at 27°C; relative humidity at 40%; concrete temperature at 27°C; and a wind velocity of 26 km/h.

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 26 km/hour—and then horizontally to the left to intersect the scale for the rate of evaporation.

The rate of evaporation would be 1.6 kg/m^2/hour.

Use of evaporation retarder

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.

The Superintendent may require re-application of evaporation retarder after level floating

Prevention of excessive moisture loss

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.

The cost of providing and maintaining such equipment and providing such personnel shall be borne by the Contractor.

7.3 MECHANICAL PAVING

Paving machine

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.
- Internal vibrators capable of compacting the full depth of the concrete.
- Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

Concrete finish

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.

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.

Supporting surface

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.

Continuity of paving operation

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.

7.4 HAND PLACING

Formwork

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.

Placing in forms

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 two passes only 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.

Disruption to paving

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.

Concrete finish

A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

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.

7.5 ALIGNMENT AND SURFACE TOLERANCES

Horizontal alignment tolerance

Outer edge: The outer edges of the subbase shall be square to the subgrade and shall be constructed 50 mm wider than the plan position of the base formation with a tolerance of ±25 mm.

Longitudinal construction joint: Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with **Longitudinal construction joints**.

Surface tolerances

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. The top surface of the subbase shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.

7.6 CURING

Curing compounds

The subbase shall be cured by the use of one of the following:

- 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
- White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if a concrete base is used, or
- Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt or concrete base.

Efficiency index

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, denoting non-volatile content, and confirming an Efficiency Index of not less than 90 % when tested in accordance with Appendix B of AS 3799.

Application method

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/m^2, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25 %.

Application rate

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.

Curing period

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.

The cost of making good such damaged curing membrane shall be borne by the Contractor.

Equipment on site

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

7.7 PROTECTION OF WORK

Temperature control

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 Worksection, the concrete shall be rejected.

Rain protection

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.

Traffic restrictions

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:

- Bond-breaker and spall treatment and
- Concrete or asphalt paving.

Damage Restoration

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.

8 JOINTS

8.1 TRANSVERSE CONSTRUCTION JOINTS

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.

8.2 LONGITUDINAL CONSTRUCTION JOINTS

Longitudinal construction joints shall:

- be formed no closer than 300 mm 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.
- be perpendicular to the subgrade surface.

9 BOND BREAKER AND SPALL TREATMENT

9.1 GENERAL

Bond breaker

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.

No bond breaker

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.

Spalled areas

Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete.

9.2 PREPARATION OF SUBBASE

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.

9.3 TREATMENT OF SPALLING

Method

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.

Spalling repair time

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

Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor.

The cost of making good treated spalled areas which have been damaged shall be borne by the Contractor.

9.4 APPLICATION OF BOND BREAKER

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.

The method of application shall conform to the requirements of **Curing**.

9.5 TREATMENT OF UNPLANNED CRACKS

The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3 mm.

This may take the form of applying an approved 300 mm minimum width geotextile backed polymer modified bitumen strip (see AUSTROADS *Guide to Geotextiles*) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300 mm along the crack when a concrete base is required.

The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

Extra application of wax emulsion shall ensure a doubling of the application rate over the strip width.

Where transverse cracking over 0.3 mm in crack width occurs at average spacing less than 2 metres over a length of 5 metres or where longitudinal cracking occurs contiguously for a length exceeding 5 metres, the area of slab so effected shall be rejected, removed and replaced at Contractor's expense

The Superintendent may reject slab areas where cracking over 0.3 mm in crack width occurs within a distance of 1.5 metres from a construction joint, isolation joint or free edge.

10 SUBGRADE BEAMS

10.1 LOCATION

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.

10.2 EXCAVATION

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 recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. Excavated material shall be legally disposed of by the Contractor.

10.3 CONCRETE

Concrete in subgrade beams shall comply with 0310 *Minor concrete work*. The minimum compressive strength at 28 days shall be 32 MPa.

10.4 STEEL REINFORCEMENT

Steel reinforcement shall be of the type and size shown on the Drawings and shall be supplied and installed in accordance with 1133 *Plain and reinforced concrete base*.

10.5 CONSTRUCTION AND PROTECTION

Timing and type of finish

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 recompacted 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. A steel float shall be used to produce a smooth surface finish, free of any texture.

Protection from damage

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.

10.6 CURING

The top surface of the subgrade beam shall be cured in accordance with Placing and finishing of concrete subbase (curing) before placing the subbase.

10.7 BOND BREAKER

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 24 hours nor more than 72 hours before placing of subbase concrete.

11 TRIAL CONCRETE SUBBASE

11.1 GENERAL

Location

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 Worksection.

This section shall be constructed so that it may be incorporated in the finished work.

Purpose

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.

Quality parameters

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.

Dimensions

A trial length of between 100 m and 200 m, or less length as approved by the Superintendent, for mechanical paving equipment or between 20 m and 50 m for hand placement is required.

The trial length shall be the maximum width proposed to be laid and shall be constructed in one continuous operation.

Continuation of works after trial section

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this Worksection, the Contractor may proceed with placing concrete subbase from a

time five 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.

New trial section

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 Worksection.

Trial concrete subbase, which does not comply with the Worksection, shall be rejected by the Superintendent and shall be removed and disposed from the site by the Contractor.

Rejected trial concrete subbase

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.

All non-conforming material shall be discarded in a legal fashion at a location that meets Superintendent approval.

12 REMOVAL AND REPLACEMENT OF SUBBASE

12.1 GENERAL

Rejected Subbase

Where directed by the Superintendent, rejected subbase shall be removed and replaced in accordance with this Clause. Rejected subbase, which extends more than 25 m longitudinally, shall be replaced by mechanical means unless the slabs are odd-shaped or mismatched.

At least seven days before the commencement of sub 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 subbase.

This action shall constitute a **Hold Point**.

Superintendent approval of subbase removal and disposal is required prior to commencement of operations. The cost of all work and materials under this Clause shall be borne by the Contractor.

12.2 REMOVAL AND DISPOSAL OF SUBBASE

Transverse sawcut

At each end of the section of subbase to be removed, a transverse sawcut shall be made for the full depth of the subbase layer. Such transverse sawcuts shall be normal to the control line. No over-sawing into the adjoining base or underlying sub base shall be permitted.

Longitudinal sawcuts

Longitudinal sawcuts shall be made at a location 150–300 mm offset from planned longitudinal contraction joints in the overlying base. Such longitudinal sawcuts shall not extend more than 250 mm past the transverse sawcut at each end of the section to be removed.

Over-sawing

No over-sawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the subbase.

Disposal

The Contractor shall dispose of the removed base slabs at locations of his choice acceptable to the Superintendent.

Damage to adjoining pavement

Any pavement adjacent to the original area of rejected subbase damaged by the Contractor’s operations shall also be removed and replaced.

Replacement of base
After construction of the replacement subbase, the pavement shall be prepared and debonded in accordance with this worksection.

13 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 13.1.

Table 13.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**		**Worksection Clause Reference**
Materials for concrete			
- Misshapen particles	2 : 1 ratio	< 35 percent	**Aggregates**
- Aggregates grading	Deviation from submitted sample not greater than Table 2.1		**Aggregates**
- Durability	Wet strength 10% Fines	> 50 kN < 35 percent	**Aggregates**
Concrete			
- Shrinkage	Drying shrinkage <450 microstrain		**Shrinkage**
- Consistency	Mechanically placed:	>25 mm<40 mm	**Consistency**
	Hand placed:	>50 mm <65 mm	**Consistency**
- Air content	≥3, ≤7 percent		**Air content**
- Thickness	Concrete shall be removed if thickness >20 mm below specified thickness.		**Conformance for thickness**
- Mixing and transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within:		**Mixing and transport methods**
	- One and a half hours where transported by truck mixer or agitator. - One hour where transported by non agitating trucks.		
- Placing	Concrete shall not be placed when the air temperature in the shade is less than 5°C or >35°C. Temperature of concrete shall be >10°C but <32°C.		**Placing and finishing concrete subbase**
	Concrete shall not be placed when the Rate of Evaporation exceeds 0.5 kg per square metre per hour.		**Rate of evaporation**
Alignment and surface tolerances			
- Horizontal alignment	Outer edges not to deviate from plan position by more than ±25 mm.		**Alignment and surface tolerances**
- Surface	- Level on top surface to be no more than +0 mm or -20 mm to that shown on the drawings. - The top surface shall not deviate from a 3 m straightedge laid in any direction by more than 5 mm.		**Alignment and surface tolerances**
Joints			

Activity	Limits/Tolerances	Worksection Clause Reference
- Transverse construction	Shall not deviate from a 3 m straight-edge placed along the joint by more than 10 mm.	**Transverse construction joints**
- Longitudinal joint	- Shall not deviate from the plan or nominated position at any point by more than 20 mm. - Shall not deviate from a 3 m straightedge placed along the joint by more than 10 mm after allowing for any curvature.	**Longitudinal construction joints**
Bond breaker		
- Wax emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	**Application of bond breaker**

14 MEASUREMENT AND PAYMENT

14.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed under this worksection in accordance with Pay Items 1132.1 to 1132.5 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced. The cost of all work, materials and equipment shall be included in the schedule rate for each Pay Item. Concrete and steel reinforcement for subgrade beams is measured and paid in accordance with this worksection and not 0291 *Minor concrete work* and 1133 *Plain and reinforced concrete base*. Base slab anchors are measured and paid in accordance with 1133 *Plain and reinforced concrete base*.

14.2 PAY ITEMS

1132.1 Supply and place concrete in subbase

The unit of measurement shall be the cubic metre in place.

The width and length shall be as specified on the Drawings or as directed by the Superintendent.

The depths shall be the depths specified or as directed by the Superintendent across each section.

No account shall be taken of the allowable tolerances.

The cost of providing transverse construction joints and longitudinal construction joints shall be included in the schedule rate for this Pay Item.

1132.2 Finish and cure subbase

The unit of measurement shall be the square metre of subbase.

The width and length shall be taken as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowance tolerances.

The sides of slabs shall not be included in the measurement of surface area.

1132.3 Crack treatment by stress alleviating membrane strip (for asphalt bases)

The unit of measurement shall be the linear metre.

The quantity is a provisional quantity. The actual lengths shall be measured on site.

The rate shall include supply and installation of the Stress Alleviating Membrane strip.

1132.4 Bond breaker

The unit of measurement shall be the square metre.

The area shall be determined by multiplying the actual length with design width as shown on the Drawings. No account shall be taken of tolerances.

1132.5 Subgrade beams

The unit of measurement shall be the cubic metre.

The volume shall be determined by multiplying the width, length and depth as specified on the Drawings or as directed by the Superintendent.

The rate shall include all activities and materials to complete the subgrade beams as shown on the Drawings.

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1133 PLAIN AND REINFORCED CONCRETE BASE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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.

The work also includes the construction of reinforced concrete approach slabs at bridge abutments and traffic signal approach slabs where specified on the Drawings.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 THICKNESS AND LEVELS OF BASE

The base thickness and levels shall be shown on the Drawings.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

1121 Open drains, including kerb and channel (gutter)

1132 Mass concrete subbase

1172 Subsoil and fountain drains

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling of fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.4.2	Determination of air content of freshly mixed concrete—Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1	Method for making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.12.2	Determination of mass per unit volume of hardened concrete—Water displacement method
AS 1012.13	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
AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.14	Particle shape, by proportional calliper
AS 1141.18	Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Wet/dry strength variation
AS 1141.24	Aggregate soundness—Evaluation by exposure to sodium sulfate solution
AS 1160	Bituminous emulsions for the construction and maintenance of pavements

AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulfate content of a natural soil and the sulfate content of the groundwater—Normal method
AS 1379	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	Determination of chloride ion content
AS 3799	Liquid membrane—forming curing compounds for concrete
AS 3972	Portland and blended cements
AS/NZS 1554	Structural steel welding
AS/NZS 1554.3	Welding of reinforcing steel
AS/NZS 4671	Steel reinforcing materials

Other publications

NSW 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
T 1192	Adhesion of sealant
T 1193	Accelerated Ageing of cured sealant
T 240	Test Method—Average texture depth

ASTM Standards

D792	Standard test methods for density and specific gravity (relative density) of plastics by displacement
C793	Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
C794	Standard test method for adhesion-in-peel of elastomeric joint sealants
D2240	Standard test method for rubber property-durometer hardness
D2628	Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements
D2835	Standard specification for lubricant for installation of preformed compression seal in concrete pavements

US Military Specifications

SAE AMS-S-8802 Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion

2 MATERIALS FOR CONCRETE

2.1 CEMENT

NSW QA scheme

Cement shall be Type GP Portland cement complying with AS 3972.

Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

Nominated brand and source
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes** the Contractor shall nominate the brand and source of the cement.

The Contractor shall use only the nominated cement in the work.

Proof of quality

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.

Storage time
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.

The cost of re-testing the cement shall be borne by the Contractor and results of the testing forwarded to the Superintendent prior to incorporation of cement into the works.

Transport and storage
Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

2.2 FLYASH

NSW QA scheme
Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and quality of flyash shall comply with AS 3582.1.

Source
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the powerhouse source of the flyash.

The Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence
Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent at time of submission of nominated mix design.

2.3 WATER

Water used in the production of concrete shall be potable, free from oils and materials harmful to concrete or reinforcement, and be neither salty nor brackish.

Water used in the production of concrete shall contain:

- less than 600 ppm of chloride ion, determined by AS 3583.13; and;
- less than 400 ppm of sulphate ion, determined by AS 1289.4.2.1.

2.4 ADMIXTURES

Quality and use
Chemical admixtures and their use shall comply with AS 1478.1.

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 **Air content (Quality requirements of concrete)**.

Excess air content
Fresh concrete with an air content not complying with **Air content (Quality requirements of concrete)** shall be rejected.

Retarder for warm season
During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) approved by the Superintendent shall be used to control slump within the limits stated in **Consistency**.

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 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with **Design and control of concrete mixes**.

Retarder for cool season

During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 % reducing sugars (Type WRRe complying with AS 1478.1) 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 **Check of mix by statistical analysis of test specimens**.

Source and type

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the proprietary source, dose concentration, type and name for each admixture to be used.

Documentary evidence of the quality shall be furnished in conjunction with any health and safety regulations concerning the products by the Contractor to the Superintendent upon request at any stage of the work.

2.5 AGGREGATES

General

Quartz sand content: At least 40 % 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 % quartz, by mass.

Where present, chert fragments will be regarded as 'quartz' for the purpose of this worksection, but the ratio of chert to quartz shall not exceed unity.

Source and type: When submitting details of the nominated mix in accordance with Clause 5.1, 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.

Fine aggregate

Quality: 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 %), 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 2.1.

Table 2.1 Sodium sulphate soundless limits

Australian Standard Sieve	% Loss by Mass
4.75 mm to 2.36 mm	4
2.36 mm to 1.18 mm	6
1.18 mm to 600μm	8
600 μm to 300μm	12

Blending: In the case of a blend of two or more fine aggregates, the above limits shall apply to each constituent material.

Grading: The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table 2.2.

Proposed grading: 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 fine aggregate grading'.

Test for each constituent: 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.

Grading deviation: 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 2.2.

Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in **Table 2.2**.

Table 2.2 Fine aggregate grading

Australian Standard sieve	Proportion Passing (% of mass of sample)	Deviation from proposed grading (% of mass of sample)
9.50 mm	100	
4.75 mm	90–100	± 3
2.36 mm	65–95	± 10
1.18 mm	40–80	± 10
600 μm	24–52	± 10
300 μm	8–25	± 5
150 μm	1–8	± 2
75 μm	0–3	

Coarse aggregate

Quality: 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 %), 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 Worksection.

If required, coarse aggregate shall be washed to satisfy these requirements.

Coarse aggregates shall comply with **Table 2.4**.

Grading: The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in **Table 2.3**.

Proposed grading: 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 coarse aggregate grading'.

Test for each constituent: 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.

Grading deviation: 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 2.3**.

Notwithstanding these tolerances, the coarse aggregate used in the work shall comply with the limits shown in **Table 2.3**.

Table 2.3 Coarse aggregate grading

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	(accepted design mix)	± 5
9.50 mm	25–55	± 5
4.75 mm	0–10	± 3
2.36 mm	0–2	

Table 2.4 Coarse aggregate properties

Property	Specification Limits	Method
Wet strength	≥ 80 kN	AS 1141.22
Wet/dry strength variation	≤ 35%	AS 1141.22
Soundness—loss in mass	≤ 9.0%	AS 1141.24
Misshapen particles (2:1 ratio)	≤ 35%	AS 1141.14

Property	Specification Limits	Method
Fractured faces (two or more)	≥ 80%	AS 1141.18

Additional tests

The coarse aggregate shall also conform to the following requirements:

- Wet Strength—AS 1141.22. Shall not be less than 80 kN for any fraction and/or constituent.
- 10 % Fines Wet/Dry Variation—AS 1141.22. Shall not exceed 35 % for any fraction and/or constituent.
- Soundness—AS 1141.24. The loss in mass when tested with sodium sulphate shall not exceed 9 % for any constituent.
- Particle Shape—AS 1141.14. The proportion of misshapen particles (2:1 ratio) shall not exceed 35 %.
- Fractured Faces—AS 1141.18. At least 80 % by mass of the particles shall have two or more fractured faces.

Storage

Storage and handling facilities: Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

Area surrounding the storage facilities and mixing plant : 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.

3 QUALITY REQUIREMENTS OF CONCRETE

3.1 CEMENT AND FLYASH CONTENT

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.

3.2 COMPRESSIVE STRENGTH

The compressive strength of concrete shall be determined in accordance with AS 1012.9.

The minimum compressive strength at twenty-eight days shall be 36 MPa.

3.3 SHRINKAGE

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 % of the median of the three readings obtained in accordance with AS 1012.13.

3.4 CONSISTENCY

The Contractor’s nominated slump, determined in accordance with AS 1012.3.1, shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.

3.5 AIR CONTENT

The air content of the concrete, determined in accordance with AS 1012.4.2, shall be neither less than 4 % nor more than 7 %, when discharged from the transport vehicle ready for placement.

4 STEEL REINFORCEMENT

4.1 MATERIAL

Standards
Steel reinforcement shall comply with AS/NZS 4671.

Type and size
The type and size of bars shall be as shown on the Drawings.

Cleanliness
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.

Documentary evidence
The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS 4671.

Test certificates shall show the results of mechanical tests and chemical analysis.

Material not identified with a test certificate
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.

Bar chairs
Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for one hour at 23 ±5°C without malfunction.

The Contractor shall demonstrate that the proposed chairs conform with these requirements.

4.2 BENDING

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.

Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

Bars bent by any method shall not be straightened and incorporated within the works.

4.3 BAR SPLICING

Lengths indicated on drawings
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.

Plan lengths
The length of lapped splices not shown on the Drawings shall be as follows for unhooked bars:

- Plain bars, Grade 250 - 40 bar diameters
- Deformed bars, Grade 400 - 35 bar diameters
- Hard-drawn wire - 50 bar diameters

Splice dimensions
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.

Welded splices
In welded splices, bars shall only be welded by an approved electrical method. Grade 400 deformed bars shall not be welded.

Welding shall comply with AS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

4.4 PROTECTION OF REINFORCEMENT DURING STORAGE

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.

4.5 PLACING AND COVER REQUIREMENTS

Position

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 1.0 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.

Tack welding

Tack welding instead of wire ties may be used on reinforcing steel. Cold-worked reinforcing bars shall not be tack welded.

Order of placement

Longitudinal steel shall be placed upon transverse steel.

Longitudinal steel shall have a minimum top cover of 70 ±10 mm unless otherwise shown on the Drawing.

Bar cover

The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the Drawings.

Tie bars

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 % of the yield strength of the bar in tension.

Approval

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.

The inspection of reinforcement shall constitute a **Hold Point**.

Superintendent inspection and approval of reinforcement placing and fastening is required prior to release of **Hold Point**.

5 DESIGN AND CONTROL OF CONCRETE MIXES

5.1 GENERAL

Nominated mixes for approval

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’.

This action constitutes a **Hold Point**.

Superintendent inspection and approval is required prior to release of **Hold Point**.

Certified test results
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 worksection.

All phases of any particular test must be performed at one laboratory.

All relevant test results shall accompany the Certificate.

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.

Compressive strength
The compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS 1012.9.

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. The compressive strength for 28 days shall not be less than 36 MPa.

Submission of details
These details shall be submitted at least 21 days before using the nominated mix in the work.

5.2 CHECK OF MIX BY STATISTICAL ANALYSIS OF TEST SPECIMENS

Mix adjustment
In order to determine any need for mix adjustment throughout the progress of the work, the Contractor shall carry out a statistical check of the compressive strength of concrete, using consecutive 28 day test results representing concrete placed in the work for each approved mix used. Such checking shall be carried out for each 1000 m^3 of concrete placed.

Test results analysis
Test results shall be analysed on the basis of groups of consecutive pairs of specimens, and the results submitted to the Superintendent within five weeks of the last pour included in the analysis.

Mix acceptance
The concrete mix and its method of production shall be considered satisfactory if the following requirements are met:

- The average compressive strength of any six consecutive pairs of specimens shall not be less than the specified minimum compressive strength plus the standard deviation as determined in (b) below.
- The standard deviation of any ‘n’ consecutive pairs of specimens shall not exceed 3.0 MPa where ‘n’ shall not be less than 30.

Modification
Should any of the above compressive strength conditions not be met, the Contractor shall modify the mix and/or improve the method of production of concrete.

Concrete to meet all requirements of specification
Compliance with the requirements of **Design and control of concrete mixes** shall not affect the Contractor’s obligations to produce concrete which satisfies all requirements of the worksection.

5.3 VARIATIONS TO APPROVED MIXES

Approval for mix variation
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.

Revised nominated mix and materials
Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with **Design and control of concrete mixes**.

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% by mass for each other constituent, except admixtures, per yielded cubic metre of concrete the Superintendent may approve changes once without new trials being carried out.

Minimum cement and maximum flyash
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.

6 CONCRETE STRENGTH, COMPACTION AND THICKNESS

6.1 CONCRETE CYLINDERS

Test specimens

Compressive strength: Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8.1.

Moulds and laboratory: 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.

Test results: Copies of test results shall be forwarded to the Superintendent within 24 hours of receipt by Contractor.

Sampling: 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.

Curing: The method of making and curing specimens shall be in accordance with AS 1012.8.1 with compaction by internal vibration.

Marking: The Contractor shall mark the specimens for identification purposes at the time of sample casting.

Cost of testing: The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.

Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

- For the determination of the compressive strength at twenty-eight days: For each lot of up to 50/m^3 of concrete placed at the one time—One pair of specimens
- For the determination of the compressive strength at seven days: For each lot of up to 50/m^3 of concrete placed at the one time—One pair of specimens
- For the determination of compressive strength for any early testing as deemed necessary by the Contractor: For each lot of up to 50/m^3 of concrete placed at the one time—One pair of specimens.

Lot size

A lot is defined as a continuous pour of up to 50/m^3 of concrete placed.

Inspection, capping and crushing of specimens

Laboratory: Specimens required by this Specification shall be tested at the NATA registered laboratory nominated by the Contractor.

Cost of testing: The cost of such testing shall be borne by the Contractor.

Standards: Specimens shall be inspected, capped and crushed in accordance with AS 1012.9.

Mass unit volume: Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS 1012.12.2, so that the relative compaction of cores taken from the same lot of concrete base can be determined.

6.2 COMPRESSIVE STRENGTH OF CONCRETE

Determination of strength

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 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

Adjustment of test compressive strength for age of specimen

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 6.1.

For intermediate ages the factor shall be determined by interpolation.

Table 6.1 Concrete age conversion factors

Age of Specimen at time of test (days)	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

Conformance for compressive strength

Limits: If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Deductions for below specified strength: Concrete with a 28 day strength between 33 MPa and 36 MPa may be accepted providing such concrete shall be subject to a deduction for supply and place concrete in base, in accordance with **Measurement and payment** provided that such concrete represents isolated sections which comprise less than 5 % of the area of the lot.

Non-conformance: 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.

Additional cylinders: If the Contractor considers that coring will be required to verify the conformity of any lot then arrangements shall be made at the trial batch stage to have sufficient cylinders to extend the compressive strength gain graph from 28 days to at least 72 days as required by **Cement and flyash content**.

The Superintendent may use these results to calculate the equivalent 28 day compressive strength of the cores taken.

Superintendent's absolute discretion: After testing for compressive strength of cores, where required, the Superintendent shall consider the test results and shall, with absolute discretion, determine the compressive strength of the concrete to be either:

- The average of the 28 day compressive strength of the pair of specimens moulded at the time of placing; or
- The equivalent 28 day compressive strength of the core.

Lot size: 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.

6.3 CONFORMANCE FOR THICKNESS

Thickness measurement

Thickness measurements of the concrete base shall be determined by survey from the level difference between the base and the subbase surface models on a 5 m grid.

In special circumstances the Superintendent may authorise coring and measurements at the edges.

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 5 mm.

Under thickness

More than 10 mm below: Base which is more than 10 mm below the specified thickness shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

10 mm or less below:

Base which is 10 mm or less below the specified thickness may be accepted providing that it represents isolated sections within a lot and such sections comprise less than 5 % of the area of the lot. Such concrete shall be subject to a deduction in accordance with **Measurement and payment**.

Excess thickness. Where the thickness of the base exceeds the specified thickness, conformance of the base is dependent on strength, in accordance with **Compressive strength of concrete.**

6.4 RELATIVE COMPACTION OF CONCRETE

Test specimens

Cores: 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:

- 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.
- The nominal diameter of the cores shall not be less than 75 mm.

Location of cores: 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 Worksection.

Cores shall be marked for identification.

Storage: 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.

Temperature control: 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.

Frequency of coring

Minimum frequency: The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with **Concrete cylinders**.

Hand placed concrete: 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.

Repair of core holes

Restore all core holes: 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.

Surface condition: The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

Guarantee: The Contractor shall guarantee the integrity of the core for a period of 6 months after the completion of works and passage by traffic. The Contractor shall make good any core sites damaged by traffic within the warranty period.

Cost of core restoration: The cost of core restoration or reparation shall be borne by the Contractor.

Testing of cores for compaction

Curing: 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.

Relative compaction: 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 1012.12.2.

Cost of obtaining, curing and testing: All costs associated with obtaining, curing and testing of cores shall be borne by the Contractor.

Conformance for compaction

Rejection percentage: If the relative compaction is less than 97 %, the lot represented by the core shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Core preparation: 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.

Adjustment for age: The test strength shall be adjusted for age at test in accordance with **Compressive strength of concrete** and for length/diameter ratio by multiplying by the correction factor in **Table 6.2**.

Core compressive strength: If the 28 day compressive strength of the core is less than 33 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Table 6.2 Correction factors

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

7 PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

7.1 PRODUCTION AND HANDLING OF CONCRETE

Approval of methods

At least four weeks before commencing work under this worksection, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials and mixtures for concrete, details of proposed mixers and methods of agitation, mixing and transport.

Handling and batching methods – AS 1379 and additional requirements

The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:-

- 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.
- Cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first.
- 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.

Mixers and agitation methods

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.

7.2 MIXING AND TRANSPORT – AS 1379 AND ADDITIONAL REQUIREMENTS

Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:

- The mixer shall be charged in accordance with the manufacturer’s instructions.

- 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 % and 85 % along the length of the tray.
- 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.
- Admixtures shall be separately prediluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs.
- Where a continuous type mixer is employed, the plant shall not be run so as to produce at a rate greater than the manufacturer's rated capacity at any time. The Superintendent may require that the production rate be reduced if the quality of the concrete produced indicates a longer mixing time is required. Product from continuous type mixers must conform to the requirements of uniformity as detailed for batch mixers.
- 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.
- The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 % of the gross volume of the drum of the mixer.

7.3 MIXING TIME

Minimum time

Minimum mixing time will be as determined for the approved mix and verified when the trial concrete base is constructed.

Batch in mixer

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.

Long delays

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.

7.4 CONSISTENCY

Tolerances

At all times between mixing and discharge, the slump shall be within 10 mm of the Contractor's nominated slump for the nominated mix for mechanically placed concrete and within 15 mm thereof for hand placed concrete.

Test method

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1. The test shall be made on concrete samples obtained in accordance with AS 1012.1.

Timing of testing

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.

Cost of consistency testing

The cost of consistency testing shall be borne by the Contractor.

8 PLACING AND FINISHING CONCRETE BASE

8.1 GENERAL

Quality plan submission

At least four weeks before commencing work under this worksection, the Contractor shall submit as part of the Quality Plan, 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.

Notice of intention to commence construction of work section

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 **Trial concrete base**.

Subbase condition

The subbase surface shall be clean and free of loose or foreign matter and prepared in accordance with 1132 *Mass concrete subbase*.

Air temperature

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

Concrete temperature

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.

Slab anchors

Where required, slab anchors shall be constructed prior to construction of the base.

8.2 RATE OF EVAPORATION

Evaporation limit

When the value of Rate of Evaporation, determined from the graph in Figure 8.1, exceeds 0.50 kg/m^2/hr 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 kg/m^2/hr.

Use of evaporation retarder

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.

Documentation specifying type, rate of application and manufacturer's instructions shall be submitted to the Superintendent for approval prior to application.

Prevention of excessive moisture loss

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.

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.

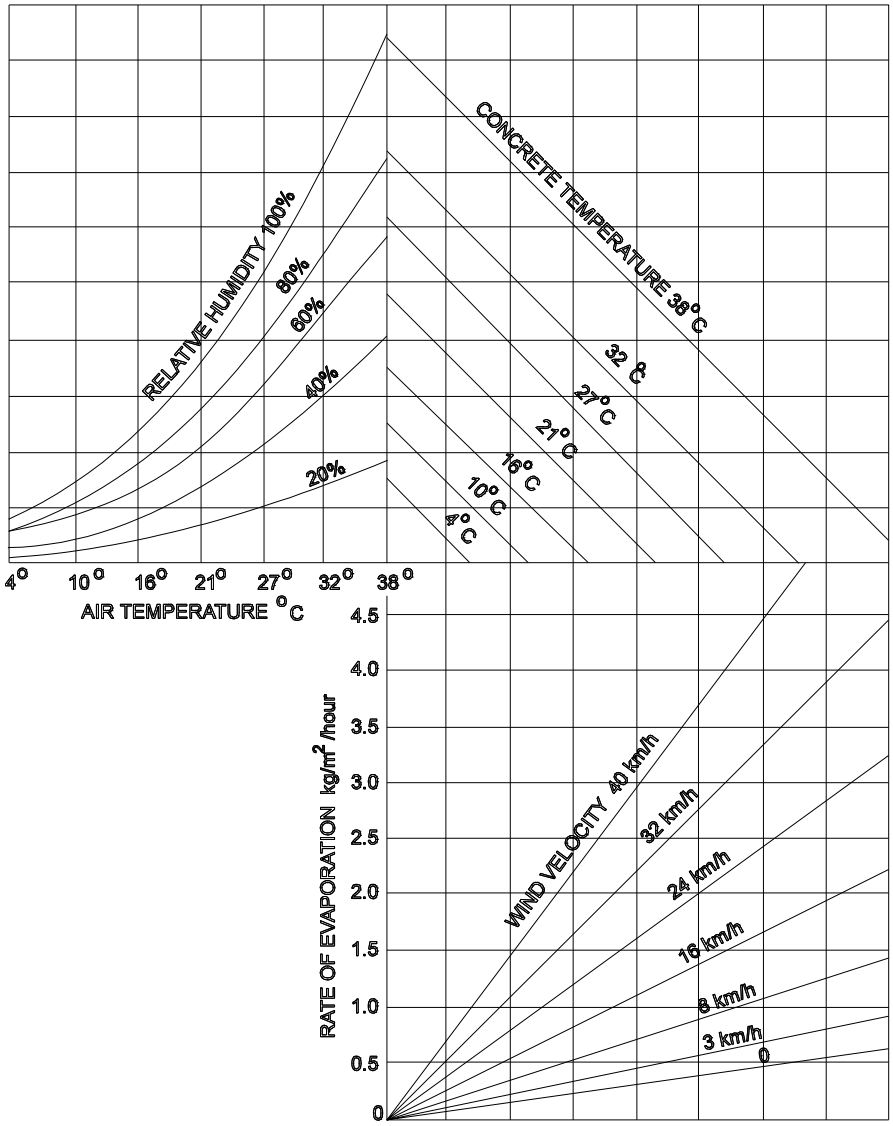

Figure 8.1 Rate of evaporation

8.3 MECHANICAL PAVING

Paving machine

The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes/ 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.
- Internal vibrators capable of compacting the full depth of the concrete.
- Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

Concrete finish

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 **Texturing of surface**

Supporting surface

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.

Continuity of paving operation

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.

Interruption to paving

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 **Transverse construction joints**.

Non-monolithic concrete

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 **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

8.4 HAND PLACING

Restriction

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.

Formwork

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.

Placing in forms

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.

Disruption to paving

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.

Concrete finish

A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with **Texturing of surface**.

Transverse construction joint

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 **Transverse construction joints**.

Non-Monolithic Concrete

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 **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

8.5 ALIGNMENT AND SURFACE TOLERANCES

Horizontal alignment tolerance

Outer edge: 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.

Longitudinal joint line: Where an edge of a slab is to form a longitudinal joint line the allowable horizontal alignment tolerances shall comply with **Longitudinal isolation joints**.

Tolerances and rideability

Top of base level: The tolerance on thickness of the base shall be zero below the specified thickness and in accordance with **Conformance for thickness** for excess thickness.

Surface level: The top surface of the base shall also not deviate at any measurement from a 3 m straightedge, laid in any direction, by more than 5 mm.

Measurements for conformance shall be taken in accordance with the maximum lot size and minimum test frequencies in 016 *Quality (Construction)*.

Notwithstanding this requirement, the surface shall not pond water.

Tolerance: The level at any point on the base shall not deviate from those dimensions on the drawings by more than +10 mm or -0 mm.

Ponding: Notwithstanding the above clauses, the surface shall not pond water.

8.6 TEXTURING OF SURFACE

Transverse texture

As soon as possible after placing, the surface of the freshly placed concrete shall be transversely textured by means of a mechanical device for grooving plastic concrete.

The texturing equipment shall utilise rectangular-shaped tynes of flat spring steel, approximately 0.6 mm thick. The width of the tynes shall be 3 mm. The tynes shall be spaced in a random pattern.

Depth

The average texture depth shall be between 0.30 mm and 0.65 mm when tested in accordance with Test Method T240. This corresponds to an individual groove depth of 1.5 mm to 3 mm.

Machine texture

For paving widths exceeding 2.5 m the texturing shall be carried out by means of a machine spanning the concrete slab and guided, with regard to both level and direction, by the rails in the case of side-form construction or by the paver guide wires in the case of slip form construction.

Texturing combs

The width of the texturing brushes or combs shall be at least 750 mm. Provision shall be made for downward adjustment to compensate for wear.

Submission equipment details and methods of texturing

The Contractor shall submit to the Superintendent details of the proposed texturing device and demonstrate the method proposed to achieve the required texture. Before texturing commences, the texturing equipment and the method of texturing shall be approved by the Superintendent.

Saw grooves

Areas with an average texture depth, determined by Test Method T240, or less than 0.3 mm shall be transversely saw grooved to meet the average texture depth requirements of 0.3 mm to 0.65 mm. Saw grooves shall be of the following approximate dimensions: 3 mm wide, 3 mm deep, at random spacing approved by the Superintendent and having a mean spacing neither less than 10 mm nor more than 21 mm.

Alternative

Where the Superintendent directs or where an asphalt surfacing is specified over the concrete base, texturing of the contract surface may be effected by use of a fine broom or hessian-drag.

8.7 CURING

Compounds

The base shall be cured by the use of one of the following:

- 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
- White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or
- Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.

Efficiency index

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 % when tested in accordance with Appendix B of AS 3799.

Application method

Application of the curing compound using a fine spray shall be as follows:

- For transversely tuned surfaces—in two applications. The first application shall be applied immediately following texturing and the second application shall be applied fifteen to thirty minutes later. Each application shall be at the rate stated on the certificate of compliance or at 0.2 litres /m^2, whichever rate is the greater.
- For hessian-dragged surface—immediately following texturing at the rate stated on the Certificate of Compliance or at 0.2 litres/m^2, which rate is the greater.

  Bitumen emulsion shall be applied at a minimum rate of 0.5 litres/m^2.
- The curing compound shall be applied by a mechanical sprayer, spraying transversely or longitudinally, having a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.

  The sprayer shall incorporate a device for continuous agitation and mixing of the compound in its container during spraying. After shut-off of the spray nozzles, there shall be no dripping of the curing compound on the concrete surface.

Application time

Curing compound shall be applied immediately after the surface is free of bleed water, or when directed by the Superintendent.

Application rate

The application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound falling on three felt maters, each approximately 0.25/m^2 in area, placed as directed by the Superintendent.

Hand spraying

For the sides of formed slabs and for small areas where a mechanical means of distribution cannot be used, the compound shall be sprayed by hand lance at a rate 25 % higher than that used on the main base.

Curing membrane

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.

The cost of making good such damaged curing membrane shall be borne by the Contractor.

Equipment on site

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

Plant unavailable

If the mechanical sprayer becomes inoperable, concrete paving by mechanical means shall cease and shall not recommence until the mechanical sprayer becomes fully operable again.

Any uncovered areas shall be sprayed with suitable hand operated equipment.

8.8 PROTECTION OF WORK

Temperature control

The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first 24 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 worksection, the concrete shall be rejected.

Rain protection

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.

Traffic restrictions

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 20 MPa.

Traffic management required to effect the traffic restrictions shall comply at a minimum with 1101 *Control of traffic*.

The Superintendent may direct the Contractor to provide Traffic Management either pedestrian or vehicular in excess of that specified if such measures are warranted due to site specific requirements.

The costs associated with Traffic Management and Safety shall be borne by the Contractor.

8.9 ODD-SHAPED AND MISMATCHED SLABS

Definition

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.

Joint criteria

Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

Reinforcing fabric

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.

8.10 TERMINAL SLABS

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.

8.11 TRIAL CONCRETE BASE

Location

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 this worksection.

This section shall be constructed so that it may be incorporated in the finished work.

Purpose

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.

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.

Dimensions

A trial length of between 100 m and 200 m, or lesser length as approved by the Superintendent, for mechanical paving equipment or between 20 m and 50 m for hand placement is required.

The maximum width proposed to be laid, shall be constructed in one continuous operation.

Deficiencies in trial section

Unless advised by the Superintendent of any deficiencies in the trial concrete base, due to failure to comply with this worksection, 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.

New trial section

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 worksection.

Delays due to trial pavement

Any costs incurred by delays as a result of construction of trial pavement are to be borne by the Contractor.

Payment

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 worksection, shall be rejected by the Superintendent and shall be removed by the Contractor in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

9 JOINTS

9.1 LOCATION

Joints shall be provided at locations indicated on the Drawings or as approved by the Superintendent.

9.2 TRANSVERSE CONSTRUCTION JOINTS

Location

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 **Steel reinforcement**.
- be smooth across the joint before texturing.
- not deviate from a 3 m straightedge placed along the joint by more than 10 mm.

Remove laitance prior to placing adjoining concrete

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.

9.3 TRANSVERSE CONTRACTION JOINTS

Sawcut and plastic joint inducing systems

Transverse contraction joints shall be continuous across the full width of the base and shall be sawn unless otherwise approved by the Superintendent.

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.

Normal and skewed joints

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.

Sawcutting

Sequence: Joints shall be sawn by a two-cut operation comprising an initial 3 mm wide cut and a widening saw cut.

Timing and equipment: The Contractor shall ensure that sawcutting be conducted between 6 hours and 24 hours after initial paving so as not to cause excessive ravelling of aggregate adjacent to the cut and 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.

Tolerances: 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.

Ravelling: 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.

Rejected sawcuts: Sawcuts, which do not conform to the documented requirements, shall be rejected by the Superintendent. Rejected sawcuts may be repaired by a method approved by the Superintendent.

Cleaning of sawcut

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.

Temporary sealing

Material: 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.

Tolerance: 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.

Maintenance: 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.

PVC Spline and preliminary sealant

Immediately after cleaning the initial saw cut, a continuous UV-stabilised PVC spline 5 ± 1 mm in diameter shall be installed at the top of the saw cut, passing under any sealant inserted in longitudinal sawn joints.

The maximum increase in length of a preliminary sealant after installation shall be 10 % of the original length.

Permanent sealing

Within ten days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint.

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 width limitations, parameters and the method of installation recommended by its manufacturer.

Neoprene compression sealants

Standards: Neoprene compression sealants shall comply with all the requirements of ASTM D2628. Test methods used to determine compliance with these requirements shall include Test Methods T1160, T1161 and T1163.

Certification of compliance: 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 D2628.

Installation: 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 D2835.

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 % of original length.

Any sealant exceeding 5 % extension shall be rejected.

The sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle.

Tolerances: 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.

The Contractor shall supply documentation to the Superintendent ensuring compatibility in width and depth between the compression seal and the formed or saw cut joints incorporated within works 21 days prior to installation.

Silicone sealants

Specification: Silicone sealants shall be formed using a silicone joint sealant complying with Table 9.1.

Certificate of compliance

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 9.1**.

Table 9.1 Silicone joint sealant requirements

Test Method	Test	Requirements
ASTM-D792	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 D2240	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
N.A.	Colour	Grey, Compatible with pavement concrete

Installation: 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.

Action before sealing: 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.

If the backer rod is damaged in any way it shall be replaced for the full length of the joint.

Manufacturer information shall be supplied to the Superintendent by the Contractor to ensure compatible fit and of the appurtenance with designed joint dimensions 21 days prior to installation.

Approval of method: 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 worksection.

Treatment prior to asphalt overlay

Where asphaltic surfacing over the concrete base is specified only the initial 3 mm wide saw cut shall be provided and filled with silicone joint sealant in accordance with this worksection.

9.4 TRANSVERSE ISOLATION JOINTS

Location

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.

Construction

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.

Spacing

Transverse isolation joints shall not be placed closer than 2 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.

Standards

Joint filler shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent and the joint sealant shall comply with the silicone sealant requirements of **Transverse contraction joints**.

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.

Tolerance

The line of the isolation joint shall not deviate from a 3 m straightedge more than 10 mm.

9.5 LONGITUDINAL TIED JOINTS

General

Location: 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.

Method: Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.

Ties: The ties shall be 12 mm diameter deformed steel bars Grade 400Y, 1 m long and shall be inserted in accordance with **Placing and cover requirements**.

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 % of the yield strength of the bar.

Tolerances: 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.

Corrugated joint face: Where the longitudinal tied joint is formed or slipformed, the joint face shall be corrugated in accordance with the details shown on the Drawings.

Isolation joint: 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 **Longitudinal isolation joints**.

Asphalt surface: Where an asphalt surfacing is specified or directed to be provided by the Superintendent, the longitudinal tied joints shall comply with this Clause.

Sawn-induced joints

Location: Sawn longitudinal tied joints shall be provided to the dimensions shown on the Drawings.

Sawcutting: Sawcutting shall comply with **Transverse contraction joints**.

Sealant quality: Within 24 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.

Sealant insertion: 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 % of the original length, otherwise the sealant shall be rejected.

Joints in sealant: 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.

Ribbon-induced joints

Location and insertion: 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.

Finish: 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.

Joints in ribbon: 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 joint 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.

Treatment of sawn longitudinal tied joints prior to asphalt overlay

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.

9.6 LONGITUDINAL JOINT WITH KERB AND/OR GUTTER

Form

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.

Tie Bars

Where constructed separately, they shall be tied to the concrete base by 12 mm diameter deformed steel tie bars Grade 250S or 400Y, 1000 mm long at 1 m centres.

Location

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 **Placing and cover requirements**.

Face of joint

The face of the longitudinal joint need not be scabbled and the joint need not be sealed.

Tolerances

The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with **Longitudinal tied joints**

Kerb and/or channel (gutter)

The construction of kerb and/or gutter shall be in accordance with 1121 *Open drains, including kerb and channel (gutter)* regardless of method of construction except that the strength of the concrete used in the kerb and/or gutter shall be greater than 36 MPa.

9.7 LONGITUDINAL ISOLATION JOINTS

Location

Longitudinal isolation joints shall be provided where shown on the Drawings and where directed by the Superintendent.

Tolerances

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.

Filler and sealant

The joint filler shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent and the joint sealant shall comply with the silicone sealant requirements of **Transverse contraction joints**.

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.

10 SLAB ANCHORS

10.1 LOCATION

Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the Drawings.

Slab anchors shall extend over the full width of the base and the associated transverse expansion joint shall not be placed closer than 2 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.

10.2 EXCAVATION

Dimensions

Excavation of trenches for slab anchors shall be to the dimensions and details shown on the Drawings.

Trim and consolidate

All loose material shall be removed and the vertical faces trimmed to neat lines.

The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material.

Spoil

The Contractor shall dispose of excavated material at locations approved by the Superintendent.

Adjacent to flexible pavement

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.

The cost of making good any disturbance or damage to the flexible pavement shall be borne by the Contractor.

Sub-soil drains

A subsoil drain shall be provided at the bottom of the trench, in accordance with 1172 *Subsoil and fountain drains*.

10.3 CONSTRUCTION

Method as per hand-place base concrete

Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand-placed base concrete.

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.

Transverse isolation joint

A transverse isolation joint shall be provided on the downhill side of the slab anchor.

Steel reinforcement

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 **Steel reinforcement**.

Bridge approach slabs

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.

11 REMOVAL AND REPLACEMENT OF BASE

11.1 GENERAL

Replacement method

Where directed by the Superintendent, rejected base shall be removed and replaced.

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.

Approval of method

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.

Cost of works

The cost of all work and materials for removal and replacement of base shall be borne by the Contractor.

11.2 REMOVAL AND DISPOSAL OF BASE

Full depth transverse sawcut

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.

Longitudinal sawcuts

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.

Oversawing

No oversawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base.

Disposal

The Contractor shall legally dispose of the removed base slabs at locations acceptable to the Superintendent.

Further damage

Any slab, adjoining the removed slabs, damaged by the Contractor's operations shall also be removed and replaced.

11.3 REPLACEMENT OF BASE

Subbase preparation

Before construction of the replacement base, the subbase shall be prepared and debonded in accordance with 1132 *Mass concrete subbase*.

Compliance with this worksection and following additional requirements

All work involved in the replacement of base shall comply with the worksection, including the following additional requirements:

- 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 **Transverse construction joints**.
- 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 **Transverse contraction joints**.
- 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 **Longitudinal tied joints**.
- 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 % of the yield strength of the bar.
- 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 10 days have elapsed since placing replacement base concrete or the concrete has reached a compressive strength of at least 20 MPa.

12 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this worksection are summarised in Table 12.1.

Table 12.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Aggregates		
General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	**Aggregates**
Fine aggregate		
- Grading	To be within the limits as per Table 2.2 and shall not deviate from Proposed Grading by more than amounts in Table 2.2	**Aggregates**
Coarse Aggregate		**Aggregates**
- Wet Strength	Not less than 80 kN for any fraction and/or constituent	
- 10% Fines wet/dry variation	Not to exceed 35% for any fraction and/or constituent	
- Soundness	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	
- Particle shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	
- Fractured faces	At least 80% by mass of the particles shall have two or more fractured faces	
Concrete quality		
- Cement content	At least 270 kg per yielded cubic metre of concrete	**Cement and flyash content**
- Flyash	Not greater than 50 kg per yielded cubic metre of concrete	**Cement and flyash content**
- Compressive Strength	The minimum 28 day compressive strength shall be 36 Mpa	**Compressive strength (Quality requirements of concrete)**
- Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	**Shrinkage**
- Slump	Nominated slump shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete. It shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.	**Consistency**
- Air content	Shall not be less than 4% nor more than 7% when	**Air content**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
	discharged from the transport vehicle ready for placement	**(Quality requirements of concrete)**
Concrete mixing and transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within:	**Mixing and transport – AS 1379 and additional requirements**
	One and a half hours where transported by truck mixer or agitator.	
	One hour where transported by non-agitating trucks.	
Concrete placing	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 10oC nor more than 32°C.	**Placing and finishing concrete base**
	Where the value of Rate of Evaporation exceeds 0.50 kg/m^2/hr, the Contractor shall cease work.	**Rate of evaporation**
Alignment and surface		
-Horizontal alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10 mm.	**Alignment and surface tolerances**
-Surface level	The level at any point on the top of the base shall not vary by more than +10 mm or –0 mm from that shown on the Drawings or as directed by the Superintendent. The top surface of the base shall not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.	**Alignment and surface tolerances**
-Surface texture	The rectangular shaped tynes for transversely texturing surface shall not be spaced less than 10 mm or more than 21 mm.	**Texturing of surface**
Concrete protection		
-Temperature	The temperature of the concrete shall not be permitted to fall below 5°C during the first 24 hours after placing.	**Protection of work**
Joints		
-Transverse construction	The line of the transverse construction joints shall not deviate from a 3 m straightedge placed along the joint by more than 10 mm.	**Transverse construction joints**
-Transverse contraction	. May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors.	**Transverse contraction joints**
	. No edge shall deviate from a 3 m straightedge by more than 10 mm.	
	. 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.	
	. Temporary Sealing—the top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface.	
	. Permanent Sealing—The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base.	
-Transverse Isolation	The line of the transverse expansion joint shall not deviate from a 3 m straight edge more than 10 mm.	**Transverse isolation joints**

Activity	Limits/Tolerances	Worksection Clause Reference
- Longitudinal tied joints	. All parts of any tie bar shall be within 50 mm of its designed position.	**Longitudinal tied joints**
	. 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.	
	. 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 5 mm nor more than 7 mm below the surface of the base.	
	. For Ribbon-Induced joints, the inducer ribbon shall be a minimum of 0.5 mm thick and when placed it shall be within 5° of the vertical plane.	
- Longitudinal isolation joints	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.	**Longitudinal isolation joints**
- Slab anchors	Not placed closer than 2.0 m to transverse joints (other than associated transverse expansion joints).	**Location**

13 MEASUREMENT AND PAYMENT

13.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this worksection in accordance with Pay Items 1133.1 to 1133.10 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Where the 28 day compressive strength of test cylinders for any lot is less than 33 MPa, the lot represented by the test cylinders shall be removed, in which case no payment shall be made.

Where the relative compaction of the concrete is determined at less than 97 %, the lot represented by the core shall be removed, in which case no payment shall be made.

Where the concrete base thickness is more than 10 mm below the specified thickness, the concrete shall be removed, in which case no payment shall be made.

Preparation of subbase and application of bond breaker is measured and paid in accordance with 1132 *Mass concrete subbase*.

Construction of kerb and/or gutter is measured and paid in accordance with 1121 *Open drains, including kerb and channel (gutter)*.

Subsoil drains at slab anchors are measured and paid in accordance with this worksection and not 1172 *Subsoil and fountain drains*.

Site specific traffic management measures are measured and paid in accordance with 1101 *Control of traffic*.

13.2 DEDUCTIONS

Concrete with a 28 day compressive strength between 33 MPa and 36 MPa (**Compressive strength (Quality requirements of concrete)**) shall be subject to a deduction of 4 % of the applicable schedule rate for Pay Item1133.1 for the lot represented, for each 0.5 MPa or part thereof deficiency in strength.

Acceptance of this concrete is conditional on it representing isolated sections and such sections comprise less than 5 % of the area of the base.

Concrete base which is less than 10 mm below the specified thickness (Clause 3.3.2), after application of allowable tolerances for the base, may be accepted.

Such concrete shall be subject to a deduction to the schedule rate for Pay Item 1133.1, for the lot represented, of 24 % for areas with 5 mm less than the specified thickness and60 % for areas with 10 mm less than the specified thickness.

13.3 PAY ITEMS

1133.1 Supply and place concrete in base

The unit of measurement shall be the cubic metre in place

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. The depth shall be the depth specified or as directed by the Superintendent across each section.

No account shall be taken of the allowable tolerances.

The cost of providing transverse construction joints shall be included in the schedule rate for this Pay Item.

The cost of longitudinal tied joints in association with kerbs and/or gutters shall be included in the schedule rate for this Pay Item.

1133.2 Finish, cure and texture base

The unit of measurement shall be the square metre of surface of the base.

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The sides of slabs shall not be included in the measurement of surface area.

1133.3 Supply and place wire reinforcing fabric

The unit of measurement shall be the square metre of wire reinforcing fabric placed.

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. No account shall be taken of the allowable tolerances nor of any laps.

Unless otherwise indicated elsewhere, all wire reinforcing fabric shall be paid for at the schedule rate for this Pay Item.

1133.4 Supply and install steel bar reinforcement

The unit of measurement shall be the tonne of steel reinforcement.

The mass shall be determined from the unit masses given in AS/NZS 4671 and the actual length of bar measured in place. No account shall be taken of laps and splices.

Unless otherwise indicated elsewhere, all steel bar reinforcement shall be paid for at the schedule rate for this Pay Item.

The pay items excludes dowels and tie bars.

1133.5 Transverse contraction joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

1133.6 Transverse expansion and isolation joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

1133.7 Longitudinal tied joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

The pay item includes provision of tie bars.

1133.8 Longitudinal isolation joints

The unit of measurement shall be the linear metre.

The length shall be measured along the line of the joint.

The pay item includes the provision of dowels where specified or shown on the Drawings.

1133.9 Slab anchors

The unit of measurement shall be the cubic metre of concrete.

The volume shall be taken from the Drawings with appropriate adjustments being made for any authorised variation. The depth shall be measured from the top of the subbase.

The pay item includes all work, materials and equipment required for the construction of slab anchors including excavation, disposal of material, supply and placing of reinforcement and the subsoil drain.

1133.10 Bridge approach slabs

The unit of measurement shall be the cubic metre.

The width, depth and length shall be as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The pay item includes all work, materials and equipment required for the construction of a bridge approach slab, including provision of a transverse expansion joint at the bridge abutment but excluding the supply and fixing of steel which shall be paid for at the schedule rate for Pay Item 1133.4.

1134 STEEL FIBRE REINFORCED CONCRETE BASE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the supply, placing, finishing and curing of Steel Fibre Reinforced Concrete (SFRC) at locations, dimensions and levels shown on the

Drawings and in accordance with steel fibre manufacturer documentation and the provisions of the Contract.

This worksection covers SFRC concrete base and minor SFRC concrete work for pavements where alternative reinforcing has been nominated.

The worksection does not apply to large scale highway construction works.

1.2 MANUFACTURER INFORMATION

Where conflict exists between the guidelines of this worksection and steel fibre manufacturer information regarding design, manufacture, transportation, placement or curing , manufacturer guidelines shall prevail.

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.4 THICKNESS AND LEVELS OF BASE

The base thickness and levels shall be as shown on the Drawings.

1.5 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksection

0161 Quality (Construction)

1101 Control of traffic

1121 Open drains, including kerb and channel (gutter)

1132 Mass concrete subbase

1172 Subsoil and fountain drains

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling of fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.4.2	Determination of air content of freshly mixed concrete—Measuring reduction in air pressure in chamber above concrete
AS 1012.5	Determination of mass per unit volume of freshly mixed concrete
AS 1012.8.1	Method for making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.12.2	Determination of mass per unit volume of hardened concrete—Water displacement method
AS 1012.13	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
AS 1141	Methods for sampling and testing aggregates

AS 1141.4	Bulk density of aggregate
AS 1141.6.2	Particle density and water absorption of coarse aggregate—Pycnometer method
AS 1141.11	Particle size distribution by sieving
AS 1141.12	Materials finer than 75 mm in aggregates (by washing)
AS 1141.13	Material finer than 2 mm
AS 1141.14	Particle shape, by proportional calliper
AS 1141.18	Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Wet/dry strength variation
AS 1141.23	Los Angeles value
AS 1141.24	Aggregate soundness—Evaluation by exposure to sodium sulfate solution
AS 1141.32	Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS 1141.37	Iron unsoundness
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulphate content of a natural soil and the sulphate content of the groundwater—Normal method
AS 1379	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	Determination of chloride ion content
AS 3799	Liquid membrane—forming curing compounds for concrete
AS 3972	Portland and blended cements
AS/NZS 1554	Structural steel welding
AS/NZS 1554.3	Welding of reinforcing steel
AS/NZS 4671	Steel reinforcing materials

Other publications

NSW RTA Test Methods

T 1192	Adhesion of sealant
T 1193	Accelerated Ageing of cured sealant
ASTM A820	Specification for steel fibres for fibre reinforced concrete
ASTM D792	Standard test method for density and specific gravity (relative density) of plastics by displacement
ASTM C793	Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
ASTM C794	Standard test method for adhesion-in-peel of elastomeric joint sealants
ASTM D2240	Standard test method for rubber property-durometer hardness

US Military Specifications

SAE AMS-S-8802 Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion

2 MATERIALS FOR CONCRETE

2.1 CEMENT

NSW QA scheme
Cement shall be Type SL or GP Portland cement complying with AS 3972 and shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

Nominated brand and source
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes** the Contractor shall nominate the brand and source of the cement.

On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work.

Proof of quality
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.

Storage time
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.

The cost of re-testing the cement shall be borne by the Contractor and results of the testing forwarded to the Superintendent prior to incorporation of cement into the works.

Transport and storage
Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

2.2 FLYASH

NSW QA scheme
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.

Source
When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the powerhouse source of the flyash.

The Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence
Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent at time of submission of nominated mix design.

2.3 WATER

Water used in the production of concrete shall be potable, free from oils and materials harmful to concrete or reinforcement, and be neither salty nor brackish.

Water used in the production of concrete shall contain:

- less than 600 ppm of chloride ion, determined by AS 3583.13; and
- less than 400 ppm of sulphate ion, determined by AS 1289.4.2.1.

2.4 ADMIXTURES

Quality and use
Chemical admixtures and their use shall comply with AS 1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator.

Admixtures and combinations of admixtures other than those specified below shall not be used.

Air entraining
Air Entraining admixtures shall not be used in steel fibre reinforced concrete.

Retarder for warm season

During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) approved by the Superintendent shall be used to control slump within the limits stated in **Consistency**.

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 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage rate' in accordance with **Design and control of concrete mixes**.

Retarder for cool season

During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 % reducing sugars (Type WRRe complying with AS 1478.1) 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 **Design and control of concrete mixes**.

Source and type

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the proprietary source, dose concentration type and name for each admixture to be used.

Documentary evidence of the quality shall be furnished in conjunction with any health and safety regulations concerning the products by the Contractor to the Superintendent upon request at any stage of the work.

2.5 AGGREGATES

General

Quartz sand content: At least 40 % 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 % quartz, by mass. Where present, chert fragments will be regarded as 'quartz' for the purpose of this worksection, but the ratio of chert to quartz shall not exceed unity.

Coarse aggregate fraction: The Coarse Aggregate fraction shall not comprise more than 55 % of the total aggregate blend incorporated within the steel fibre reinforce concrete without endorsement from the steel fibre and concrete manufacturer.

Source and type: When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, 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.

Fine aggregate

Quality: 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 (minimum 1200 kg/m^3), water absorption (maximum 5 %), 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 2.1.

Table 2.1 Sodium sulphate soundless limits

Australian Standard sieve	% loss by mass
4.75 mm to 2.36 mm	4
2.36 mm to 1.18 mm	6
1.18 mm to 600 mm	8
600 mm to 300 mm	12

Blending: In the case of a blend of two or more fine aggregates, the above criteria shall apply to each constituent material.

Grading: The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table 2.2.

Proposed mix: 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'.

Test for each constituent: 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 documented requirements.

Grading deviation: 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 2.2.

Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table 2.2.

Table 2.2 Fine aggregate grading

Australian Standard sieve	**Proportion passing (% of mass of sample)**	**Deviation from proposed grading (% of mass of sample)**
9.50 mm	100	
4.75 mm	90–100	±3
2.36 mm	65–95	±10
1.18 mm	40–80	±10
600 mm	24–52	±10
300 mm	8–25	±5
150 mm	1–8	±2
75 mm	0–3	

Coarse aggregate

Quality: Coarse aggregate shall consist of clean, crushed, hard, durable rock. Coarse aggregate shall comply with AS 2758.1 in respect of properties listed in Table 2.3.

In all other respects, the coarse aggregate shall comply with this worksection.

If required, coarse aggregate shall be washed to satisfy these requirements.

Grading: The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table 2.3.

Proposed mix: 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 coarse grading’.

Test for each constituent: 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 documented requirements.

Grading deviation: 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 2.3.

Notwithstanding these tolerances, the coarse aggregate used in the work shall comply with the limits shown in Table 2.3.

Storage

Facilities: Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

Introduction of foreign matter: 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.

Table 2.3 Coarse aggregate grading

Property	**Requirement**	**Test Method**
Particle density	minimum 2100 kg/m3	AS 1141.6

Bulk density		minimum 1200 kg/m3		AS 1141.4
Water absorption		maximum 2.5%		AS 1141.6.2
Grading	Australian Standard Sieve	Proportion passing (% of mass of sample)	Deviation from proposed grading (% of mass of sample)	AS 1141.11
	26.50 mm 19.00 mm 13.20 mm 9.50 mm 4.75 mm 2.36 mm	100 95–100 35–80 0–25 0–10 0–2	 ±2 ±5 ±5 ±3	
Material finer than	75 µm 2 µm	≤ 2.0% ≤ 1.0%		AS 1141.12 AS 1141.13
Particle shape	2:1 ratio 3:1 ratio	≤ 35% ≤ 10%		AS 1141.14
Wet strength		≥ 80 kN		AS 1141.22
Wet/dry strength variation		≤ 35%		AS 1141.22
Los Angeles value—loss in mass		≤ 30%		AS 1141.23
Soundness—loss in mass		≤ 9.0%		AS 1141.24
Weak particles		≤ 0.3%		AS 1141.32
Iron unsoundness (slag)		≤ 1.0%		AS 1141.37
Fractured faces		≥ 80%		AS 1141.18

3 QUALITY REQUIREMENTS OF CONCRETE

3.1 STEEL FIBRE

Quality
Steel fibre shall be dry, unoxidised and free from oils or any other material deleterious to concrete or to the development strength of the steel fibre anchorage system.

Classification
Steel fibre shall comply with the respective classification of ASTM A820.

Storage
Steel fibre kept on-site shall be stored off the ground in a dry, covered environment free from potential contamination by oils, water or other deleterious substances.

Aspect ratio
Loose (non-collated) fibres with a Manufacturer's nominated aspect ratio (L:D) in excess of 50 shall not be used unless the Contractor can provide assurance to satisfy the Superintendent that uniform distribution of fibre can be achieved within the nominated mix.

Fibre mixing
Fibres shall be mixed in such a manner so as to provide an even distribution throughout the mix.

3.2 CEMENT AND FLYASH CONTENT

The minimum Portland cement content shall be of 350 kg/yielded m^3 of concrete.

The maximum flyash content shall be determined in conjunction with the joint recommendation of the concrete and steel fibre manufacturers.

3.3 COMPRESSIVE STRENGTH

The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at twenty-eight days shall be 36 MPa.

3.4 SHRINKAGE

Three shrinkage tests shall be performed upon the lesser of every 150 m^3 of concrete poured or the daily production of concrete poured.

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 ±10 mm shall be taken as the average of the readings within 5 % of the median of the readings obtained in accordance with AS 1012.13 within 30 microstrain of the median value.

3.5 AIR CONTENT

The air content of the concrete, determined in accordance with AS 1012.4.2, shall not exceed 5 % without written authorisation of the Superintendent.

Concrete possessing an air content in excess of 5 % shall be considered nonconforming material and is subject to removal and replacement at the discretion of the Superintendent.

Air entraining agent shall not be used.

4 STEEL REINFORCEMENT

4.1 MATERIAL

Standards
Steel reinforcement shall comply with AS/NZS 4671.

Type and size
The type and size of bars shall be as shown on the Drawings.

Cleanliness
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.

Documentary evidence
Upon request of the Superintendent, the Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS 4671.

Test certificates shall show the results of mechanical tests and chemical analysis. Certification and testing if necessary shall be at Contractor's cost.

Material not identified with a test certificate
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.

Bar chairs
Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for one hour at 23 ±5°C without malfunction.

The Contractor shall demonstrate that the proposed chairs conform with these requirements.

4.2 BENDING

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.

Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

Bars bent by any method shall not be straightened and incorporated within the works.

4.3 BAR SPLICING

Lengths indicated on drawings
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.

Plan lengths

The length of lapped splices not shown on the Drawings shall be as follows for unhooked bars:

- Plain bars, Grade 250 - 40 bar diameters
- Deformed bars, Grade 400 - 35 bar diameters
- Hard-drawn wire - 50 bar diameters

Splice dimensions

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.

Welded splice

In welded splices, bars shall only be welded by an approved electrical method. Grade 400 deformed bars shall not be welded.

Welding shall comply with AS/NZS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

4.4 PROTECTION OF REINFORCEMENT DURING STORAGE

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 exposures to the satisfaction of the Superintendent.

4.5 PLACING AND COVER REQUIREMENTS

Position

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 1.0 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.

Tack welding

Tack welding instead of wire ties may be used on reinforcing steel.

Cold-worked reinforcing bars shall not be tack welded.

Order of placement

Longitudinal steel shall be placed upon transverse steel. Longitudinal steel shall have a minimum top cover of 70 ±10 mm unless otherwise shown on the Drawing.

Bar cover

The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the Drawings.

Tie bars

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 % of the yield strength of the bar in tension.

Dowelled joints

For dowelled joints, dowels shall be placed parallel to the pavement surface and normal to the line of the joint, unless shown otherwise on the Drawings.

Dowels shall be installed ahead of paving by a dowel support assembly approved by the Superintendent.

One end of each dowel on the same side of each joint shall be coated for a distance of (L/2 +25 mm) with two coats of bitumen emulsion (or one coat of bitumen) and sanded to ensure free movement of the concrete base slab with temperature variations.

The coated end shall have a preformed cap to provide a minimum of 30 mm clearance for movement.

The ends of dowels shall be burr free and circular in cross-section.

Dowels possessing crimped or ovoid end faces shall not be incorporated into the works.

Approval

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.

The inspection of reinforcement shall constitute a **Hold Point**.

Superintendent inspection and approval of reinforcement placing and fastening is required prior to release of **Hold Point**.

5 DESIGN AND CONTROL OF CONCRETE MIXES

5.1 GENERAL

Nominated mixes for approval

The Contractor shall submit, for approval by the Superintendent, details of the concrete mix (or mixes) and the materials, including source, and admixtures to be used and their dosage rates.

Such details are required for each 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'.

This action constitutes a **Hold Point**.

Superintendent inspection and approval is required prior to release of **Hold Point**.

All details and test results specified within this worksection section shall be submitted at least 28 days before using the nominated mix in the work.

Certified test results

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 worksection.

All phases of any particular test must be performed at one laboratory.

All relevant test results shall accompany the Certificate.

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.

Steel fibre documentation

Original proprietary steel fibre documentation shall be obtained by the contractor and submitted to the Superintendent 21 days prior to commencement of works for inspection and approval.

The required documentation shall detail: manufacturer's name, model, steel strength, method of manufacture, cross-section and anchorage configuration, length, diameter, aspect ratio and suggested fibre concentration of the steel fibre reinforced concrete.

Compressive strength

The compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 14 and 28 days. The compressive strength at each specified day shall be determined by the testing of three cylinders prepared in accordance with AS 1012.8.1 and tested in accordance with AS 1012.5.

The average of the three specimens within 2 MPa of the median shall be the nominated mix compressive strength. The compressive strength for 28 days shall not be less than 36 MPa.

Supplementary documentation

Documentation shall also be supplied indicating aggregate grading, nominated slump, V-B reading at nominated slump and the content of all constituents expressed in kg/m^3.

Identical mix

The Contractor may be relieved of the responsibility to test the nominated mix if it can be shown that an identical mix has been tested within the last 12 months and the results from earlier testing meets with the Superintendent's approval.

Special requirements

Ancillary documentation shall be provided to the Superintendent detailing any special materials, or practices required to produce transport, place, cure or maintain the steel fibre reinforced concrete.

Any additional costs resulting from the works or omission of works as detailed in the paragraph above other than those expressly stated in this worksection shall be borne by the Contractor.

Approved mix

After inspection of test results and approval by Superintendent, the nominated mix will be referred to as the 'approved mix'.

5.2 VARIATIONS TO APPROVED MIXES

Approval for mix variation

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.

Revised nominated mix and materials

Where changes to an approved mix are proposed, the Contractor shall re-test the proposed mix and provide details of the nominated mix and materials, in accordance with **Design and control of concrete mixes**.

Any costs associated with re-testing the approved mix shall be borne by the Contractor.

6 CONCRETE STRENGTH, COMPACTION AND THICKNESS

6.1 CONCRETE CYLINDERS

Test specimens

Compressive strength: Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8.1.

Moulds and laboratory: The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing documented 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.

Test results: Copies of test results shall be forwarded to the Superintendent within 24 hours of completion by laboratory.

Sampling: 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 possible.

Curing: The method of making and curing specimens shall be in accordance with AS 1012.8.1 with compaction by internal vibration.

Marking: The Contractor shall mark the specimens for identification purposes at the time of sample casting. The samples shall be marked so as to duly indicate the area of works represented by each concrete cylinder at the time of testing.

Costs of testing: The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.

Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

- For the determination of the compressive strength at twenty-eight days.
  For each lot of up to 50 m^3 of concrete placed at the one time—One pair of specimens
- For the determination of the compressive strength at seven days.
  For each lot of up to 50 m^3 of concrete placed at the one time—One pair of specimens
- For the determination of compressive strength for any early testing as deemed necessary by the Contractor.
  For each lot of up to 50 m^3 of concrete placed at the one time—One pair of specimens

Lot size

A lot is defined as a continuous pour of up to 50 m^3 of concrete placed.

Inspection, capping and crushing of specimens

Laboratory: Specimens required by this worksection shall be tested at the NATA registered laboratory nominated by the Contractor.

Cost of testing: The cost of such testing shall be borne by the Contractor.

Standards: Specimens shall be inspected, capped and crushed in accordance with AS 1012.9.

Mass unit volume: Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS 1012.12.2, so that the relative compaction of cores taken from the same lot of concrete base can be determined.

6.2 COMPRESSIVE STRENGTH OF CONCRETE

Determination of strength

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 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

Adjustment of test compressive strength for age of specimen

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 6.1.

For intermediate ages the factor shall be determined by linear interpolation of neighbouring values.

Table 6.1 Concrete age conversion factors

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

Conformance for compressive strength

Limits: If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Below specified strength: Concrete with a 28 day strength between 33 MPa and 36 MPa may be accepted providing such concrete represents less than 5 % of the lot.

Non-conformance: 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.

Additional cylinders: If the Contractor considers that coring will be required to verify the conformity of any lot then arrangements shall be made at the trial batch stage to have sufficient cylinders to extend

the compressive strength gain graph from 28 days to at least 72 days as required by **Design and control of concrete mixes**. The Superintendent may use these results to calculate the equivalent 28 days compressive strength of the cores taken.

Superintendent's absolute discretion: After testing for compressive strength of cores, where required, the Superintendent shall consider the test results and shall, with absolute discretion, determine the compressive strength of the concrete to be either:

- The average of the 28 day compressive strength of the pair of specimens moulded at the time of placing; or
- The equivalent 28 day compressive strength of the core.

Lot size: A lot is defined as a continuous pour of up to 50 m^3 of base represented by a pair of test specimens cast from a sample of the concrete used in its construction.

6.3 CONFORMANCE FOR THICKNESS

Thickness measurement

Thickness measurements of the concrete base shall be determined by survey from the level difference between the base and the subbase surface models on a 5 m grid. In special circumstances the Superintendent may authorise coring and measurements at the edges. Audit checks using a suitable probe may be carried out whilst the concrete is being placed. The readings shall be rounded off the nearest 5 mm.

Under thickness

Base which is more than 10 mm below the specified thickness shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Excess thickness

Base which is thicker than the design thickness will be acceptable provided the finish satisfies the requirements of **Hand placing**.

6.4 RELATIVE COMPACTION OF CONCRETE

Test specimens

Cores: 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:

- 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.
- The nominal diameter of the cores shall not be less than 75 mm.

Location of cores: The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars, if applicable, 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 worksection. Cores shall be marked for identification.

Storage: Cores shall be placed immediately in an individual plastic bag and sealed to prevent water loss. Cores stored in plastic bags shall be kept in the shade.

Temperature control: 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.

Frequency of coring

Minimum: The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with **Concrete cylinders**.

Hand placed concrete: 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.

Repair of core holes

Restore all core holes: 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.

Surface condition: The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

Guarantee period: The Contractor shall guarantee the integrity of the core for a period of 6 months after the completion of works and repair any damage exhibited within this time frame.

Cost of core restoration: The cost of core hole replacement or reparation shall be borne by the Contractor.

Testing of cores for compaction

Curing: 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.

Relative compaction: 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 1012.12.2.

Cost of obtaining, curing and testing: All costs associated with obtaining, curing and testing of cores shall be borne by the Contractor.

Conformance for compaction

Rejection percentage: If the relative compaction is less than 97%, the lot represented by the core shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Core preparation: 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.

Adjustment for age: The test strength shall be adjusted for age at test in accordance with **Compressive strength of concrete** and for length/diameter ratio in accordance with Table 6.2.

Core compressive strength: If the 28 day compressive strength of the core is less than 33 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

Table 6.2 Correction factors

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

7 PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

7.1 PRODUCTION AND HANDLING OF CONCRETE

Methods of handling, storing and batching

At least four weeks before commencing work under this worksection, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials and mixtures for concrete, details of proposed mixers and methods of agitation, mixing and transport.

Handling and batching methods—AS 1379 and additional requirements

The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:

- 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.

- Cementatious material shall be weighed in an individual hopper, with the Portland cement weighed first.
- 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.

Mixer and agitation methods

Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379.

7.2 MIXING AND TRANSPORT—AS 1379 AND ADDITIONAL REQUIREMENTS

Methods

Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:

- The mixer shall be charged in accordance with the manufacturer's instructions.
- 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 % and 85% along the length of the tray.
- 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.
- Admixtures shall be separately prediluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs.
- Where a continuous type mixer is employed, the plant shall not be run so as to produce of a rate greater than the manufacturer's rated capacity at any time.
  The Superintendent may require that the production rate be reduced if the quality of the concrete produced indicates a longer mixing time is required. Product from continuous type mixers must conform to the requirements of uniformity as detailed for batch mixers.
- 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 of the times at which cement was added to the aggregate shall be provided to the Superintendent for approval.
  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.
- The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 % of the gross volume of the drum of the mixer after incorporation of steel fibre reinforcement.
- Mixing shall continue for a minimum of 5 minutes after the addition of steel fibre to the transit mix truck if steel fibre is not added simultaneously with the aggregate but shall not continue for a time greater than that time specified by the steel fibre manufacturer's guidelines to prevent balling.

7.3 MAXIMUM MIXING TIME

Batch in mixer

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.

Long delays

For longer periods, the batch may be held in the mixer and turned over at regular intervals subject to the lesser of: the time limits specified for incorporation of the concrete into the work not being exceeded, or that time stated as a maximum by the steel fibre manufacturer.

7.4 CONSISTENCY

Target slump
The target slump shall be specified by the steel fibre and concrete manufacturer based upon the nominated design mix or tests performed upon a nominated mix prior to the commencement of works.

Tolerances
At all times between mixing and discharge, the slump shall be within 10 mm of the nominated slump for the nominated mix for mechanically placed concrete and within 15 mm thereof for hand placed concrete.

Test method
The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1.

The test shall be made on concrete samples obtained in accordance with AS 1012.1.

Timing of testing
The consistency of the concrete shall be checked within 30 minutes of adding cement to the aggregate if the steel fibre is added to the mix with the aggregate or immediately prior to discharge if the steel fibre is added as the final constituent to the mix (in accordance with **Production and handling of concrete** and **Mixing and transport—AS 1379 and additional requirements**.

Cost of consistency testing
The cost of consistency testing shall be borne by the Contractor.

8 PLACING AND FINISHING CONCRETE BASE

8.1 GENERAL

Quality plan submission
At least 21 days before commencing work under this worksection, 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.

Notice of the intention to commence construction
The Contractor shall give the Superintendent seven days written notice of the intention to commence construction of the base on any section of work.

Subbase condition
The subbase surface shall be clean and free of loose or foreign matter and prepared in accordance with 1132 *Mass concrete subbase*.

Air temperature
Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

Concrete temperature
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.

Slab anchors
Where required, slab anchors shall be constructed prior to construction of the base.

Wooden floats
At no time shall wooden floats be used to finish steel fibre reinforced concrete.

8.2 RATE OF EVAPORATION

Evaporation limit
When the value of Rate of Evaporation, determined from the graph in Figure 8.1, exceeds 0.50 kg/m^2/hr 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 kg/m^2/hr.

Use of retarder

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.

Measuring and recording concrete temperature and wind velocity

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.

Costs of measurement and control

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.

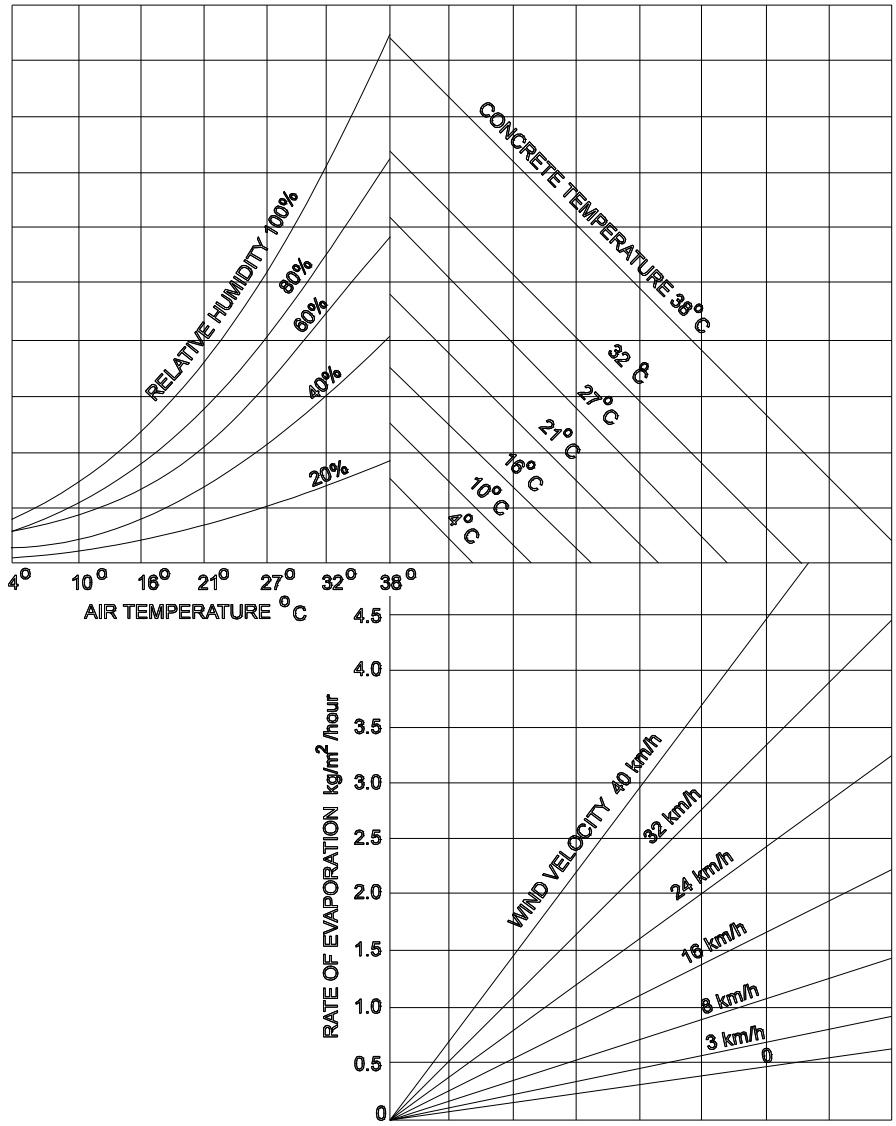

Figure 8.1 Rate of evaporation

8.3 MECHANICAL PAVING

Paving machine

The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes/ 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.
- Internal vibrators capable of compacting the full depth of the concrete.
- Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

Concrete finish

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 **Texturing of surface**.

Supporting surface

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.

Continuity of paving operation

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.

Interruption to paving

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 Transverse construction joint.

Non-monolithic concrete

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 **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

8.4 HAND PLACING

Restriction

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.

Formwork

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.

Placing in forms

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 a hand-guided vibratory screed set at maximum frequency traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

Disruption to paving

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.

Trowelling

Wooden trowels shall not be used to finish steel fibre reinforced concrete.

Concrete finish

A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with **Texturing of surface**.

Transverse construction joint

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 **Transverse construction joints**.

Non-monolithic concrete

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 **Removal and replacement of base**, **Removal and disposal of base** and **Replacement of base**.

8.5 ALIGNMENT AND SURFACE TOLERANCES

Horizontal alignment tolerance

Outer edge: 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.

Longitudinal joint line: Where an edge of a slab is to form a longitudinal joint line the allowable horizontal alignment tolerances shall comply with **Longitudinal isolation joints**.

Tolerances and rideability

Top of base level: The tolerance on thickness of the base shall be zero below the specified thickness and in accordance with **Conformance for thickness** for excess thickness.

Surface level: The top surface of the base shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.

Tolerance: The level at any point on the base shall not deviate from those dimensions on the drawings by more than +10 mm or –0 mm.

Ponding: Notwithstanding with the above clauses, the surface shall not pond water.

8.6 TEXTURING OF SURFACE

The surface of the steel fibre reinforced concrete shall be textured perpendicular to the direction of the traffic flow by means of a stiff broom or other device approved by the Superintendent for the purpose.

The width of the texturing apparatus shall not be less than 750 mm.

A hessian dragged surface finish shall not be employed with steel fibre reinforced concrete.

8.7 CURING

Compounds

The base shall be cured by the use of one of the following:

- 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
- White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or
- Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.

Efficiency index

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 % when tested in accordance with Appendix B of AS 3799.

Application method

Application of the curing compound using a fine spray shall be as follows:

- For transversely tyned surfaces—in two applications. The first application shall be applied immediately following texturing and the second application shall be applied fifteen to thirty minutes later.
  Each application shall be at the rate stated on the certificate of compliance or at 0.2 litres/m^2, whichever rate is the greater.
- The curing compound shall be applied by a mechanical sprayer, spraying transversely or longitudinally, having a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.
  The sprayer shall incorporate a device for continuous agitation and mixing of the compound in its

container during spraying. After shut-off of the spray nozzles, there shall be no dripping of the curing compound on the concrete surface.

Application time

Curing compound shall be applied immediately after the surface is free of bleed water, or when directed by the Superintendent.

Hand spraying

For the sides of formed slabs and for small areas where a mechanical means of distribution cannot be used, the compound shall be sprayed by hand lance at a rate 25 % higher than that used on the main base.

Curing membrane

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.

The cost of making good such damaged curing membrane shall be borne by the Contractor.

Equipment on site

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

Plant unavailable

If the mechanical sprayer becomes inoperable, concrete paving by mechanical means shall cease and shall not recommence until the mechanical sprayer becomes fully operable again.

Any uncovered areas shall be sprayed with suitable hand operated equipment.

8.8 PROTECTION OF WORK

Temperature control

The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first 24 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 worksection, the concrete shall be rejected.

Rain protection

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.

Traffic restrictions

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 20 MPa.

Traffic management required to effect the traffic restrictions shall comply, at a minimum, with

1101 *Control of traffic*.

The Superintendent may direct the Contractor to provide traffic management either pedestrian or vehicular in excess of that specified if such measures are warranted due to site specific requirements.

The costs associated with traffic management and safety shall be borne by the Contractor.

8.9 ODD-SHAPED AND MISMATCHED SLABS

Definition

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.

Joint criteria

Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

9 JOINTS

9.1 LOCATION

Joints shall be provided at locations indicated on the Drawings or as approved by the Superintendent.

9.2 TRANSVERSE CONSTRUCTION JOINTS

Location

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 **Steel reinforcement**.
- be smooth across the joint before texturing.
- not deviate from a 3 m straightedge placed along the joint by more than 10 mm.
- aligned so as not to increase the skew angle of odd-shaped slabs

Remove laitance prior to placing adjoining concrete

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.

9.3 TRANSVERSE CONTRACTION JOINTS

Sawcut and plastic joint inducing systems

Transverse contraction joints shall be continuous across the full width of the base and shall be sawn unless otherwise approved by the Superintendent. 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.

Normal and skewed joints

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.

Sawcutting

Sequence: Joints shall be sawn by a two-cut operation comprising an initial 3 mm wide cut and a 7 mm widening saw cut. The first (3 mm) sawcut shall extend to a depth below the surface of the slab of 0.4D where (D) is the full depth of the base slab. The second (7 mm) sawcut shall extend to a depth of 35 mm below the surface of the base slab.

Timing and equipment: The Contractor shall ensure that sawcutting proceeds within 4–18 hours (depending upon ambient conditions) so as to prevent cracking of the base concrete other than at the bottom of the 3 mm wide 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.

Tolerances: 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.

Ravelling: 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 1.0 m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

Rejected sawcuts: Sawcuts, which do not conform to the documented requirements, shall be rejected by the Superintendent. Rejected sawcuts shall be repaired by a method approved by the Superintendent.

Cleaning of sawcut

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.

Temporary sealing

Material: 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.

Tolerance: 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.

Maintenance: 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.

Preliminary sealing

Immediately after cleaning the initial saw cut, a continuous UV-stabilised PVC spline 5 ±1 mm in diameter shall be installed at the top of the saw cut, passing under any sealant inserted in longitudinal sawn joints. The maximum increase in length of a preliminary sealant after installation shall be 10 % of the original length.

Permanent sealing

Within ten days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint. The permanent sealant shall be 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 operating width limitations, physical parameters and the method of installation recommended by the manufacturer.

Silicone sealants

Specification: Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table 9.1.

Certificate of compliance: 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 9.1.

Table 9.1 Silicone joint sealant requirements

Test Method	Test	Requirements
ASTM-D792	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 D2240	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
N.A.	Colour	Grey, compatible with pavement concrete

Installation: 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.

Action before sealing: 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. If the backer rod is damaged in any way it shall be replaced for the full length of the joint. Manufacturer information shall be supplied to the Superintendent by the Contractor to ensure compatible fit with designed joint dimensions 21 days prior to installation.

Approval of method: 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 worksection.

Treatment prior to asphalt overlay: Where asphaltic surfacing over the concrete base is specified only the initial 3 mm wide saw cut shall be provided and filled with silicone joint sealant in accordance with this worksection.

9.4 TRANSVERSE ISOLATION JOINTS

Location

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.

Construction

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.

Spacing

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.

Standards

Joint filler shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent and joint sealant with the silicone sealant requirements of **Transverse contraction joints**.

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.

Tolerance

The line of the isolation joint shall not deviate from a 3 m straightedge more than 10 mm.

9.5 LONGITUDINAL TIED JOINTS

General

Location: 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.

Formation: Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.

Ties: The ties shall be 12 mm diameter and 1 m long deformed steel bars Grade 400Y, and shall be inserted in accordance with **Placing and cover requirements**. 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. Installed tie bars shall not deviate from a line normal to the longitudinal plane of the 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% of the yield strength of the bar.

Tolerances: 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.

Corrugated joint face: Where the longitudinal tied joint is formed or slipformed, the joint face shall be corrugated in accordance with the details shown on the Drawings.

Isolation joint: 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 **Longitudinal isolation joints**.

Asphalt surface: Where asphalt surfacings is specified or directed to be provided by the Superintendent, the longitudinal tied joints shall comply with the documented requirements.

Sawn-induced joints

Location: Sawn longitudinal tied joints shall be provided to the dimensions shown on the Drawings.

Sawcutting: Sawcutting shall comply with **Transverse contraction joints (Sawcutting)**.

Sealant quality: Within 24 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.

Sealant insertion: 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% of the original length, otherwise the sealant shall be rejected.

Joints in sealant: 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.

Ribbon-induced joints

Location and insertion: 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.

Finish: 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.

Joint in ribbon: 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 joint 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.

Treatment of sawn longitudinal tied joints prior to asphalt overlay

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.

9.6 LONGITUDINAL JOINT WITH KERB AND/OR GUTTER

Form

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.

Tie bars

Where constructed separately, they shall be tied to the concrete base by 12 mm diameter deformed steel tie bars Grade 250S or 400Y, 1000 mm long at 1 m centres.

Location

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 **Placing and cover requirements**.

Face of joint

The face of the longitudinal joint need not be scabbled and the joint need not be sealed.

Tolerances

The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with **Longitudinal tied joints**.

Kerb and/or Channel (gutter)

The construction of kerb and/or gutter shall be in accordance with 1121 *Open drains, including kerb and channel (gutter)* regardless of method of construction except that the strength of the concrete used in the kerb and/or gutter shall be greater than 32 MPa.

9.7 LONGITUDINAL ISOLATION JOINTS

Location

Longitudinal isolation joints shall be provided where shown on the Drawings and where directed by the Superintendent.

Tolerances

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.

Filler and sealant

The joint filler shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent and joint sealant with the silicone sealant requirements of **Transverse contraction joints**.

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.

10 SLAB ANCHORS

10.1 GENERAL

Location

Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the Drawings.

Transverse joint

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.

10.2 EXCAVATION

Dimensions

Excavation of trenches for slab anchors shall be to the dimensions and details shown on the Drawings.

Trim and consolidate

All loose material shall be removed and the vertical faces trimmed to neat lines.

The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material.

This action constitutes a **Hold Point**.

Superintendent inspection and approval of compacted trench is required before release of the **Hold Point**.

Spoil

The Contractor shall dispose of excavated material at locations approved by the Superintendent.

Adjacent to flexible pavement

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.

The cost of making good any disturbance or damage to the flexible pavement shall be borne by the Contractor.

Sub-soil drains

A subsoil drain shall be provided at the bottom of the trench, in accordance with 1172 *Subsoil and fountain drains* and details shown on the Drawings.

10.3 CONCRETE

Produced, transported and placed

Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements of this worksection.

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.

Transverse isolation joint
A transverse isolation joint shall be provided on the downhill side of the slab anchor.

Steel reinforcement
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 **Steel reinforcement**.

Bridge approach slabs
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.

11 REMOVAL AND REPLACEMENT OF BASE

11.1 GENERAL

Replacement method
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.

Approval of method
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.

Costs of works
The cost of all work and materials under this Clause shall be borne by the Contractor.

11.2 REMOVAL AND DISPOSAL OF BASE

Transverse sawcut
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.

Longitudinal sawcuts
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.

Oversawing
No oversawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base.

Disposal
The Contractor shall legally dispose of the removed base slabs at locations acceptable to the Superintendent.

Further damage
Any slab, adjoining the removed slabs, damaged by the Contractor’s operations shall also be removed and replaced.

11.3 REPLACEMENT OF BASE

Subbase preparation
Before construction of the replacement base, the subbase shall be prepared and debonded in accordance with 1132 *Mass concrete subbase*.

Compliance with this specification and following additional requirements

All work involved in the replacement of base shall comply with the worksection, including the following additional requirements:

- 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 **Transverse construction joints**.
- 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 **Transverse contraction joints**.
- 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 **Longitudinal tied joints**.
- 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 % of the yield strength of the bar.
- 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 20 MPa.

12 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 12.1.

Table 12.1 Summary of limits and tolerances

Activity	**Limits/tolerances**	**Worksection Clause Reference**
Aggregates		
- General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	**Aggregates**
Aggregates		
- Fine aggregate		
. Grading	To be within the limits as per Table 2.2 and shall not deviate from Proposed Grading by more than amounts in Table 2.2	**Aggregates**
- Coarse aggregate		
. Grading	To be within the limits as per Table 2.3 and shall not deviate from Proposed Grading by more than amounts in Table 2.3.	**Aggregates**
. Wet strength	Not less than 80 kN for any fraction and/or constituent	**Aggregates**
. 10% Fines wet/dry variation	Not to exceed 35% for any fraction and/or constituent	**Aggregates**
. Soundess	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	**Aggregates**
. Particle shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	**Aggregates**
. Fractured faces	At least 80% by mass of the particles shall have two or more fractured faces	**Aggregates**

Activity	Limits/tolerances	Worksection Clause Reference
Concrete quality		
- Cement content	At least 350 kg per yielded cubic metre of concrete	**Cement and flyash content**
- Compressive strength	The minimum 28 day compressive strength shall be 36 MPa	**Compressive strength**
- Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	**Shrinkage**
- Air content	Shall not be more than 5% when discharged from the transport vehicle ready for placement	**Air content**
Concrete mixing and transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within:	**Mixing and transport—AS 1379 and additional requirements**
	. One and a half hours where transported by truck mixer or agitator.	
	. One hour where transported by non-agitating trucks.	
Concrete placing	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.	**Placing and finishing concrete base**
	Where the value of Rate of Evaporation exceeds 0.50 kg per square metre per hour, the Contractor shall cease work.	**Rate of evaporation**
Alignment and surface		
- Horizontal alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10 mm.	**Alignment and surface tolerances**
- Surface level	The level at any point on the top of the base shall not vary by more than +10 mm or –0 mm from that shown on the Drawings or as directed by the Superintendent. The top surface of the base shall not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.	**Alignment and surface tolerances**
Concrete protection		
- Temperature	The temperature of the concrete shall not be permitted to fall below 5°C during the first twenty-four hours after placing.	**Protection of work**
Joints		
- Transverse construction	The line of the transverse construction joints shall not deviate from a 3 m straightedge placed along the joint by more than 10 mm.	**Transverse construction joints**
- Transverse contraction	. May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors.	**Transverse contraction joints**
	. No edge shall deviate from a 3 m straightedge by more than 10 mm.	**Transverse contraction joints**
	. 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.	**Transverse contraction joints**

Activity	Limits/tolerances	Worksection Clause Reference
	. Temporary Sealing—the top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface.	**Transverse contraction joints**
-Transverse isolation	The line of the transverse expansion joint shall not deviate from a 3 m straight edge more than 10 mm.	**Transverse isolation joints**
-Longitudinal tied joints	. All parts of any tie bar shall be within 50 mm of its designed position.	**Longitudinal tied joints**
	. 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.	
	. 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 5 mm nor more than 7 mm below the surface of the base.	
	. For Ribbon-Induced joints, the inducer ribbon shall be a minimum of 0.5 mm thick and when placed it shall be within 5° of the vertical plane.	
-Longitudinal isolation joints	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.	**Longitudinal isolation joints**
Slab anchors	Not placed closer than 2.0 m to transverse joints (other than associated transverse expansion joints).	**Slab anchors**

13 MEASUREMENT AND PAYMENT

13.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this worksection in accordance with Pay Items 1134.1 to 1134.10 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Where the 28 day compressive strength of test cylinders for any lot is less than 29 MPa, the lot represented by the test cylinders shall be removed, in which case no payment shall be made.

Where the relative compaction of the concrete is determined at less than 97 %, the lot represented by the core shall be removed, in which case no payment shall be made.

Where the concrete base thickness is more than 10 mm below the specified thickness, the concrete shall be removed, in which case no payment shall be made.

Preparation of subbase and application of bond breaker is measured and paid in accordance with 1132 *Mass concrete subbase*.

Construction of kerb and/or gutter (channel) is measured and paid in accordance with 1121 *Open drains, including kerb and channel (gutter)*.

Subsoil drains at slab anchors are measured and paid in accordance with this Worksection and not 1172 *Subsoil and fountain drains*.

Site specific traffic management measures are measured and paid in accordance with 1101 *Control of traffic*.

13.2 PAY ITEMS

1134.1 Supply and place steel fibre reinforced concrete in base

The unit of measurement shall be the cubic metre in place. This unit rate shall be inclusive of steel fibre reinforcements.

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.

The depth shall be the depth specified or as directed by the Superintendent across each section.

No account shall be taken of the allowable tolerances.

The cost of providing transverse construction joints shall be included in the schedule rate for Pay Item 1134.1.

The cost of longitudinal tied joints in association with kerbs and/or gutters shall be included in the schedule rate for Pay Item 1134.1.

1134.2 Finish, cure and texture base

The unit of measurement shall be the square metre of surface of the base.

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The sides of slabs shall not be included in the measurement of surface area.

1134.3 Supply and place wire reinforcing fabric (if applicable)

The unit of measurement shall be the square metre of wire reinforcing fabric placed.

The width and length shall be as specified on the Drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. No account shall be taken of the allowable tolerances nor of any laps.

Unless otherwise indicated elsewhere, all wire reinforcing fabric shall be paid for at the schedule rate for Pay Item 1134.3.

1134.4 Supply and install steel bar reinforcement (if applicable)

The unit of measurement shall be the tonne of steel reinforcement.

The mass shall be determined from the unit masses given in AS/NZS 4671 and the actual length of bar measured in place. No account shall be taken of laps and splices.

Unless otherwise indicated elsewhere, all steel bar reinforcement shall be paid for at the schedule rate for Pay Item 1134.4.

The pay items excludes dowels and tie bars.

1134.5 Transverse contraction joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

1134.6 Transverse expansion and isolation joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

1134.7 Longitudinal tied joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

The pay item includes provision of tie bars.

1134.8 Longitudinal isolation joints

The unit of measurement shall be the linear metre.

The length shall be measured along the line of the joint.

The pay item includes the provision of dowels where specified or shown on the Drawings.

1134.9 Slab anchors

The unit of measurement shall be the cubic metre of concrete.

The volume shall be taken from the Drawings with appropriate adjustments being made for any authorised variation. The depth shall be measured from the top of the subbase.

The pay item includes all work, materials and equipment required for the construction of slab anchors including excavation, disposal of material, supply and placing of reinforcement and the subsoil drain.

1134.10 Bridge approach slabs

The unit of measurement shall be the cubic metre.

The width, depth and length shall be as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The pay item includes all work, materials and equipment required for the construction of a bridge approach slab, including provision of a transverse expansion joint at the bridge abutment but excluding the supply and fixing of steel which shall be paid for at the schedule rate for Pay Item 1134.4.

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1135 CONTINUOUSLY REINFORCED CONCRETE BASE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the supply of concrete, the construction by mechanical placement or hand placement in those areas impractical for mechanical placement, of continuously reinforced concrete base, including trial sections and slab anchors. The work also includes the supply and installation of steel reinforcement.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161*Quality(Construction)*.

1.3 PROGRAMME

Where jointed concrete shoulders are specified, the continuously reinforced concrete pavement shall be constructed first.

1.4 THICKNESS AND LEVELS OF BASE

The base thickness and levels shown on the Drawings shall be subject to increase by the direction of the Superintendent by up to 30 mm before commencement of base construction on each section of work.

No payment additional to the schedule rate for Pay Item 1135.1 shall be made for this work.

1.5 REFERENCE DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

1121 Open drains, including kerb and channel (gutter)

1132 Mass concrete subbase

1172 Subsoil and fountain drains

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling of fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.3.3	Determination of properties related to the consistency of concrete—Vebe test
AS 1012.4.2	Determination of air content of freshly mixed concrete—Measuring reduction in air pressure in chamber above concrete
AS 1012	Methods of testing concrete
AS 1012.8.1	Method for making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.12.2	Determination of mass per unit volume of hardened concrete—Water displacement method
AS 1012.13	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

AS 1141	Methods for sampling and testing aggregates
AS 1141.4	Bulk density of aggregate
AS 1141.6.2	Particle density and water absorption of coarse aggregate—Pycnometer method
AS 1141.11	Particle size distribution by sieving
AS 1141.12	Materials finer than 75 mm in aggregates (by washing)
AS 1141.13	Material finer than 2 mm
AS 1141.14	Particle shape, by proportional calliper
AS 1141.18	Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Wet/dry strength variation
AS 1141.23	Los Angeles value
AS 1141.24	Aggregate soundness—Evaluation by exposure to sodium sulfate solution
AS 1141.32	Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS 1141.37	Iron unsoundness
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1	Soil chemical tests—Determination of the sulphate content of a natural soil and the sulphate content of the groundwater—Normal method
AS 1379	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 1683	Methods of test for elastomers
AS 1683.23	Rubber—Vulcanized—Determination of resistance to liquids
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	Determination of chloride ion content
AS 3799	Liquid membrane—forming curing compounds for concrete
AS 3972	Portland and blended cements
AS/NZS 1554	Structural steel welding
AS/NZS 1554.3	Welding of reinforcing steel
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles

Other publications

NSW RTA Test Methods

T 240	Texture depth of coarse textured road surfaces
T 1160	Low temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1161	High temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1192	Adhesion of sealant
T 1193	Accelerated aging of cured sealant

ASTM Standards

ASTM D 792	Standard test method for density and specific gravity (relative density) of plastics by displacement
ASTM C 793	Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants

ASTM C 794 Standard test method for adhesion-in-peel of elastomeric joint sealants

ASTM D 2240 Standard test method for rubber property-durometer hardness

ASTM D 2628 Specification for preformed polychloroprene elastomeric joint seals for concrete

ASTM D 2835 Specification for lubricant for installation of preformed compression seal in concrete pavements

US Military Specification

SAE AMS-S-8802 Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion

2 MATERIALS FOR CONCRETE

2.1 CEMENT

NSW QA scheme

Cement shall be Type GP Portland cement complying with AS 3972.

Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

Nominated brand and source

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes** the Contractor shall nominate the brand and source of the cement.

The Contractor shall use only the nominated cement in the work.

Proof of quality

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.

Storage time

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 cement shall be re-tested, to ensure the cement still complies with AS 3972, before it is used in the work.

The cost of re-testing the cement shall be borne by the Contractor and results of the testing forwarded to the Superintendent prior to incorporation of cement into the works.

Transport and storage

Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

2.2 FLYASH

NSW QA scheme

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.

Source

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the powerhouse source of the flyash.

The Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence

Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent.

2.3 WATER

Quality

Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

The water shall be free from oil and shall not contain more than:

- 600 ppm of chloride ion, determined by AS 3583.13;
- 400 ppm of sulphate ion, determined by AS 1289.4.2.1.

2.4 ADMIXTURES

Quality and use

Chemical admixtures shall comply with AS 1478.1.

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 **Air content**.

Excess air content

Fresh concrete with an air content not complying with **Air content** shall be rejected.

Retarder for warm season

During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) shall be used to control slump within the limits stated in **Consistency** unless otherwise authorised by the Superintendent.

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 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with **Design and control of concrete mixes**.

Retarder for cool season

During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6 % reducing sugars (Type WRRe complying with AS 1478.1) 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 variation shall constitute a proposed change to an approved mix for the purposes of **Variations to approved mixes**.

The Contractor shall ensure that admixtures used in concrete production are the same as those for which Certificates of Compliance have been obtained.

Source and type

When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, the Contractor shall nominate the proprietary source, type, dose concentration and name for each admixture to be used.

Documentary evidence of the quality shall be furnished in conjunction with any health and safety regulations concerning the product by the Contractor to the Superintendent upon request at any stage of the work.

2.5 AGGREGATES

General

Quartz sand content: At least 40% 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% quartz, by mass. Where present, chert fragments will be regarded as 'quartz' for the purpose of this worksection, but the ratio of chert to quartz shall not exceed unity.

Slipform grading requirements: In addition, for concrete mixes proposed for slipforming, the grading of the combined total aggregates shall have a proportion by mass passing the Australian Standard sieves as shown in Table 2.1

Table 2.1 Combined aggregate grading

Australian Standard sieve	**% passing by mass of sample**
19.00 mm	95–100
9.50 mm	55–75
4.75 mm	36–48
2.36 mm	30–42

1.18 mm	22–34
600 µm	16–27
300 µm	5–12
150 µm	0–3
75 µm	0–2

Source and type: When submitting details of the nominated mix in accordance with **Design and control of concrete mixes**, 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 together with the combined aggregate grading for the mix.

Fine aggregate

Quality: 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 (minimum 1200 kg/m^3), water absorption (maximum 5 %), material finer than 2 micrometres, and impurities and reactive materials.

The sodium sulphate soundness, determined by testing in accordance with AS 1141.24, shall not exceed the limits in Table 2.2.

Table 2.2 Sodium sulphate soundness limits

Australian Standard sieve	**% loss by mass**
4.75 mm to 2.36 mm 2.36 mm to 1.18 mm 1.18 mm to 600µm 600 µm to 300µm	4 6 8 12

Blending: In the case of a blend of two or more fine aggregates, the above criteria shall apply to each constituent material.

Grading: The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table 2.3.

Table 2.3 Fine aggregate grading

Australian Standard sieve	**Proportion passing (% of mass of sample)**	**Deviation from proposed grading (% of mass of sample)**
9.50 mm	100	
4.75 mm	90–100	±3
2.36 mm	65–95	±10
1.18 mm	40–80	±10
600 µm	24–52	±10
300 µm	8–25	±5
150 µm	1–8	±2
75 µm	0–3	

Proposed mix: 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 fine aggregate grading’.

Test for each constituent: 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.

Grading deviation: 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 2.3.

Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table 2.3.

Coarse aggregate

Quality: 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 properties listed in Table 2.4. In all other respects, the coarse aggregate shall comply with this worksection.

If required, coarse aggregate shall be washed to satisfy these requirements.

Grading: The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table 2.4.

Proposed mix: 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 coarse aggregate grading'.

Test for each constituent: 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.

Grading deviation: The coarse aggregate used in the work shall comply with the requirements set out in Table 2.4.

Table 2.4 Coarse aggregate properties

Property		**Requirement**		**Test method**
Particle density		minimum 2100 kg/m3		AS 1141.6.2
Bulk density		minimum 1200 kg/m3		AS 1141.4
Water absorption		maximum 2.5%		AS 1141.6.2
Grading	Australian Standard sieve	Proportion passing (% of mass of sample)	Deviation from proposed grading (% of mass of sample)	AS 1141.11
	26.50 mm 19.00 mm 13.20 mm 9.50 mm 4.75 mm 2.36 mm	100 95–100 35–80 0–25 0–10 0–2	 ±2 ±5 ±5 ±3	
Material finer than	75 µm 2 µm	≤2.0% ≤1.0%		AS 1141.12 AS 1141.13
Particle shape	2:1 ratio 3:1 ratio	≤ 35% ≤ 10%		AS 1141.14
Wet strength		≥ 80 kN		AS 1141.22
Wet/dry strength variation		≤ 35%		AS 1141.22
Los Angeles value—loss in mass		≤ 30%		AS 1141.23
Soundness—loss in mass		≤ 9.0%		AS 1141.24
Weak particles		≤ 0.3%		AS 1141.32
Iron unsoundness (slag)		≤ 1.0%		AS 1141.37
Fractured faces		≥ 80%		AS 1141.18

Storage

Facilities: Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

Introduction of foreign matter: 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.

3 QUALITY REQUIREMENTS OF CONCRETE

3.1 CEMENT AND FLYASH CONTENT

Cement and flyash

The minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete.

The maximum flyash content shall not be more than 50 kilograms per yielded cubic metre of concrete.

3.2 COMPRESSIVE STRENGTH

Compressive strength

The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at twenty-eight days shall not be less than 36 MPa nor greater than 42 MPa.

In addition, the compressive strength F28 for the trial batch (**Design and control of concrete mixes**) shall not be less than 36 MPa nor greater than 40 MPa.

3.3 SHRINKAGE

The drying shrinkage of the nominated mix, determined by AS 1012.13, shall not exceed 450 microstrain after three weeks air drying.

Shrinkage tests shall be performed upon (the lesser of) every 150 cubic metres of concrete poured or one day's production.

The drying shrinkage at the nominated slump ±10 mm shall be taken as the average of all readings within 30 microstrain of the median value.

3.4 CONSISTENCY

Slump tolerance

The Contractor's nominated slump, when tested in accordance with AS 1012.3.1, shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.

VeBe reading

The VeBe reading of the nominated mix for mechanically placed concrete, when tested in accordance with AS 1012.3.3, shall be a maximum of three seconds at the nominated slump less 10 mm.

3.5 AIR CONTENT

Tolerances

The air content of the concrete, determined by AS 1012.4.2, shall be neither less than 3 % or more than 6 % when discharged from the transport vehicle ready for placement.

Fresh concrete with an air content outside these limits shall not be used in the base.

Repeat testing

If the measured air content is not within the limits specified, one repeat test shall be made immediately from another portion of the sample.

If the value from the repeat test falls within the specified limits, the sample shall be deemed to comply with the Worksection. Concrete with air content outside these limits on the second test shall not be used in the base.

4 STEEL REINFORCEMENT

4.1 MATERIAL

Standards

Steel reinforcement shall comply with AS/NZS 4671.

Type and size
The type and size of bars shall be as shown on the Drawings.

Cleanliness
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.

Galvanised bars
Where galvanised bars are specified, the bars shall be hot dipped to provide an average minimum coating thickness of 85 micrometre of not less than 98 % by mass of zinc.

Should any doubt arise, in the opinion of the Superintendent, as to the quality of the applied coating, tests shall be required and these shall be carried out in accordance with AS/NZS 4680.

Documentary evidence
The Contractor shall obtain a Certificate from a registered NATA laboratory stating that all steel reinforcement complies with AS/NZS 4671. All relevant test results shall accompany the Certificate.

Test certificates and identification
Test certificates shall show the results of mechanical tests and chemical analysis. No material shall be used in the work until it has been identified with the tests to the satisfaction of the Superintendent.

Further sampling
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.

4.2 BENDING

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.

Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

Bars bent by any method shall not be straightened and incorporated within the works.

4.3 BAR SPLICING

Lengths indicated on the Drawings
All reinforcement shall be furnished in the lengths indicated on the Drawings. Splicing of bars shall only be permitted at the locations shown on the Drawings.

Plan lengths
The length of lapped splices not shown on the Drawings shall be as follows for unhooked bars:

- Plain bars, Grade 250 - 40 bar diameters
- Deformed bars, Grade 400 - 35 bar diameters
- Hard-drawn wire - 50 bar diameters

Splice dimensions
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.

Welded splice
In welded splices, bars shall only be welded by an approved electrical method. Grade 400 deformed bars shall not be welded.

Documentation denoting welding means and related materials are to be submitted to the Superintendent 5 working days prior to commencement of operation for inspection and approval.

Welding shall comply with AS/NZS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

4.4 PROTECTION OF REINFORCEMENT DURING STORAGE

Reinforcement, unless promptly incorporated into the concrete, shall be stored under a waterproof shelter and supported clear of the ground, and shall be protected from damage and from deterioration due to exposure.

4.5 PLACING AND COVER REQUIREMENTS

Position

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, plastic or plastic tipped wire chairs and by wiring together where required using annealed iron wire not less than 1.2 mm diameter. These supports shall be in a regular grid not exceeding 1.0 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.

Chair supports

The arrangement and spacing of chairs shall be such that the reinforcement will be supported in proper position with permanent deflection or displacement of the reinforcement of no more than 2 mm during placing and consolidation of the concrete.

The chairs shall also have sufficient bearing at their base to prevent overturning.

The mass of reinforcing steel supported by any one chair shall not exceed 10 kg.

Chairs shall be capable of supporting a 200 kg mass without permanent distortion in excess of 2 mm.

The distance from the supporting surface on which the chair rests to exposed steel of the chair shall be not less than 50 mm.

Cover dimensions

Longitudinal steel shall be placed on top of transverse steel. Longitudinal steel shall have a minimum top cover of 70 ±10 mm unless otherwise shown on the Drawings.

The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless shown otherwise on the Drawings.

Tack welding

Tack welding may be used instead of wire ties on reinforcing steel.

Tie bars

Tie bars for longitudinal joints shall not be placed through the finished top surface of the concrete base. The bars shall be placed ahead of paving or by a suitable bar vibrator into the edge of the joint or by an automatic tie bar inserted on the mechanical paver.

The method of insertion shall be such that tie bars develop an anchorage strength of at least 85 % of the yield strength of the bar.

Details of the proposed method of tie bar insertion shall be submitted to the Superintendent for approval.

The finished surface shall conform to **Alignment and tolerances** regarding surface tolerance.

Loose tie bars

Bars found to be loose shall be removed and reset by using a suitable epoxy or polyester setting system to develop an anchorage strength of at least 85 % of the yield strength of the bar.

Bar insertion shall not disturb the concrete surface.

Dowelled joints

For dowelled joints, dowels shall be placed parallel to the pavement surface and normal to the line of the joint, unless shown otherwise on the Drawings.

Dowels shall be installed ahead of paving by a dowel support assembly approved by the Superintendent.

One end of each dowel on the same side of each joint shall be coated for a distance of (L/2 + 25 mm) with two coats of bitumen emulsion (or one coat of bitumen) and sanded to ensure free movement of the concrete base slab with temperature variations.

The coated end shall have a preformed cap to provide a minimum of 30 mm clearance for movement.

The ends of dowels shall be burr free and circular in cross-section.

Dowels possessing crimped or ovoid end faces shall not be incorporated into the works.

5 DESIGN AND CONTROL OF CONCRETE MIXES

5.1 GENERAL

Nominated mixes for approval

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'.

Certified test results

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 worksection.

All phases of any particular test must be performed at one laboratory.

All relevant test results shall accompany the Certificate.

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.

Compressive strength

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 AS 1012.9.

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 MPa of the median and the compressive strength for 28 days shall be between 36 MPa and 40 MPa.

Slump for trial batch

The concrete for compressive strength cylinders shall be mixed with a water content resulting in the slump being 10 mm higher than the maximum specified for machine placed and hand placed concrete.

Approval of nominated mixes

These details shall be submitted at least 21 days before using the nominated mix in the work.

This action constitutes a **Hold Point**.

The Superintendent's approval of the nominated mix (or mixes) is required prior to release of the **Hold Point**.

5.2 VARIATIONS TO APPROVED MIXES

Approval for mix variation

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.

Revised nominated mix and materials

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with **Design and control of concrete mixes (General)**.

If the variations to the quantities of the constituents in the approved mix are less than 10 kg per cubic metre for Portland cement and flyash and 5 % by mass for each other constituent, except admixtures, per yielded cubic metre of concrete the Superintendent may approve the changes once without new trials being carried out.

Any change will require retesting in accordance with **Design and control of concrete mixes (General)** and **Concrete cylinders**.

Content per cubic metre

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.

6 CONCRETE STRENGTH, COMPACTION AND THICKNESS

6.1 CONCRETE CYLINDERS

Test specimens

Compressive strength: Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8.1.

Moulds and laboratory: The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing 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.

Test results: Copies of test results shall be forwarded to the Superintendent within 24 hours of receipt by Contractor.

Sampling: Samples of concrete for testing shall be taken in accordance with AS 1012.1.

The specimens shall be moulded from each sample so that they are as identical as practicable.

Curing: The method of making and curing specimens shall be in accordance with AS 1012.8.1 with compaction by internal vibration.

Marking: The Contractor shall mark the specimens for identification purposes. Marking shall include sampler's name, date, batch number, and representative location of sample within works.

Costs of testing: The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Contractor.

Frequency of moulding of test specimens

For each lot of base concrete placed at the one time, one (1) pair each of test specimens shall be moulded for the determination of the compressive strength at both 7 days and 28 days.

Lot size: A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed.

Inspection, capping and crushing of specimens

Laboratory:" Specimens required by this Worksection shall be tested at the NATA registered laboratory nominated by the Contractor.

Cost of testing: The cost of such testing shall be borne by the Contractor.

Standards: Specimens shall be inspected, capped, crushed and tested in accordance with AS 1012.9.

Mass unit volume: Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS 1012.12.2 so that the relative compaction of the cores taken from the same lot of concrete base can be determined.

6.2 COMPRESSIVE STRENGTH OF CONCRETE

Determination of strength

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 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

The 7 day and 28 day test results shall be used for statistical checking of the nominated mix in accordance with **Compressive strength of concrete**.

Adjustment of test compressive strength for age of specimen

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 6.1.

For intermediate ages the factor shall be determined by interpolation from Table 6.1.

Table 6.1 Concrete conversion factors

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

Conformance for compressive strength

Limits: If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa or greater than 45 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with **Removal and disposal of concrete base** and **Replacement of base**.

Below specified strength: Concrete with a 28 day strength between 33 MPa and 36 MPa may be accepted providing such concrete shall be subject to a deduction for supply and place concrete in base in accordance with **Deductions** provided that such concrete represents isolated sections which comprise less than 5% of the area of the lot.

Where concrete with a 28 day strength less than 36 MPa comprises more than 5% of the area of the lot, the lot shall be rejected.

Strength and thickness acceptance: Acceptance of concrete with a twenty eight day compressive strength between 42 MPa and 45 MPa is dependent on the thickness of the concrete base, as detailed in **Conformance for thickness**.

Coring: The Contractor may elect to carry out in situ strength testing by coring. In such cases, the procedures as detailed in 1132 *Mass concrete subbase* shall be followed.

Additional cylinders: If the Contractor considers that coring will be required to verify the conformity of any lot then arrangements shall be made at the trial batch stage to have sufficient cylinders to extend the compressive strength gain graph from 28 days to at least 72 days as required by **Design and control of concrete mixes**.

The Superintendent may use these results to calculate the equivalent 28 day compressive strength of the cores taken. Superintendent's absolute discretion

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:

- The average of the 28 day compressive strength of the pair of specimens moulded at the time of placing; or
- The equivalent twenty-eight day compressive strength of the core.

Lot size: 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.

Concrete uniformity check by statistical analysis

Tests for each nominated mix: A statistical check shall be made by the Contractor of the compressive strength of machine placed concrete, using consecutive seven day test results representing concrete placed in the work for each nominated mix used.

Test method: Test specimens for determining the compressive strength of concrete at seven days shall be moulded and tested in accordance with **Concrete cylinders**.

Test results shall be analysed on the basis of groups of consecutive pairs of specimens.

Mix acceptance: The concrete mix and its method of production shall be considered satisfactory if the following requirements are met:

- The standard deviation (S) of any 'n' consecutive pairs of specimens shall not exceed 3 MPa where 'n' shall not be less than 30.
- The average strength of any six consecutive pairs of specimens shall not be less than $(F_1/F_{28})\times 32 + S$ (Mpa)

  (Where F_7 and F_{28} are the compressive strengths at age 7 days and 28 days respectively.)
  Prior to 30 samples becoming available, a value of 3 MPa shall be adopted for S.

Strength conditions not met: Should either of the above strength conditions not be met the Contractor shall furnish a report to the Superintendent and modify the mix and/or improve the method of production of concrete.

Compliance with specification: Compliance with these requirements shall not affect the Contractor's obligations to produce concrete which satisfies all requirements of the Worksection.

6.3 CONFORMANCE FOR THICKNESS

Thickness measurement

Thickness measurements of the concrete base shall be determined by survey from the level difference between the base and the subbase surface models on a 5 m grid.

In special circumstances the Superintendent may authorise coring and measurements at the edges.

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 5 mm.

More than 10 mm below the specified thickness

Base which is more than 10 mm below the specified thickness shall be removed and replaced in accordance with **Removal and disposal of concrete base** and **Replacement of base**.

10 mm or less below the specified thickness Acceptance

Base which is 10 mm or less below the specified thickness may be accepted providing that it represents isolated sections within a lot and such sections comprise less than 5 % of the area of the lot. Such concrete shall be subject to a deduction in accordance with **Deductions**.

Excess thickness

Where the thickness of the base exceeds the specified thickness, conformance of the base is dependent on both thickness and strength, as shown in Figure 6.1.

Deductions shown shall be applied in accordance with **Deductions**.

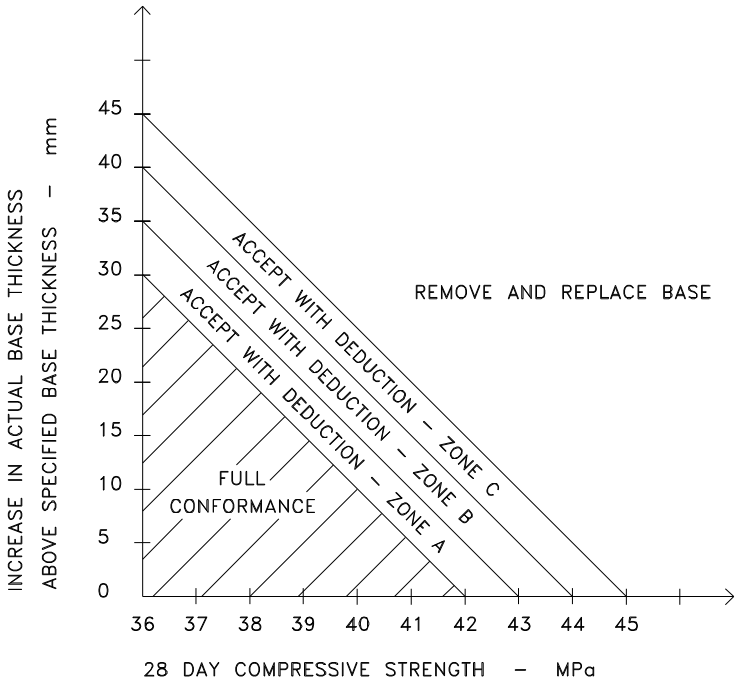

Figure 6.1 Base conformance criteria (thickness/strength)

6.4 RELATIVE COMPACTION OF CONCRETE

Test specimens

Cores: 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:

- The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However concrete must not be less than six days old before coring. This period may be adjusted with the approval of the Superintendent.
- The nominal diameter of the cores shall not be less than 75 mm.

Location of cores: The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars from the core. Cores shall be marked for identification.

Storage: 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.

Temperature control: 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.

Frequency of coring

Minimum: 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 6.1.

Hand placed concrete: 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.

Repair of core holes

Restore all core holes: 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.

Surface condition: The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

Cost of core restoration: The cost of restoring core holes shall be borne by the Contractor.

Testing of cores for compaction

Curing: 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.

Relative compaction: 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 1012.12.2.

Cost of obtaining, curing and testing: All costs associated with obtaining, curing and testing of cores shall be borne by the Contractor.

Conformance for compaction

Rejection percentage: If the relative compaction is less than 97%, the lot represented by the core shall be removed and replaced in accordance with **Removal and disposal of base and replacement of base.**

Conditional acceptance: If the relative compaction is between 97% and 98% , conformance shall be conditional on the 28 day strength of a core specimen. Cores for compressive strength testing shall be obtained, except when the concrete base shall be at least 25 days old at the time of removing the specimen.

Core preparation: 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.

Adjustment for age: The test strength shall be adjusted for age at test in accordance with **Compressive strength of Concrete** and for length/diameter by multiplying by the correction factor in Table 6.2.

Core compressive strength: If the 28 day compressive strength of the core is less than 32 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with **Removal and disposal of concrete base** and **Replacement of base**.

Table 6.2 Correction factors

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

7 PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

7.1 PRODUCTION AND HANDLING OF CONCRETE

Contractor's responsibility

At least four weeks before commencing work under this worksection, 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.

Handling and batching methods

The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:

- 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.
- Cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first.
- The moisture content of the aggregates shall be determined as frequently as requested by the Superintendent. Corresponding corrections shall be made to the quantities of aggregates and water.
- 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.

Mixer requirements

Details of proposed mixers and agitation methods shall be in accordance with AS 1379, with the additional requirement that the maximum permissible difference in slump shall be 10 mm.

7.2 MIXING AND TRANSPORT—AS 1379 AND ADDITIONAL REQUIREMENTS

Methods

Mixing and transport methods shall be in accordance with the Production and Delivery sections of AS 1379, with the following additional requirements:

- The mixer shall be charged in accordance with the manufacturer's instructions.
- 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 as directed by the Superintendent into the tray of a moving vehicle.
  The length of the tray shall be a minimum of 8 m. The concrete shall then be sampled from the tray of the vehicle at points approximately 15% and 85% along the length of the tray.
- 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 circumstances shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

- Admixtures shall be separately prediluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs.
- Where a continuous type mixer is used, the plant shall not be run so as to produce at a rate greater than its manufacturer's rated capacity at any time.
  The Superintendent may require that the production rate be reduced if the quality of the concrete produced indicates that a longer mixing time is required. Product from continuous type mixers must conform to the requirements of uniformity as detailed for batch mixers.
- 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.
- Depending on weather, minor finishing and texturing may be carried out outside these limits.
  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.
- The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 % of the gross volume of the drum of the mixer.
  For non-agitating trucks, the load shall not exceed the rated capacity of the trucks.

7.3 MIXING TIME

Minimum mixing time

The minimum mixing time will be as determined by the trial mix design and confirmed when the trial concrete base is constructed.

Maximum mixing time

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.

Long delays

For longer delays 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.

7.4 CONSISTENCY

Tolerances

At all times between mixing and discharge, the slump shall be within 10 mm of the Contractor's nominated slump for the nominated mix for mechanically placed concrete and within 15 mm thereof for hand placed concrete.

Test method

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1. The test shall be made on concrete samples obtained in accordance with AS 1012.1 or other method approved by the Superintendent.

Timing of testing

The consistency of the concrete shall 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.

Cost of consistency testing

The cost of consistency testing shall be borne by the Contractor.

8 PLACING AND FINISHING CONCRETE IN BASE

8.1 GENERAL

Quality plan submission

At least 28 days before commencing work under this worksection, 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 proposed paving widths and estimated daily outputs. Paving widths shall conform to the allowable locations of longitudinal joints shown on the Drawings.

Notice of the intention to commence construction

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 **Trial concrete base**).

Subbase condition

The subbase surface shall be clean and free of loose or foreign matter and prepared in accordance with 1132 *Mass concrete subbase*.

Air temperature

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

Concrete temperature

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.

Slab anchors

Where required, slab anchors shall be constructed prior to construction of the base.

8.2 RATE OF EVAPORATION

Evaporation limit

When the value of Rate of Evaporation, determined from the graph in Figure 8.1, exceeds 0.50 kg/m^2/hr 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 kg/m^2/hr.

Use of retarder

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.

Documentation specifying the type, rate of application and manufacturers instruction shall be submitted to the Superintendent for approval prior to application.

Measuring and recording concrete temperature and wind velocity

The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement when directed by the Superintendent, 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.

Costs of measurement and control

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.

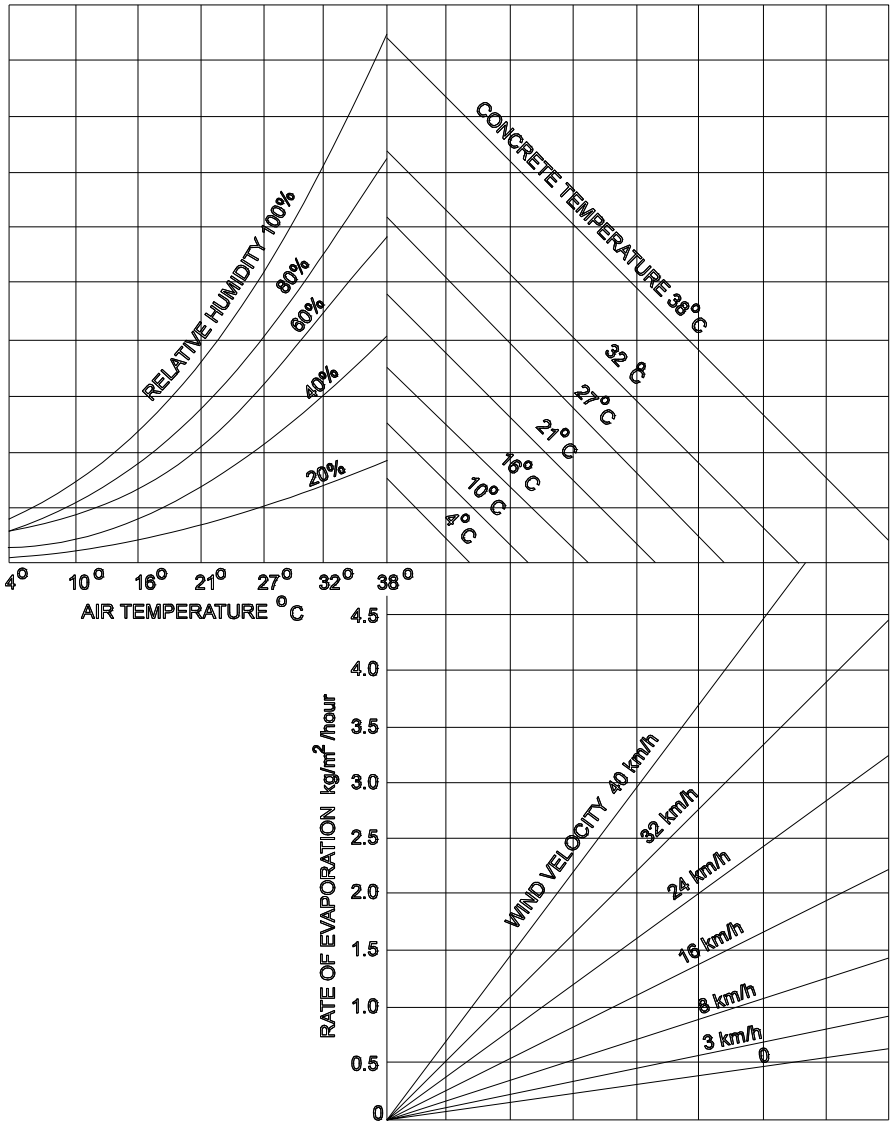

Figure 8.1 Rate of evaporation

8.3 MECHANICAL PAVING

Spreading device

A separate device shall be used ahead of the mechanical paver to transport and spread concrete uniformly over the full width being paved.

The spreading device shall not disturb the reinforcement or its supports.

It shall be capable of transporting and spreading concrete at a rate sufficient for the continuous operation of the paver and in a manner such that the concrete is not segregated or otherwise adversely affected.

Paving machine

The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than four 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.
- Internal vibrators capable of compacting the full depth of the concrete.

- Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

Concrete finish

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 free from visual defects.

Supporting surface

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.

Continuity of paving operation

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 joints shall be borne by the Contractor.

Interruption to paving

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 **Transverse construction joints** at the direction of the Superintendent.

Non-monolithic concrete

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 **Removal and disposal of concrete base**, **Replacement of base** and **Rectification of finished surface and rideability nonconformance**.

8.4 HAND PLACING

Restriction

Hand placement shall only be used in areas where mechanical placement is impracticable.

Formwork

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.

Placing in forms

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 build up of concrete between the forms and vibratory screed shall be prevented.

Disruption to paving

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.

Finished concrete

A dense and homogeneous concrete with non-porous surface finish shall be provided. It shall be textured in accordance with **Texturing of surface**, or as otherwise specified by the Superintendent.

Transverse construction joint

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 **Transverse construction joints**.

Non-monolithic concrete

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 **Removal and disposal of concrete base**, **Replacement of base** and **Rectification of finished surface and rideability nonconformance**.

8.5 ALIGNMENT AND TOLERANCES

Horizontal alignment tolerances

Outer edges: The outer edges of the base shall be square to the subbase surface and shall not deviate from the plan position at any point by more than 30 mm.

Longitudinal joint: Where an edge is to form a longitudinal joint line the allowable horizontal alignment shall comply with **Longitudinal tied joints**.

Tolerances and rideability

Thickness of concrete: The tolerance on thickness for the base shall be zero below the specified thickness and in accordance with **Conformance for thickness** for excess thickness.

Top of base level: The top surface of the base shall not be below that shown on the Drawings.

Surface level: The top surface of the base shall also not deviate from a 3 m straight-edge, laid in any direction, by more than 5 mm.

Ponding: Notwithstanding this requirement the surface shall not pond water.

Inspection within 24 hours

The Contractor shall survey the alignment, surface and edge thickness for conformance with the above requirements within 24 hours of placing an area of base or as otherwise agreed with the Superintendent.

8.6 TEXTURING OF SURFACE

Transverse texture

As soon as possible after placing, the surface of the freshly placed concrete shall be transversely textured by means of a mechanical device for grooving plastic concrete.

The texturing equipment shall utilise rectangular-shaped tynes of flat spring steel, approximately 0.6 mm thick. The width of the tynes shall be 3 mm. The tynes shall be spaced in a random pattern.

Depth

The average texture depth shall be between 0.30 mm and 0.65 mm when tested in accordance with Test Method T240. This corresponds to an individual groove depth of 1.5 mm to 3 mm.

Machine texture

For paving widths exceeding 2.5 m, the texturing shall be carried out by means of a machine spanning the concrete slab and guided, with regard to both level and direction, by the rails in the case of side-form construction or by the paver guide wires in the case of slip form construction.

Texturing combs

The width of the texturing brushes or combs shall be at least 750 mm. Provision shall be made for downward adjustment to compensate for wear.

Submission of method

The Contractor shall submit to the Superintendent details of the proposed texturing device and demonstrate the method proposed to achieve the required texture. Before texturing commences, the texturing equipment and the method of texturing shall be approved by the Superintendent.

Saw grooves

Areas with an average texture depth, determined by Test Method T240, of less than 0.3 mm shall be transversely saw grooved to meet the average texture depth requirements of 0.3 mm to 0.65 mm.

Saw grooves shall be approximately 3 mm wide, 3 mm deep, at random spacing approved by the Superintendent and having a mean spacing neither less than 10 mm nor more than 21 mm.

Alternative texturing

Where the Superintendent directs or where an asphalt surfacing is specified over the concrete base, texturing of the concrete surface may be effected by use of a fine broom or hessian-drag.

8.7 CURING

Compounds

Curing shall be by the use of materials complying with AS 3799 Class B Resin Based Curing compound Type 1D or Type 2 or Class C Chlorinated Rubber Curing Compound Type 1D.

Where an asphalt wearing surface is to be applied, Bitumen emulsion Grade CRS/170, complying with AS 1160 may be used.

Efficiency index

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance from an Australian laboratory, approved by the Superintendent, showing a non-volatile content and an Efficiency Index of not less than 90% when tested in accordance with Appendix B, AS 3799.

Application method

Application of the curing compound using a fine spray shall be as follows:

- For transversely tyned surfaces—in two applications. The first application shall be applied immediately following texturing and the second application shall be applied fifteen to thirty minutes later.
  Each application shall be at the rate stated on the certificate of compliance or at 0.2 litres /m^2, whichever rate is the greater.
- For hessian-dragged surface—immediately following texturing at the rate stated on the Certificate of Compliance or at 0.2 litres/m^2, whichever rate is the greater.
  Bitumen emulsion shall be applied at a minimum rate of 0.5 litres/m^2.
- The curing compound shall be applied by a mechanical sprayer, spraying transversely or longitudinally, having a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.

  The sprayer shall incorporate a device for continuous agitation and mixing of the compound in its container during spraying. After shut-off of the spray nozzles, there shall be no dripping of the curing compound on the concrete surface.

Application time

Curing compound shall be applied immediately after the surface is free of bleed water, or when directed by the Superintendent.

Contractor's responsibility

The application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound falling on three felt mats, each approximately

0.25 litres /m^2 in area, placed as directed by the Superintendent.

Hand spraying

For the sides of formed slabs and for small areas where a mechanical means of distribution cannot be used, the compound shall be sprayed by hand lance at a rate 25% higher than that used on the main base.

Curing membrane

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.

The cost of making good such damaged curing membrane shall be borne by the Contractor.

Equipment on site

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

Plant unavailable

If the mechanical sprayer becomes inoperable, concrete paving by mechanical means shall cease and shall not recommence until the mechanical sprayer becomes fully operable again.

Any uncovered areas shall be sprayed with suitable hand operated equipment

8.8 PROTECTION OF WORK

Temperature control

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 worksection, the concrete shall be rejected.

Rain protection

The Contractor shall protect the work from rain damage. Detailed proposals for procedures and equipment to be used for such protection shall be submitted to the Superintendent prior to the commencement of works. The procedures shall not damage the work and shall be such that finishing and curing operations can be completed. The equipment for protection of work shall be kept on site and be capable of being fully operational at short notice.

Personnel experienced in the operation of such equipment shall be available at short notice.

Traffic restrictions

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 ten days have elapsed since placing concrete, and the concrete has reached a compressive strength of at least 20 MPa.

Traffic management required to effect the requirements of this clause shall comply, at a minimum, with 1101 *Control of traffic*.

The Superintendent may direct the Contractor to provide Traffic Management either pedestrian or vehicular in excess of that specified if such measures are warranted due to site specific requirements.

The costs associated with Traffic Management and Safety shall be borne by the Contractor.

8.9 TRIAL CONCRETE BASE

Location

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 worksection.

This section shall be constructed so that it may be incorporated in the finished work.

Method

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.

Machine placing

For machine placed operation, a trial length of between 100 m and 200 m, or lesser length as approved by the Superintendent, and at the maximum width proposed to be laid, shall be constructed in one continuous operation.

Hand placing

For hand placed operation, a trial length between 20 m and 50 m and at the maximum width proposed to be laid, shall be placed in one continuous operation.

Trial results

The Contractor shall submit to the Superintendent relative density and 7 day cylinder and core compressive strength results from the trial base.

This action shall constitute a **Hold Point**.

Inspection and approval of the test results are required by the Superintendent prior to the release of the **Hold Point**.

Deficiencies in trial section

Unless advised by the Superintendent of any deficiencies in the trial concrete base, due to failure to comply with this worksection, 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.

New trial section

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 worksection.

Payment for trials

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 worksection, shall be rejected by the Superintendent and shall be removed by the Contractor in accordance with **Removal and disposal of concrete base**, **Replacement of base** and **Rectification of finished surface and rideability nonconformance**.

8.10 CONCRETE CRACKING

Planned cracks

Planned cracks in continuously reinforced concrete pavements are discrete full depth transverse cracks over the full width of a paving run. These cracks do not require any treatment.

Unplanned cracks

If unplanned cracking occurs, the Contractor shall immediately implement treatment as follows:

- Cracks whose width exceeds 0.3 mm shall be filled with a suitable low viscosity penetrating epoxy resin.
- Individual longitudinal cracks which are greater than 300 mm long and which lie within 1.0 m of an edge or longitudinal joint, shall be cross-stitched as detailed in the Drawings.
- If the cumulative length of unplanned cracks exceeds 40 m in any 40 m2 area measured between adjacent longitudinal joints or edges, then that area of concrete base shall be removed and replaced in accordance with **Removal and disposal of concrete base**, **Replacement of base** and **Rectification of finished surface and rideability nonconformance**.
- Unplanned cracks not covered in items (a) to (c) above shall not require treatment.

9 JOINTS

9.1 TRANSVERSE CONSTRUCTION JOINTS

Location

Transverse construction joints shall be provided at discontinuities in the placement of concrete determined by the Contractor’s paving operations.

These joints shall be constructed at 90° ±5° to the longitudinal joint.

Additional reinforcement

Additional reinforcement shall be provided at the joint as detailed on the Drawings. Where the additional reinforcement is inserted by drilling and fixing in hardened concrete, the length of bar inserted shall be not less than 0.5 m.

A suitable epoxy mortar shall be used and the setting system shall develop an anchorage strength of at least 85% of the yield strength of the bar.

Tolerance

The line of the joint shall not deviate by more than 10 mm from a 3 m straight-edge placed along the joint.

Placing adjoining concrete

Prior to placing adjoining concrete, the surface of the joint shall be roughened to expose coarse aggregate. The roughened surface and projecting reinforcement shall be washed clean and all excess water and loose material removed.

9.2 LONGITUDINAL TIED JOINTS

General

Location: Longitudinal tied joints shall be provided at the locations and to the details shown on the Drawings.

Reinforcing steel: Reinforcing steel shall be provided across all longitudinal joints as detailed in the Drawings.

Tie bars: Insertion of tie bars shall comply with **Placing and cover requirements**. 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.

Tolerances: The line of all 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 straight-edge by more than 10 mm having made due allowance for any planned curvature.

Ribbon-induced joints

Machine inserted: Where induced joints are produced by machine-inserted ribbon, the top of the ribbon shall not protrude above the concrete surface, nor be below the concrete surface by more than 3 mm.

Finish: The ribbon shall be not less than 0.5 mm thick and sufficiently stiff such that on placement it shall not curve in transverse section by more than 3 mm from straight. Furthermore, when placed it shall be within 5° of the vertical plane.

Ribbon ends: Ribbon ends shall be spliced to ensure continuity of the induced joint.

Sawn-induced joints

Method: Where induced joints are provided by sawcutting, the sawcut shall be 3 mm wide. Sawcutting shall be conducted between 6 and 24 hours after initial pour so as not to cause excessive ravelling of aggregate adjacent to the cut.

Edge ravelling: The surface of the sawn joint shall not exhibit more than 5 mm width of vertical or horizontal edge ravelling. The cumulative length of such edge ravelling shall not exceed 300 mm in any 1 m length of joint on each edge.

Sealing of joint: The joint shall be thoroughly cleaned of all debris and sealed in accordance with the Drawings. The permanent sealant shall be colour-compatible with the concrete base.

If permanent sealing is not carried out within 24 hours of sawing, a temporary seal shall be installed within 24 hours to prevent ingress of grit, debris or other foreign materials.

Temporary sealing

Material: 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.

Tolerance: The top of the backer rod shall be neither higher or lower than 10 mm below the concrete surface. The backer rod shall pass over any longitudinal joint seal already in place.

Maintenance: 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.

Permanent sealing—General

Timing: Within ten days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint unless specified otherwise by manufacturer's instruction.

Sealant quality: 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.

Permanent sealing—Neoprene compression sealants

Standards: Neoprene compression sealants shall comply with all the requirements of ASTM D2628. Test methods used to determine compliance with these requirements shall include Test Methods T1160, T1161 and AS 1683.23.

Installation: 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 sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle. The maximum increase in length of the sealant after installation shall be 5 % of original length. Any sealant exceeding 5 % extension shall be rejected.

Tolerances: 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.

Permanent sealing—Silicone sealants

Requirements: Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table 9.1.

Table 9.1 Silicone joint sealant requirements

Test method	Test	Requirements
ASTM-D792 (Method A)	Specific gravity	1.1—1.55
ASTM-D2240 (Standard Curing)	Durometer hardness	10—25
MIL-S-8802	Extrusion rate	90—250 g/min
MILS-S-8802	Tack free time	30—70 mins
ASTM-C793	Accelerated weathering	No chalking, cracking or bond loss at 5000 hrs
ASTM-C794	Adhesion to concrete	Minimum 35N average peel strength
T1192 T1193	Durability	Extension to 70% compression to 50%
N.A.	Colour	Grey, compatible with pavement concrete

Colour and installation: 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.

Action before sealing: 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. If the backer rod is damaged in any way it shall be replaced for the full length of the joint. The replacement 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.

Contractor's responsibility: 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 worksection.

Permanent sealing—Treatment prior to asphalt overlay

Where asphaltic surfacing over the concrete base is specified, only the initial 3 mm wide sawcut shall be provided and filled with silicone joint sealant in accordance with **Longitudinal tied joints**.

9.3 LONGITUDINAL JOINT WITH KERB AND/OR CHANNEL (GUTTER)

Tie bars

Where the kerb and/or gutter is not constructed integrally with the concrete base, tie bars shall be inserted in accordance with the Drawings and **Placing and cover requirements**.

Treatment

The face of the longitudinal joint need not be roughened and the joint need not be sealed.

9.4 ISOLATION JOINTS

Location

Isolation joints shall be provided at the locations and to the details shown on the Drawings.

Tolerances

The line of the 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 straight-edge by more than 10 mm.

Filler and sealant

The joint filler shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent and sealant shall comply with the requirements listed in Table 9.1. They shall be installed in accordance with the Drawings and in a manner conforming to the manufacturer's recommendations.

9.5 INSPECTION OF JOINTS

The Contractor shall inspect each joint within 24 hours of its construction.

If nonconformance is detected in relation to joint alignment and/or edge ravelling, the Contractor shall immediately undertake remedial action at no cost.

10 SLAB ANCHORS AND BRIDGE APPROACH SLABS

10.1 GENERAL

Location

Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the Drawings or where directed by the Superintendent.

Transverse joint

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.

10.2 EXCAVATION

Dimensions

Excavation of trenches for slab anchors shall be to the dimensions and details shown on the Drawings.

Trim and consolidate

All loose material shall be removed and the vertical faces trimmed to neat lines.

The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material and to the satisfaction of the Superintendent.

Spoil

The Contractor shall dispose of excavated material at locations approved by the Superintendent.

Adjacent to flexible pavement

Where a slab anchor is required at the junction of an existing flexible pavement, a straight sawcut to the full depth of any asphaltic concrete 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. The cost of making good any disturbance or damage to the flexible pavement shall be borne by the Contractor.

Sub-soil drains

A subsoil drain shall be provided at the bottom of the trench, in accordance with 1172 *Subsoil and fountain drains* and details shown on the Drawings.

10.3 CONSTRUCTION

Produced, transported and placed

Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand-placed base concrete.

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.

Transverse isolation joint
A transverse isolation joint shall be provided on the downhill side of the slab anchor.

Steel reinforcement
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 **Steel reinforcement**.

10.4 BRIDGE APPROACH SLABS

Bridge approach slabs shall be constructed at bridge abutments to the dimensions and details shown on the Drawings and in accordance with the requirements for base concrete.

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.

Transverse expansion joints shall be provided in accordance with the Drawings.

11 REMOVAL AND REPLACEMENT OF BASE

11.1 REMOVAL AND DISPOSAL OF CONCRETE BASE

Submission of method
Where nonconforming base is to be removed and replaced, the Contractor shall submit the proposed method to the Superintendent before commencing such work.

Timing
Breaking up of concrete shall not proceed until adjoining concrete for 100 m each side of the section (including adjacent paving lengths) to be removed has achieved the specified 28 daycompressive strength.

Transverse saw cuts
At each end of the section to be removed a transverse sawcut shall be made in a straight line and continuous between adjacent longitudinal joints and perpendicular to the control line or longitudinal joint at a depth of 40 + 10 mm and at a location not closer than 500 mm to an existing transverse crack in the concrete which is to remain.

Face of the construction joint
The face of the construction joint is left scabbled below, but not within, the depth of the sawcut, and not less than 1.0 m of every longitudinal bar is left protruding and undamaged beyond those joints.

Oversawing
Oversawing into the adjoining base shall not be permitted.

Longitudinal joint or edge
At each longitudinal edge of the non-conforming base the concrete shall be removed:

- to an existing longitudinal joint or edge; and
- in such a way that the exposed face complies with the criteria for longitudinal construction joints as defined in this worksection.

Extent of sawcut
Longitudinal sawcuts shall not extend beyond the transverse sawcuts which define the limits of removal.

Additional sawcuts
Should the contractor elect to make additional sawcuts (either longitudinal or transverse) within the non-conforming concrete to facilitate its removal, these shall not extend beyond the limits of the removal into either the adjacent base or the underlying subbase.

Oversawing
No oversawing shall be permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base.

Disposal
The Contractor shall dispose the removed base slabs at a location of his choice acceptable to the Superintendent.

11.2 REPLACEMENT OF BASE

Subbase preparation

Before construction of the replacement base, the subbase shall be prepared and debonded in accordance with 1132 *Mass concrete subbase*.

Compliance with this specification and following additional requirements

All work involved in the replacement of base shall comply with the worksection, including the following additional requirements:

- 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 **Transverse construction joints**.
- Continuity in the reinforcement shall be provided in accordance with **Bar splicing** regarding splicing.
- 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.
- 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 % of the yield strength of the bar.
- 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.

11.3 RECTIFICATION OF FINISHED SURFACE AND RIDEABILITY NONCONFORMANCE

Individual locations identified as nonconforming in accordance with **Alignment and tolerances** shall be rectified to achieve conformance by grinding with purpose-built equipment employing sawblades. Impact methods such as rotomilling shall not be used to rectify nonconformances.

12 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 12.1.

Table 12.1 Summary of limits and tolerances

Activity	Limits/tolerances	Worksection Clause Reference
Water		
- Chloride Ion	Less than 600 ppm	**Water**
- Sulphate Ion	Less than 400 ppm	**Water**
Aggregates		
- General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	**Aggregates**
- Combined aggregate	Grading limits. Table 2.1.	**Aggregates**
- Fine aggregate		
. Grading	To be within the limits as per Table 2.2 and shall not deviate from Proposed Grading by more than amounts in Table 2.2	**Aggregates**
- Coarse aggregate		
. Grading	To be within the limits as per Table 2.3 and shall not deviate from the Proposed Grading by more than the amounts in Table 2.3	**Aggregates**

Activity	**Limits/tolerances**	**Worksection Clause Reference**
. Properties	Table 2.4.	**Aggregates**
Concrete quality		
- Cement content	At least 270 kg per yielded cubic metre of concrete	**Cement and flyash content**
- Flyash	Not greater than 50 kg per yielded cubic metre of concrete	**Cement and flyash content**
- Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	**Shrinkage**
- Consistency	Nominated slump shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete. It shall be neither less than 55 mm nor more than 65 mm for hand placed concrete. The VeBe reading shall be a maximum of 4 seconds at the nominated slump less 10 mm	**Consistency**
- Air content	Shall be 3% to 6% when discharged from the transport vehicle ready for placement	**Air content**
- Compressive strength	The minimum 28 day compressive strength shall be 32 MPa and the maximum 42 MPa.	**Compressive strength**
- Relative compaction	Relative compaction shall not be less than 98%.	**Relative compaction of concrete**
Steel reinforcement		
- Wire chairs	Plastic tips on chairs to withstand load of 200 kg mass on the chair for one hour at 23 ± 5°C without being pierced by the wire	**Placing and cover requirements**
- Spacing of chairs	Placed in a regular grid not exceeding 1 m	**Placing and cover requirements**
	Placed such that permanent deflection or displacement of the reinforcement is no more than 2 mm during placement and consolidation of concrete	**Placing and cover requirements**
- Bending reinforcement	Where not shown on the Drawings, bending shall be made around a pin having a diameter not less than four times diameter of bar bent	**Bending**
- Fabric splice	Not less than the pitch of the transverse wires + 25 mm	**Bar splicing**
- Longitudinal steel	Cover >70 ±10 mm	**Placing and cover requirements**
- Any bar	Cover >50 mm	**Placing and cover requirements**
- Tie bars	Anchorage Strength >85 % of the yield strength of the bar	**Placing and cover requirements**
- Dowels	Bitumen coated end to have minimum clearance of 30 mm in preformed cap	**Placing and cover requirements**
Concrete placing	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	**General**
Concrete relative compaction		
- Core size	Nominal diameter of cores >75 mm	**Relative compaction of concrete**

Activity	**Limits/tolerances**	**Worksection Clause Reference**
- Frequency of coring	Minimum of one core specimen for each lot of concrete standard cylinders	**Relative compaction of concrete**
- Repair of core holes	. Compressive strength not less than that in base	**Relative compaction of concrete**
	. Max. nominal aggregate size 10 mm	**Relative compaction of concrete**
- Relative compaction values	Should the relative compaction be less than 97% the portion of the base represented by the core shall be rejected, removed and replaced. Should the relative compaction be between 97% and 98% conformance shall be conditional on the 28 day strength of the core specimen	**Relative compaction of concrete**
Concrete thickness	. With 5 mm less than specified thickness, deduction per Clause 13.2.	**Conformance for thickness**
	. With 10 mm less than specified thickness deduction per Clause 13.2.	**Conformance for thickness**
	. Where excess thickness occurs, conformance is dependent upon thickness and strength as per Figure 2.1.	**Conformance for thickness**
Mixing and transport		
- Truck mixed concrete	Water to be added within 10 minutes of completion of batching	**Mixing and transport— AS 1379 and additional requirements**
- Haul time	Concrete not delivered within allowable haul time to be rejected	**Mixing and transport— AS 1379 and additional requirements**
- Size of batch	Batch in agitator vehicle not to exceed 80 % of gross volume of drum of mixer	**Mixing and transport— AS 1379 and additional requirements**
- Mixing time	Max. 10 minutes (Split drum mixers, max. 5 minutes)	**Mixing time**
Paving machine		
- Gross operating mass	>4 tonnes per lin. metre of paved width	**Mechanical paving**
- Paving speed	Capable of 1 metre per minute or less	**Mechanical paving**
Concrete placing		
- Air temperature	>5°C, <38°C	**Placing and finishing concrete in base**
- Concrete temperature	If concrete temperature <10°C or >32°C, concrete not to be used	**Placing and finishing concrete in base**

Activity	Limits/tolerances	Worksection Clause Reference
Alignment and surface		
- Horizontal alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 30 mm	**Alignment and tolerances**
- Surface level	The top surface of the base shall not vary by more than +10 mm or –0 mm from that shown on the Drawings. The top surface of the base shall not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.	**Alignment and tolerances**
- Surface texture	The rectangular-shaped tynes for transversely texturing surface shall not be spaced less than 10 mm nor more than 21 mm	**Texturing of surface**
	The average texture depth shall be between 0.30 mm and 0.65 mm	**Texturing of surface**
Concrete protection		
- Temperature	The temperature of the concrete shall not be permitted to fall below 5°C during the first twenty-four hours after placing	**Protection of work**
Joints		
- Transverse construction	The line of the transverse construction joints shall not deviate from a 3 m straightedge placed along the joint by more than 10 mm. Joints shall be constructed at 90°±5° to the longitudinal joint.	**Transverse construction joints**
- Longitudinal tied joints	. All parts of any tie bar shall be within 50 mm of its designed position	**Longitudinal tied joints**
	. 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	**Longitudinal tied joints**
	. For Sawn-Induced joints, the surface shall not exhibit more than 5 mm width of vertical or horizontal edge ravelling. The cumulative length of such edge ravelling shall not exceed 300 mm in any 1 m length of joint on each edge	**Longitudinal tied joints**
	. For Ribbon-Induced joints, the inducer ribbon shall be a minimum of 0.5 mm thick and when placed it shall be within 5° of the vertical plane	**Longitudinal tied joints**
- Longitudinal isolation joints	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	**Isolation joints**

13 MEASUREMENT AND PAYMENT

13.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this worksection in accordance with Pay Items 1135.1 to 1135.8 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

All work, materials and equipment required for the construction of odd-shaped and mismatched slabs shall be paid for at the schedule rate for Pay Items 1135.1, 1135.2 and 1135.3.

All work, material and equipment required for the construction of slab anchors shall be paid for at the schedule rates for Pay Items 1135.1, 1135.2, C1135.3 and 1135.4.

Where the 28 day compressive strength of test cylinders for any lot is less than 33 MPa or greater than 45 MPa, the lot represented by the test cylinders shall be removed, in which case no payment shall be made.

Where the relative compaction of the concrete is determined at less than 97%, the lot represented by the core shall be removed, in which case no payment shall be made.

Where the relative compaction is between 97% and 98% and where the 28 day compressive strength of the core is less than 36 MPa, the lot represented by the compaction core shall be removed, in which case no payment shall be made.

Where the concrete base thickness is more than 10 mm below the specified thickness after application of allowable tolerances for the base, the concrete shall be removed, in which case no payment shall be made.

Site specific traffic management measures are measured and paid in accordance with 1101 *Control of traffic*.

13.2 DEDUCTIONS

Concrete with a 28 day compressive strength between 33 MPa and 36 MPa (**Compressive strength of concrete**) shall be subject to a deduction of 4% of the applicable schedule rate for C0214.1 for the lot represented, for each 0.5 MPa or part thereof deficiency in strength. Acceptance of this concrete is conditional on it representing isolated sections and such sections comprise less than 5% of the area of the base.

Where the 28 day compressive strength of test cylinders for any lot is between 42 MPa and 45 MPa, acceptance of the concrete is dependent on the thickness and compressive strength of the concrete base and rejection, or deductions to the schedule rate for Pay Item 1135.1 as per Figure 6.1 (**Conformance for thickness**), shall apply:

- Deduction Zone A—8%.
- Deduction Zone B—16%.
- Deduction Zone C—24%.

Concrete base which is less than 10 mm below the specified thickness (**Conformance for thickness**), after application of allowable tolerances for the base, may be accepted. Such concrete shall be subject to a deduction to the schedule rate for Pay Item 1135.1, for the lot represented, of 24% for areas with 5 mm less than the specified thickness and 60% for areas with 10 mm less than the specified thickness.

13.3 PAY ITEMS

1135.1 Supply and place concrete in base

The unit of measurement shall be the cubic metre in place.

The width and length shall be as specified on the Drawings or as directed by the Superintendent. The thickness shall be the thickness specified or as directed by the Superintendent across each section.

No account shall be taken of the allowable tolerances.

The pay item includes the construction of transverse construction joints, and tied joints with kerbs and/or gutters.

1135.2 Finish, cure and texture base

The unit of measurement shall be the square metre of surface of the base.

The width and length shall be as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowance tolerances.

The sides of the slabs shall not be included in the measurement or surface area.

1135.3 Supply and place wire reinforcing fabric

The unit of measurement shall be the square metre of wire reinforcing fabric placed.

The width and length shall be as specified on the Drawings or as directed by the Super intendent. No account shall be taken of the allowable tolerances nor of any laps.

Unless otherwise indicated elsewhere, all wire reinforcing fabric shall be paid for at the schedule rate for Pay Item 1135.3.

1135.4 Supply and place steel bar reinforcement

The unit of measurement shall be the tonne of steel reinforcement placed.

The mass shall be determined from the unit masses given in AS/NZS 4671 and the actual length of bar measured in place. No account shall be taken of laps and splices.

The pay item excludes dowels and tie bars.

1135.5 Longitudinal tied joints

The unit of measurement shall be the linear metre.

The distance shall be measured along the line of the joint.

The pay item includes the provision of tie bars.

1135.6 Isolation joints

The unit of measurement shall be the linear metre.

The length shall be measured along the line of the joint.

The pay item includes the provision of dowels, where specified or shown on Drawings.

1135.7 Slab anchors

The unit of measurement shall be the cubic metre of concrete.

The volume shall be taken from the Drawings or as directed by the Superintendent. The depth shall be measured from the top of the subbase.

The pay item includes excavation, disposal of material, supply and placing of reinforcement and the subsoil drain.

1135.8 Bridge approach slabs

The unit of measurement shall be the cubic metre.

The width, thickness and length shall be as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The pay item includes all work, materials and equipment required for the construction of the approach slabs, including the provision of transverse expansion joint at the bridge abutment, but excluding the supply and fixing of steel reinforcement which shall be paid for under Pay Item 1135.4.

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1136 COLD MILLING OF ASPHALT AND BASE COURSE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the removal of asphalt and basecourse by cold milling to a specified depth, the hauling of the cold milled material to designated stockpiles and disposal areas and the sweeping of the pavement.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0179 General Requirements (Construction)

1142 Bituminous cold mix

Standards

AS 1742	Manual of uniform traffic control devices
AS 1742.3	Traffic control devices for works on roads
SAA HB 81	Field guides for traffic control at works on roads

2 MILLING OPERATION

2.1 CONTROL OF TRAFFIC

Minimise delays

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work.

When 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.

Work under traffic

If facilities for the diversion of traffic are not available, the Contractor shall arrange the work to provide for the flow of traffic in accordance with the requirements of 1101 *Control of traffic*.

Minimum signage

In addition, on the approaches to the work and at intervals shown in AS 1742.3 for the appropriate speed zone, temporary reflectorised signs ‘Cycle Hazard Grooved Road’, Type ST 1-10 shall be clearly displayed.

Signage standards

Notwithstanding the previous paragraph all temporary signage shall comply with the site specific requirements of AS 1742.3 and SAA HB 81.

Licensing and qualification of personnel

All traffic control personnel are to possess valid state drivers licences and relevant certification in accordance with 1101 *Control of traffic*.

Qualification submission

Documentation denoting the names of traffic control personnel and their respective traffic control certification are to be forwarded to the Superintendent for inspection prior to the commencement of work.

Licence validity
Notwithstanding the previous clause, inspection of the credentials of traffic control personnel does not place the Superintendent as the guarantor of such documentation.

Contractor's responsibility
Responsibility pertaining to the qualifications of Traffic Control personnel shall be borne by the Contractors.

Costs of traffic control
All costs occurring as a result of obtaining equipment, personnel or services to provide traffic control to comply with the requirements of this worksection shall be borne by the Contractor.

2.2 CONTROL OF WORK

Variations
The Superintendent may direct the depth, width, length, alignment and section of road to be cold milled at any time.

Public safety
The Superintendent may order work to cease temporarily on account of dust nuisance, excessive windrows or loose material, excessive roughness of the cold milled surface or any circumstances which the Superintendent considers may adversely affect the work or public safety.

2.3 COLD MILLING OPERATION

Control of levels
The operation of the cold milling machine shall be controlled either by levelling beam or stringline and automatic sensors unless otherwise approved by the Superintendent.

Variations in cuts
The nominated depth(s) of cut of the cold milling machine shall be as directed by the Superintendent. The cut shall be automatically controlled, with the control set such that the maximum difference in levels between adjacent runs shall not exceed 5 mm.

The average depth of cut measured across the cut from the adjacent surfaces to the top of the milled surface and at intervals along the work shall not vary by more than 5 mm from the specified thickness.

When stringline and automatic sensors are used the top of the milled surface shall not vary by more than 5 mm from the specified depth below the stringline.

Utility location
Prior to milling operations the Contractor shall determine, using appropriate equipment such as metal detectors etc, the location of any hidden utilities or buried objects that may be damaged by milling operations.

The onus of locating such structures and determining their susceptibility to damage by operations are the sole responsibility of the Contractor.

The Contractor shall liaise with the relevant Authorities for all underground utility services within the site of the works.

The utility Authorities' contact persons are given in 0179 *General Requirements (Construction)*.

Unsuitable material
If in the opinion of the Superintendent, the milled floor contains material that is deemed unsuitable, that material shall be milled to a depth as directed by the Superintendent.

Additional payment shall be based upon a square meter rate commensurable with the remainder of the works quoted.

Obstructions
When milling near access chambers or other similar structures the cold milling machine shall be operated as close as possible to the structure without causing damage to it.

The remaining asphalt and base course shall be removed by hand or other method approved by the Superintendent.

A ramp using coldmix or asphalt shall be formed and compacted around the structure.

The ramp shall have a minimum taper length of 1.0 m for each 50 mm thickness of asphalt and base course removed or part thereof.

This work shall not constitute a variation of contract.

Temporary ramps

At the end of the day's work, or whenever the milled pavement is left unattended and reopened to traffic, the work shall be arranged so that no longitudinal or transverse edges of milled asphalt and base course, which can affect traffic, are left unattended.

Prior to reopening the milled pavement to unrestricted use by traffic and at the end of the day's work, the final milled lane shall be bevelled such that the maximum lip between the milled run and the unmilled run does not exceed 10 mm.

When bevelling is not possible, the fall off in levels shall be ramped with coldmix material complying with 1142 *Bituminous cold mix*.

Temporary cold mix

The ramp area covered by coldmix shall be tack coated with bitumen emulsion prior to placing of the coldmix. All coldmix shall be compacted.

Length of ramps

Longitudinal and transverse ramps, used to tie the milled surface into the existing road levels, shall have a minimum taper length of 1 m for each 50 mm variation in levels or part thereof. Where the speed limit exceeds 60 km/h, transverse ramps shall have a taper length of 2.5 m for each 50 mm.

Hand work

Any material not removed by the cold milling machine adjacent to concrete medians, kerb and gutter or drainage structures such as pit grates shall be removed by hand or other means approved by the Superintendent. When necessary for traffic safety, or when directed by the Superintendent, coldmix or asphalt ramps shall be placed by the Contractor.

Additional cuts

Any weakened planes of asphalt and basecourse which are not removed by the milling operation but in the opinion of the Superintendent will break up under traffic shall be removed either by an additional pass of the cold milling machine or by other means to the satisfaction of the Superintendent.

Loose material

Following the cold milling operation all loose material shall be removed from the road pavement, gully pits and median areas.

The pavement shall be swept and the site left in a clean and tidy state to the satisfaction of the Superintendent.

All cold milled material shall be removed from the site and transported to stockpile site(s) or otherwise removed from the site to the satisfaction of the Superintendent.

Damage, Contractor's costs

If sub-surface utilities or structures are damaged by milling operations, the Contractor shall notify the relevant Authority and arrange for the damage to be rectified to reinstate the utility or structure to pre-construction condition.

All costs associated with such rectification works shall be borne by the Contractor.

Inspection

Prior to covering the milled surface, the Contractor shall arrange to inspect the surface with the Superintendent prior to the removal of milling equipment from site.

2.4 LOADING AND TRANSPORT OF MILLED ASPHALT

The Contractor shall supply sufficient trucks to enable a continuous output to be achieved by the cold milling machine with minimal delay.

When loading by elevator, the trucks shall back up and maintain a similar speed to the cold milling machine.

The driver shall distribute the load of milled material uniformly over the truck body.

The Contractor shall comply with all regulations regarding the covering and securing of loads where applicable.

The cover shall overlap the truck body by at least 250 mm and be tied down securely.

2.5 DISPOSAL OF MILLINGS

Superintendent's stockpiles

Proposed stockpile site(s) shall be nominated by the Superintendent in Annexure A.

Levelling of stockpiles

The cold milled material shall be tipped in orderly stockpiles and not isolated heaps. When measurement is by volume, the stockpiles shall be levelled to a height of 2 metres and be uniform in shape.

Disposal by Contractor

Where the Superintendent does not wish to keep the millings, the Contractor will be fully responsible for their disposal.

3 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1 Summary of limits and tolerances

Activity	**Limits/tolerances**	**Worksection Clause Reference**
Cuts of cold milling machine		
- Difference in levels between adjacent runs	<5 mm	**Cold milling operation**
- Average depth of cut from specified depth	<5 mm	**Cold milling operation**
- Variation of top of milled surface below stringline and automatic sensor for specified depth	<5 mm	**Cold milling operation**
Ramp at structure		
- Taper length of asphalt or cold mix around structure	>1.0 metres for each 50 mm thickness of asphalt and base course removed (or part thereof)	**Cold milling operation**
Longitudinal edge		
- Maximum lip between milled run and unmilled run	<10 mm	**Cold milling operation**
Ramp milled surface to existing road		
- At end of each day, where traffic is to use surface, minimum taper of ramp	1.0 metres for each 50 mm variation in levels or part thereof	**Cold milling operation**

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this worksection in accordance with Pay Item 1136.1.

A lump sum price shall not be accepted.

Control of traffic is measured and paid in accordance with 1101 *Control of traffic*.

4.2 PAY ITEM

1136.1 Removal of material by cold milling

1136.1(1) Up to 40 mm in depth.

1136.1(2) >40 mm.

The unit of measurement shall be the square metre for up to 40 mm in depth and square metres/10 mm depth for >40 mm..

The width, length and thickness shall be taken as specified on the Drawings or as approved by the Superintendent.

Payment will be made by cumulatively considering both unit rates depending on the depth of milling.

The schedule rate shall cover all costs associated with the milling operation including transporting and stockpiling of material and the sweeping and cleaning of the pavement.

5 ANNEXURE A

5.1 LOCATION OF STOCKPILE SITES FOR MILLINGS

Location of stockpile sites for millings in accordance with **Disposal of millings** is as follows:

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1141 FLEXIBLE PAVEMENTS

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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.

1.2 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1113 Stabilisation

1143 Sprayed bituminous surfacing

Standards

AS1141 Methods for sampling and testing aggregates

AS1141.14 Particle shape, by proportional calliper

AS1141.22 Wet/dry strength variation

AS1289 Methods of testing soils for engineering purposes

AS1289.3.1.1 Soil classification tests—Determination of the liquid limit of a soil—Four point Casagrande method

AS1289.3.3.1 Soil classification tests—Calculation of the plasticity index of a soil

AS1289.3.6.1 Soil classification tests—Determination of the particle size distribution of a soil—Standard method of analysis by sieving

AS1289.3.6.3 Soil classification tests—Determination of the particle size distribution of a soil—Standard method of fine analysis using a hydrometer

AS1289.5.2.1 Soil compaction and density tests—Determination of the dry density/moisture content relation of a soil using modified compactive effort

AS1289.5.3.1 Soils compaction and density tests—Determination of the field density of a soil—Sand replacement method using a sand cone pouring apparatus

AS1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

AS1289.5.8.1 Soil compaction and density tests—Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge—Direct transmission model

AS1289.6.1.1 Soil strength and consolidation tests—Determination of the California Bearing Ratio of a soil—Standard laboratory method for a remoulded specimen

Other publications

RTA Test Methods

T114 Maximum dry compressive strength of road materials

T116 Determination of unconfined compressive strength of remoulded road materials which are self cementing

T130 Dry density - moisture relations for mixtures of road materials stabilised or modified with proportions of cement

T131 Determination of unconfined compressive strength of road materials stabilised or modified with proportions of cement

T160 Benkelman beam deflection test

T171 Modified Texas triaxial compression test for disturbed soils

1.3 TERMINOLOGY

The following definitions shall apply:

- Materials designated as 'base' require the provision of a wearing surface comprising either a sprayed bituminous seal or asphalt up to 50 mm thick.
- Materials designated as 'subbase' require a covering course of 'base'. The subbase may consist of one or more layers.
- A flexible pavement consists of a base and a subbase constructed of unbound materials. For the purpose of this worksection it also includes 'semi-rigid' pavements.
- A semi-rigid pavement is one where the base and/or the subbase are constructed of bound materials.
- Bound material incorporates a binder to produce structural stiffness.
- Modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness.

1.4 PAVEMENT STRUCTURES

Flexible or semi-rigid pavement material types and layer thicknesses shall be as shown on the Drawings.

1.5 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality(Construction)*.

1.6 INSPECTION, SAMPLING AND TESTING

Contractor's responsibility

Inspection, sampling and testing of the pavement shall be undertaken by the Contractor in accordance with the requirements of this worksection 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.

Written notice

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.

Density tests

Field density tests shall be carried out in accordance with AS 1289.5.3.1, or, with the Superintendent's concurrence, with a Nuclear Density Meter in accordance with **Relative compaction**.

2 MATERIALS

2.1 GENERAL

Details of proposed base and subbase to be submitted

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 worksection.

If the proposed base or subbase is a bound material, the Contractor shall submit a completed Annexure A of 1113 *Stabilisation*

Approval of source of supply

No material shall be delivered until the Superintendent has approved the source of supply.

Variations by Contractor

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.

NATA Certificate

At least fourteen days before placement of the material on site, the Contractor shall submit 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 worksection.

Sampling on-site

Ongoing testing of materials during delivery and construction shall be undertaken on samples taken from the site.

NOTE to Compiler: Due regard may be taken of the opportunity to use recycled materials for pavements—(RESOURCE NSW—Specification for Supply of Recycled Materials for Pavements, Earthworks and Drainage, 2003.). Note—disclaimer in front cover of specification under 'important' re liability.

2.2 TRAFFIC CATEGORY

Pavement material traffic category

Pavement materials are specified in terms of the Traffic Categories given in Table 2.1 for the calculated design traffic of the pavement.

Drawings

The Traffic Category (or Design Traffic) for the pavement materials shall be as shown on the Drawings.

Table 2.1 Pavement and material traffic categories

Pavement material traffic category	Description
Arterial 4	Regional roads and local roads with high traffic volumes.
Sub Arterial 3	Roads with design traffic exceeding 10^6 ESAs but less than or equal to 4×10^6 ESAs.
Collector 2	Roads with design traffic exceeding 10^5 ESAs but less than or equal to 10^6 ESAs.
Local 1	Roads with design traffic less than or equal to 10^5 ESAs.

2.3 UNBOUND BASE AND SUBBASE

Granular material

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.

Crushed rock

Unbound crushed rock materials are designated as follows:

- DGB20 — 20 mm nominal sized densely graded base
- DGS20 — 20 mm nominal sized densely graded subbase
- DGS40 — 40 mm nominal sized densely graded subbase
- GMB20 — 20 mm nominal sized graded macadam base
- GMS40 — 40 mm nominal sized graded macadam subbase

Natural gravel

Unbound natural gravel materials are designated as follows:

- NGB20-2c Category 2c — 20 mm nominal sized natural gravel base for Traffic
- NGB20-2d Category 2d — 20 mm nominal sized natural gravel base for Traffic
- NGS20 — 20 mm nominal sized natural gravel subbase
- NGS40 — 40 mm nominal sized natural gravel subbase

Material types

The acceptable material types for each Traffic Category are given in Table 2.2.

Base

Base materials shall comply with the requirements of Unbound base material properties table.

Subbase

Subbase materials shall comply with the requirements of Unbound subbase material properties table.

Modified Texas Triaxial Classification

Where the proposed unbound base or subbase material complies with all of the requirements Table 2.3 or Table 2.4, as appropriate, except gradings (AS 1289.3.6.1 and AS 1289.3.6.3), the Contractor may propose the use of the material, subject to approval of the Superintendent, if the material complies with the RTA Modified Texas Triaxial Classification Number (T171) requirements specified in Table 2.5, (T171 tested at not less than 85% of Optimum Moisture Content and 98% of Maximum Dry Density as determined by AS 1289.5.2.1).

Table 2.2 Approved pavement material types

Traffic category	Approved base material	Approved subbase material
4	DGB20, GMB20	DGS20, DGS40, GMS40, NGS20, NGS40
3	DGB20, GMB20, NGS20, NGS40	DGS20, DGS40, GMSS40, NGS20, NGS40
2	DGB20, DGS20, GMB20, NGB20-2c	DGS20, DGS40, GMS40, NGS20, NGS40
1	DGB20, DGS20, GMB20, NGB20-2c, NGB20-2d	DGS20, DGS40, GMS40, NGS20, NGS40

Table 2.3 Unbound base material properties

Test method	Description	Base Material Requirements			
		DGB20	GMB20	NGB20-2c	NGB20-2d
AS 1289.3.6.1	Coarse Particle Size Distribution				
	% passing 75.0 mm sieve	—	—	—	—
	% passing 53.0 mm sieve	—	—	—	—
	% passing 37.5 mm sieve	—	—	—	—
	% passing 26.5 mm sieve	100	100	100	100
	% passing 19.0 mm sieve	95–100	95–100	93–100	93–100
	% passing 13.2 mm sieve	—	—	—	—
	% passing 9.5 mm sieve	—	—	71–87	71–87
	% passing 6.7 mm sieve	50–70	30–55	—	—
	% passing 4.75 mm sieve	—	—	47–70	47–70
	% passing 2.36 mm sieve	35–55	20–30	35–56	35–56
	% passing 0.425 mm sieve	—	—	14–32	14–32
	% passing 0.075 mm sieve	—	—	6–20	6–20
AS 1289.3.6.3	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36 mm sieve)				
	A. Pass 425 μm sieve %	35–55	30–50	—	—
	B. Pass 75 μm sieve % Pass 425 μm sieve	35–55	30–50	—	—
	C. Pass 13.5 μm sieve % Pass 75μm sieve	35–60	—	—	—
AS 1289.3.1.1	Liquid Limit (if non plastic) *	max 20	max 20	max 20	max 20
AS 1289.3.3.1	Plastic Limit (if plastic)	max 20	max 20	max 20	max 20

Test method	Description	Base Material Requirements			
		DGB20	**GMB20**	**NGB20-2c**	**NGB20-2d**
AS 1289.3.3.1	Plasticity Index †	max 6	max 6	max 6	max 8
T114	Maximum Dry Compressive Strength on fraction passing 19 mm sieve (only applies if Plasticity Index is less than 1)	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa	min 1.7 MPa
AS 1141.14	Particle Shape by Proportional Calliper - % misshapen (2 : 1)	max 35	max 35	—	—
AS 1141.22	Aggregate Wet Strength‡				
	For category 1 or 2a For category 2b or 2c For category 2d	min 80 min 70 min 60	min 150 min 130 min 100	— — —	— — —
AS 1141.22	Wet/Dry Strength Variation‡				
	((Dry—Wet)/Dry) %				
	For category 1 or 2a For category 2b or 2c For category 2d	max 35 max 40 max 45	max 30 max 30 max 30	— — –	— — –
AS 1289.6.1.1	4 day Soaked CBR (98% Modified Compaction)	–	–	80	60

NOTES:
Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75% of the particles larger than 6.70 mm.
* 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.
† For category 2d base materials the maximum Plasticity Index shall be 8.
‡ 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 19.0 mm to 13.2 mm and 6.7 mm to 4.75 mm must be tested. The other fractions do not need to be tested unless there is a risk in the opinion of the Superintendent that such fraction may fail the specification. Any fraction at risk of failing must be tested.

Table 2.4 Unbound subbase material properties

Test method	Description	Subbase material requirements				
		DGS20	**DGS40**	**GMS40**	**NGS20**	**NGS40**
AS 1289.3.6.1	Coarse particle size distribution					
	% passing 75.0 mm sieve	—	—	—	—	—
	% passing 53.0 mm sieve	—	100	100	—	100
	% passing 37.5 mm sieve	—	—	—	—	95-100
	% passing 26.5 mm sieve	100	—	—	100	80-97
	% passing 19.0 mm sieve	95–100	50–85	50–75	96–100	—
	% passing 13.2 mm sieve	—	—	—	—	—
	% passing 9.5 mm sieve	—	—	—	65-89	48-85
	% passing 6.7 mm sieve	50-70	30-55	15-35	—	—
	% passing 4.75 mm sieve	—	—	—	47–80	35–73
	% passing 2.36 mm sieve	35–55	25–50	5–15	32–67	25–58
	% passing 0.425 mm sieve	—	—	—	14–42	10–33
	% passing 0.075 mm sieve	—	—	—	6–26	3–21
AS 1289.3.6.3	Fine Particle Size Distribution Ratios expressed as percentages (for that portion of the material passing 2.36 mm sieve)					

Test method	Description	Subbase material requirements				
		DGS20	**DGS40**	**GMS40**	**NGS20**	**NGS40**
	A. Pass 425 μm sieve %	35–55	35–60	25–50	—	—
	B. Pass 75 μm sieve % Pass 425 μm sieve	35–55	35–60	25–50	—	—
	C. Pass 13.5 μm sieve % Pass 75 μm sieve	35–60	35–65	—	—	—
AS 1289.3.1.1	Liquid Limit (if non plastic)	max 23	max 23	—	max 23	max 23
AS 1289.3.3.1	Plastic Limit (if plastic)	max 20	max 20	—	max 23	max 23
AS 1289.3.3.1	Plasticity Index	max 12	max 12	max 12	max 12	max 12
T114	Maximum Dry Compressive Strength on fraction passing 19 mm 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 1141.14	Particle Shape by Proportional Calliper - % misshapen (2:1)	max 35	max 35	max 35	—	—
AS 1141.22	Aggregate Wet Strength*	min 50 kN	min 50 kN	min 130 kN	—	—
AS 1141.22	Wet/Dry Strength Variation*					
	((Dry—Wet)/Dry) %Dry	max 60	max 60	max 30	—	—
AS 1289.6.1.1	4 day Soaked CBR (98% Modified Compaction)	—	—	—	30	30

NOTES:
Material consisting of rounded river stone shall have a minimum of two fractured faces on at least 75% of the particles larger than 6.70 mm.
* 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 19.0 mm to 13.2 mm and 6.7 mm to 4.75 mm must be tested. The other fractions do not need to be tested unless there is a risk in the opinion of the Superintendent that such fraction may fail the specification. Any fraction at risk of failing must be tested.

Table 2.5 RTA Modified Texas triaxial classification number requirements

Traffic Category	Modified Texas Triaxial Classification Number (Test Method T171)	
	Base	**Subbase**
4	max 2.2	max 2.5
3	max 2.5	max 3.0
2	max 3.0	max 3.0
1	max 3.0	max 3.0

2.4 LIME MODIFIED BASE AND SUBBASE MATERIALS

Lime modification

Modification of unbound base and subbase materials to meet the requirements of **Unbound base and subbase** by the addition of hydrated lime or quicklime shall be subject to approval by the Superintendent and to the additional requirements of this clause.

After modification, the material shall meet the requirements of **Unbound base and subbase**.

Traffic Categories 1, 2a, 2b

Modification of materials for Traffic Categories 1, 2a and 2b shall only be by use of hydrated lime mixed in a stationary mixing plant at the supplier's quarry.

Traffic Categories 2c, 2d

Modification of materials for Traffic Categories 2c and 2d may be by the use of either hydrated lime through a stationary mixing plant or by hydrated lime or quicklime utilising in-situ operations.

Lime

Material requirements of hydrated lime and quicklime shall be in accordance with 1113 *Stabilisation*.

Incorporation

The method of incorporating lime through the stationary mixing plant shall ensure that the lime is mixed uniformly through the material.

In-situ Operations

In-situ operations shall be in accordance with 1113 *Stabilisation*.

Proportion

The proportion of lime shall be not less than 1.5% nor more than 4% by mass. The material prior to lime treatment shall not contain any added pozzolanic material.

Unconfined compressive strength

The lime treated material shall yield an unconfined compressive strength not exceeding 1.0 MPa, when tested in accordance with Test Method T116 where sampling is undertaken within 24 hours of adding the lime and testing is after 7 days accelerated curing.

DGB20

For DGB20 material, prior to being treated with lime, the material shall comply with the requirements of DGS20 in Table 2.4, except that the aggregate wet strength shall not be less than 80 kN and the wet/dry strength variation shall not exceed 60%.

CBR Value

For DGB20, the lime treated material shall yield a CBR value of not less than 100 when tested in accordance with AS 1289.6.1.1, where sampling is undertaken within 24 hours of adding the lime and testing is after 7 days of accelerated curing.

2.5 BOUND BASE AND SUBBASE MATERIALS

Material requirements prior to stabilisation

Prior to stabilisation, the base layer material shall meet the requirements of Table 2.4 for subbase material for the appropriate Traffic Category.

Stabilising agent

Material requirements for the stabilising agent shall be in accordance with 1113 *Stabilisation*.

Stabilisation

The stabilisation process shall meet the requirements of 1113 *Stabilisation*.

Unconfined compressive strength

The unconfined compressive strength (UCS) of the material after seven days accelerated curing as determined by RTA Test Method T131 shall be not less than 4 MPa nor more than 10 MPa.

Sampling and test specimen compaction of the material shall be undertaken within one hour of the incorporation of the stabilising agent.

3 DELIVERY, STOCKPILING AND PROCESSING OF PAVEMENT MATERIAL

3.1 DELIVERY TO SITE

Materials shall be supplied sufficiently damp to avoid segregation and loss of fines during transit.

3.2 STOCKPILING OF UNBOUND MATERIALS

Stockpile sites

Stockpile sites shall be located as shown on the Drawings or as approved by the Superintendent.

Site requirements

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%.

Prevent intermixing

Stockpiles and stockpile sites shall be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.

Stockpile height and shape

The total height of any stockpile shall not exceed 3 m.

Stockpiles shall be of uniform shape with side slopes neither steeper than 1.5h to 1v nor flatter than 3h to 1v.

Maintained damp

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.

Site cleaned at completion of work

At the completion of the works, stockpile sites shall be cleared of all surplus material and left in a clean and tidy condition unless exempted by the Council Engineer.

3.3 DELIVERY OF MODIFIED OR BOUND MATERIALS

Vehicle deliveries

Modified or bound materials shall be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport, unless otherwise approved by the Superintendent.

Time limit

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.

Delivery dockets

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.

Bound materials

Bound materials shall comply with 1113 *Stabilisation*.

4 SPREADING OF PAVEMENT MATERIAL

4.1 SPREADING PAVEMENT MATERIALS

Underlying layer quality

Unbound materials shall not be spread upon an underlying pavement layer which has a moisture content exceeding 90% 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 worksection before spreading of the next layer of pavement.

Non-complying underlying layer

Where the underlying layer was constructed by the Contractor, or where the Contractor's activities caused the underlying layer constructed by others to become non-complying with this worksection, the cost of correcting the underlying layer to comply with this worksection shall be borne by the Contractor.

Tolerances

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 **Tolerances** without subsequent addition of material.

The thickness of each compacted layer shall be neither less than 100 mm nor more than 200 mm for all pavement layer types, unless otherwise approved by the Superintendent.

Joints

At all work boundaries in bound materials the Contractor shall provide vertical faces to provide for transverse and longitudinal joints.

Moisture content of the base or subbase materials

When spread for compaction processes the moisture content of the base or subbase materials shall be in the range of 60–90% of laboratory optimum moisture content in accordance with AS 1289.5.2.1.

Ambient air temperature

Bound materials shall not be spread when the ambient air temperature in shade is either below 5°C or above 35°C unless expressly approved by the Superintendent.

5 TRIMMING AND COMPACTION

5.1 GENERAL REQUIREMENTS

Uniform compaction

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 **Relative compaction** and **Compaction requirements and acceptance**.

Compaction procedure

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.

The outer metre of both sides of the pavement shall receive at least two more passes by the compaction plant than the remainder of the pavement.

Hand operated plant

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.

Plant movement restrictions

Watering and compaction plant shall not be allowed to stand on the pavement being compacted.

Unstable areas

If any unstable areas develop during rolling, the unstable material shall be rejected. The rejected material shall be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with **Removal and replacement of rejected courses**. This operation will be at cost to the Contractor.

Placing subsequent layers

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.

Excessive moisture content

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.

5.2 CURING OF BOUND MATERIALS

Commencement time

The curing of the surface layer of a lot shall commence after compaction is completed.

Water curing

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 prime or primer-seal.

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.

6 ACCEPTANCE OF COMPACTED LAYERS

6.1 LOTS FOR ACCEPTANCE

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:

- 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;
- for unbound materials it may equal a day's output using the same material.

6.2 COMPACTION ASSESSMENT

Density testing

The Superintendent shall assess compaction for each lot based on random sampling of test locations for in-situ dry density testing.

Sampling

The Contractor shall arrange for testing to assess compaction on the basis of ten tests per 5000 sq m with a minimum of 5 tests per lot, and present the results to the Superintendent for approval. Sampling frequency may only be varied with prior written approval of the Superintendent.

Costs of testing

The cost of all testing for compaction assessment of any layer in an area of pavement shall be borne by the Contractor.

Benkelman Beam testing

Alternatively, when agreed by the Principal, acceptance of lots may be determined according to the elastic rebound deflection.

The elastic rebound deflection shall be taken as the maximum deflection in accordance with RTA Test Method T160 utilising the Benkelman Beam or equivalent.

The average maximum deflection for any lot shall not exceed 1.0 mm, and the co-efficient of variation (CV) in recorded deflections shall not exceed 30%.

Measurements shall be taken at the rate of 4 per 1000 square metres, with a minimum of ten measurements per lot.

6.3 RELATIVE COMPACTION

Calculation

The relative compaction of pavement material at each location tested for in-situ dry density shall be calculated in accordance with AS 1289.5.4.1 as follows:

Relative Compaction % = [(In-situ dry density)/(Comparative dry density)]$\times$100

The comparative dry density shall be the maximum dry density determined in the laboratory.

In-situ dry density testing

The Superintendent may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1.

Daily samples

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.

Maximum dry density

For unbound layers, the sample shall be tested in accordance with AS 1289.5.2.1 to determine the maximum dry density (modified compactive effort) for the material.

Time for testing

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 (modified compactive effort) for the material. This test method shall also be used to determine the optimum moisture content.

Comparative dry density

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.

6.4 COMPACTION REQUIREMENTS AND ACCEPTANCE

Acceptance of lots

A lot shall be accepted for compaction if:

- The minimum value of all calculated relative compaction for modified compactive effort is not less than 97% within the lot or the area of pavement being assessed.
- In the case of bound layers an area of pavement presented for compaction assessment has within that area a zone or zones with relative compaction less than 97% (modified compactive effort) but equal to or greater than 93% may be accepted by the Superintendent provided such zone or zones shall not comprise more than 5% of the area presented.
- In the case of bound layers of target final depth in excess of 250 mm, the top 150 mm shall meet the requirements of paragraph 1(b) in this clause whilst the bottom 150 mm shall have a relative compaction equal to or greater than 92%.

Rejection of lots

Lots or areas of pavement not achieving these specified values shall be rejected. Unbound layers may be reworked as provided by **Reworking of rejected unbound layers**, but the bound materials in rejected layers/courses shall be removed and replaced with fresh materials in accordance with **Removal and replacement of rejected courses** unless an alternative disposition is approved by the Superintendent.

6.5 REWORKING OF REJECTED UNBOUND LAYERS

Reworking

Lots or areas of pavement that have been rejected in regard to compaction shall be reworked before resubmission for compaction assessment.

Rejected material

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 worksection in accordance with **Removal and replacement of rejected courses**. When a lot or area of pavement is resubmitted for compaction assessment, testing shall be carried out in accordance with **Compaction assessment** and **Relative compaction**.

Contractor's costs

All costs associated with corrective work carried out before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking shall be borne by the Contractor.

6.6 TOLERANCES

General

Acceptable limits: The tolerances stated are the acceptable limits of departure from the dimensions shown on the Drawings, which may occur during construction.

Lots for assessment of conformity: 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.

Width

Horizontal dimensions: 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 50 mm less than the dimension nor more than 300 mm greater than the dimension shown on the Drawings.

Average width: 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.

Levels and surface trim

Subbase surface level: The levels of the finished surface of the top of the unbound subbase course shall not vary from the design levels by more than ±10 mm.

Base surface level: Level tolerances at the top of the unbound base course shall not exceed those stated above for subbase.

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 be flush for chip seals and not vary by more than ± 5 mm from the lip level of the gutter minus the design thickness of the wearing surface.

Subbase design level: 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, including an allowance for any chip seal layer in the pavement design.

Straight edge deviation: 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 12 mm.

Measurements for conformance shall be taken in accordance with the maximum lot size and minimum test frequencies in 0161 *Quality (Construction)*.

6.7 ACTION ON REJECTION

Unbound materials

Rejection criteria: A lot that has not complied with the requirements for width or level tolerance as set out in **Tolerances** shall be rejected, except as otherwise.

Rejected lots shall be removed, disposed of and replaced with fresh material in accordance with **Removal and replacement of rejected courses**.

Corrective action: Notwithstanding the above, where the rejected lot can be corrected by further trimming, the Superintendent may allow the surface to be corrected without complete removal and replacement with fresh material.

Such trimming shall be undertaken in a manner that produces a uniform, hard surface and shall be achieved by cutting only without filling.

After any such cutting, the level tolerances in **Tolerances** shall apply.

Costs of correction: The cost of surface correction or replacement work ordered in accordance with this Clause including removal of material, disposal and supply and transport of replacement material, shall be borne by the Contractor.

Bound materials

Rejection criteria: An area of bound material that has not complied with the requirements for width or level tolerance as set out in **Tolerances** shall be rejected, except as otherwise.

Rejected areas shall be removed, disposed of and replaced with fresh material in accordance with **Removal and replacement of rejected courses**.

Cost of removal and disposal: The cost of removal and disposal of rejected material and its replacement with fresh material shall be borne by the Contractor.

Corrective action circumstances: Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

- Where the cause for rejection is under **Tolerances**, 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.
- Where the cause for rejection is under **Tolerances**, 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 20 mm 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.
- Where the cause for rejection is under **Tolerances**, the course is a base 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. Approval by the Superintendent shall be subject to the requirements of item b) above.

Cost of surface level corrections: The cost associated with surface level corrections required in this Clause shall be borne by the Contractor.

6.8 REMOVAL AND REPLACEMENT OF REJECTED COURSES

Rejected material

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.

Length to be removed

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.

Superintendent's discretion

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction.

In this case, the new longitudinal cold joint shall be formed and located along the centreline of the road pavement.

Inspection before replacement

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 material

Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, shall comply with the requirements of this worksection.

Costs of removal and replacement

All costs associated with removals, replacements and corrections of base and subbase courses required and the extra costs incurred by the Contractor in respect of delays caused by such removals, replacements and corrections shall be borne by the Contractor.

6.9 MAINTENANCE BEFORE COMPLETION OF WEARING SURFACE

Primerseal

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 1143 *Sprayed bituminous surfacing* within 7 days of the date of the acceptance of such sections, unless otherwise approved by the Council Engineer.

Deterioration of pavement condition before primerseal

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 Council Engineer and Superintendent.

Approval by the Council Engineer is required for release of the **Hold Point**.

Cost of re-preparing areas of the deteriorated pavement

The cost of re-preparing areas of the deteriorated pavement shall be borne by the Contractor.

Surface drainage

The Contractor shall maintain adequate drainage of the pavement, and remove any ponded water within 12 hours of its creation if free drainage cannot be achieved, prior to the completion of the wearing course.

7 OPENING PAVEMENT TO TRAFFIC

7.1 RESTRICTIONS ON MOVEMENT

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.

7.2 RESTRICTIONS ON MOVEMENT OF CONSTRUCTION TRAFFIC

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.

In any case only vehicles registered for legal road usage and loaded within legal limits will be allowed to use the pavement.

7.3 OPENING BOUND PAVEMENT TO TRAFFIC

For 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.

8 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 8.1.

Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Stockpile sites	. Relative compaction > 95% . Stockpile height < 3 m . Stockpile batter < 1.5:1 and > 3:1	**Stockpiling of unbound materials**
Spreading pavement materials - Compacted layer thickness	≥ 100 mm, ≤ 200 mm	**Spreading pavement materials**
Compaction acceptance Minimum value of all calculated relative compaction results	≥ 97% (modified compactive effort). For bound pavements may accept between 92% and 97% provided it represents less than 5% of the area.	**Compaction requirements and acceptance**
Width of pavement - Design centre-line to edge of constructed pavement	–50 mm to +300 mm of dimensions on Drawings	**Tolerances**
- Average Width	The average width determined from 3 random sites over any 200 m road length, or part thereof, shall be not less than the specified width.	**Tolerances**

Activity	Limits/Tolerances	Worksection Clause Reference
Surface level - Subbase levels	<±10 mm from design level	**Tolerances**
- Base levels	<±10 mm from design level	
- Base levels adjacent to Kerb and Gutter	<±5 mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	
- Shape	Deviation from a 3 m long straightedge on base surface immediately prior to sealing shall be less than 12 mm	

9 MEASUREMENT AND PAYMENT

9.1 MEASUREMENT

Payment shall be made for the activities associated with completing the work detailed in this worksection in accordance with Pay Items 1141.1 and 1141.2 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Base course primerseal is measured and paid in accordance with 1143 *Sprayed bituminous surfacing*.

9.2 PAY ITEMS

1141.1 Supply, spread and compact subbase course

The unit of measurement shall be the square metre.

The area shall be determined by the length and width of work as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of allowable tolerances.

The schedule rate under this Pay Item shall include all the activities associated with the supply, spread, compaction, trimming, jointing, and testing of the subbase course, and curing of bound material.

1141.2 Supply, spread and compact base course

The unit of measurement shall be the square metre.

The area shall be determined by the length and width of work as specified on the Drawings or as directed by the Superintendent.

No account shall be taken of the allowable tolerances.

The schedule rate under this Pay Item shall include all the activities associated with the supply, spread, compaction, trimming, jointing, and testing of the base course, and curing of bound material.

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1142 BITUMINOUS COLD MIX

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of design, production and delivery of 'hot mixed—cold laid plant mix' (hereinafter referred to as 'cold mix') and includes supply of materials, sampling, testing and any other operations necessary to provide the conforming product. This worksection unless amended applies to dense graded cold mix of nominal sizes 7, 10 or 14 mm.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 016 *Quality (Construction).*

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

016 *Quality (Construction).*

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.15	Flakiness index
AS 1141.18	Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Wet/dry strength variation
AS 2008	Residual bitumen for pavements
AS 2157	Cutback bitumen
AS 2250	Hot mix asphalt – a guide to good practice
AS 2758	Aggregates and rock for engineering purposes
AS 2758.5	Asphalt aggregates
AS 2891	Methods of sampling and testing asphalt
AS 2891.3.1	Bitumen content and aggregate grading—Reflux method
AS 3568	Oils for reducing the viscosity of residual bitumen for pavements
AS 4283	Cold mix asphalt for maintenance patching.

NSW RTA Specifications and Forms

R106	-	Sprayed Bituminous Surfacing Cutback
R107	-	Sprayed Bituminous Surfacing , polymer modified
R111	-	Sprayed Bituminous Surfacing, Emulsion
RTA QA 3258	-	Aggregate Precoating Agents
RTA QA 3259	-	Bitumen Adhesion Agents

RTA Sprayed Sealing Guide

Other

AUSTROADS - Design of Sprayed Seals (2006)
AUSTROADS - Bitumen Sealing Safety Guide (1996)

2 MATERIALS

2.1 AGGREGATES

Uniformity

Aggregates shall be of uniform quality and grading. Aggregates complying with the requirements, when combined with the mineral filler shall be capable of achieving the properties required by this worksection.

Coarse aggregate

Quality: Coarse aggregate comprises all mineral matter retained on the 4.75 mm AS sieve.

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. All coarse aggregate shall comply with AS 2758.5.

Grading: The grading of the coarse aggregate used in the work shall be determined in accordance with AS 1141.11.

NATA Reports: 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.

Such test results shall be less than 12 months old and representative of current aggregate supply. The grading shall be known as the ‘Proposed Grading’.

Test requirements: 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 shall comply with the following requirements:

- Wet Strength—AS 1141.22
- Shall be not less than 100 kN for any source except the wet strength required for any fraction of open graded asphalt shall not be less than 150 kN.
- Wet/Dry strength variation—AS 1141.22
- Shall not exceed 35 per cent for any fraction or constituent.
- Flakiness index—AS 1141.15
- The flakiness index of the aggregate shall not exceed 35.
- Fractured faces—AS 1141.18
- The fraction of aggregate retained on a 4.75 mm A5 sieve shall comprise at least 75% by weight of particles with at least two fractured faces.

Fine aggregate

Quality: 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.

Grading: The grading of the fine aggregate used in the work shall be determined in accordance with AS 1141.11.

NATA Reports: 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.

Such test results shall be less than 12 months old and representative of current aggregate supply. The grading shall be known as the ‘Proposed Grading’.

Test requirements: 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.

2.2 MINERAL FILLER

Constituents

Mineral filler may consist of hydrated lime, fly ash, portland cement, flue dust from the manufacture of portland cement, asphalt plant baghouse fines or other material approved by the Superintendent.

Voids

The mineral filler shall comply in all other respects with the requirements of AS 2150.

2.3 BINDER

The binder shall be Class 170 or Class 320 bitumen. The residual bitumen shall be homogeneous, contain no inorganic mineral matter other than that naturally occurring.

The bitumen used in the works shall comply with AS 2008.

Subsequent to the introduction of fluxing oil or cutting oil all cutback bitumen shall comply with the requirements of AS 2157.

2.4 FLUX OIL AND CUTTER OIL

The flux oil and cutter oil to be used for reducing the viscosity of the binder and retaining the cold mix in a workable condition shall conform to AS 3568 in addition to the following requirements:

It shall be clean and free from water.

When one part by volume of oil is mixed with four parts by volume of bitumen at a temperature of 177°C the mixture shall be homogeneous and shall not foam.

2.5 BITUMEN ADHESION AGENT

Use and test requirements

A bitumen adhesion agent shall be added, if required, to the binder at one per cent by mass when nominated by the Superintendent based on experience with asphalts incorporating aggregates from the same source.

Details of the proposed bitumen adhesion agent shall be submitted for the Superintendent's approval in accordance with Clause **Nominated mix.**

The bitumen adhesion agent shall be used in a manner compatible with the manufacturer's recommendations.

3 MIX DESIGN

3.1 NOMINATED MIX

Design limits

The Contractor shall design the mix, henceforth called the 'nominated mix', within the limits shown in *Table 3.1* unless otherwise approved by the Superintendent.

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 phases of any particular test must be performed at one laboratory unless otherwise approved by the Superintendent.

All relevant test results shall accompany the Certificate. The Certificate shall confirm that the required testing has been carried out within the twelve month period before the date of submission to the Superintendent.

Mix details

Details of the nominated mix shall be submitted to the Superintendent at least twenty one days before first delivery of the cold mix.

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.

Revised mix

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 **Design limits** shall be borne by the Contractor.

Table 3.1 Limits for design of nominated mix

Property	**Requirement for nominal mix size**			**Test method**
	Aggregate % by mass passing			
	7 mm	**10 mm**	**14 mm**	
AS Sieve grading:				AS 1141.11
19.0 mm	100	100	100	
13.2 mm	100	100	95–100	
9.50 mm	100	90–100	70–85	
6.70 mm	90–100	70–85	57–74	
4.75 mm	70–90	55–70	45–65	
2.36 mm	45–60	35–50	28–45	
1.18 mm	26–45	22–38	15–30	
600 µm	15–30	12–27	10–23	
300 µm	10–20	6–16	5–17	
150 µm	4–14	4–11	3–11	
75 µm	3–8	2–6	2–5	
Filler	0.5–1.0	0.5–1.0	0.5–1.0	
Binder content (% by mass of total mix)*	4.5–6.0	4.0-5.5	4.0–5.0	AS 2891.3.1
Medium flux oil (%) in binder	10–20	10–20	10–20	
* Some increase beyond these ranges of binder may be permitted for aggregates having unusually high absorption characteristic. Such departures will require Superintendent's approval.				

3.2 APPROVED MIX

Approval

When a nominated mix has been approved by the Superintendent it shall be known as the 'Approved Mix'. Work shall not commence until cold mix design has been approved.

Superintendent's approval of specific nominated mixes or previously approved mixes ***(*Prior approval)** constitutes a **Hold Point** for use of those mixes.

The Superintendent will recognise AS 4283 as a reference in determining approval of the nominated mix.

Changes to approved mixes

The Contractor shall not make any changes to the Approved Mix, 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 **Nominated mix.**

Prior approval

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:

- 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;
- the constituent materials and their quality remain unchanged from that previously approved; and
- 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 **Mix design** at any time during the course of the contract.

Cold mix to comply with all requirement of the specifiation

Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor shall be responsible for producing the cold mix which satisfies all requirements of the Specification.

3.3 REQUIREMENTS OF PRODUCTION MIX

Name

The cold mix produced in the plant and delivered to the site shall be known as the 'production mix'.

Fluxing

Fluxing shall be carried out prior to the addition of the binder to the mix by adding the required amount of cold flux oil and cutter oil to the hot bitumen.

Flux oil

The amount of flux oil and cutter oil added shall be varied according to the season as agreed between the Contractor and the Superintendent based on local experience.

Grading variations

The grading of the total mineral aggregate in the mix produced shall not vary from the approved mix design figures by more than the amounts given in Table 3.2.

Binder variation

The binder content shall not vary from the approved mix by more than ±0.3%.

Table 3.2 Permissable grading variations table

Sieve size	**Allowable variation from nominated mix gradings (% passing)**
4.75 mm and larger	± 7%
1.18 mm and 2.36 mm	± 5%
0.600 and 0.300 mm	± 4%
Other sizes	± 2.5%

3.4 NON-COMPLYING PRODUCTION COLD MIX

Mixes not complying with this worksection may be rejected. Consideration may be given by the Superintendent to the acceptance of the material at an agreed reduced payment.

3.5 MIXING PROCEDURE

Plant

Mixing, shall be undertaken in a suitable plant nominated at tender and approved by the Superintendent, capable of uniformly mixing the coarse and fine aggregate and binder to meet the specified requirements.

Mixing time and temperature

Mixing time and temperature shall be such that all particles of the mineral aggregate are uniformly coated with binder.

Storage of mix

If stored by the contractor prior to delivery, the mix shall be stored under cover from the weather and on a concrete or asphalt slab.

The stockpile site shall be in a free draining area not susceptible to ponding of water due to precipitation.

Stockpiles shall be constructed in such a manner that no compaction, other than by the weight of the material itself, will result. No equipment of any kind shall be run over the surface of the stockpile.

All stockpiles are to remain covered and protected from precipitation and excess evaporation of incorporated oils.

Storage of the mix by the Contractor prior to delivery is limited to a period of 2 weeks.

3.6 SAMPLING AND TESTING OF PRODUCTION MIX

Responsibility for sampling

The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose. The costs associated with taking samples of production mix shall be borne by the Contractor.

Frequency of sampling

For the purpose of testing production mix, samples shall be taken at the rate of one sample for each production lot or days production whichever is the lesser. Sampling shall be in accordance with AS 2891.1.

Testing of mix

The Contractor shall maintain and operate a testing laboratory with appropriate NATA registration at, or near, the mixing plant so as to ensure complete control over the mixture produced.

Conformance reports shall be provided promptly to the Superintendent, if requested.

The cost of testing shall be borne by the Contractor.

3.7 PERFORMANCE PROPERTIES OF THE MIX

The manufactured material shall be cohesive and capable of being compacted readily into a semi-dense mass which is resistant to the destructive action of traffic.

When compacted, visual examination of the compacted material shall indicate good mechanical interlock of particles which are fully coated with binder.

3.8 TRANSPORT

Haulage trucks

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.

Load measurement

Unless other means of measurement are approved by the Superintendent, the mass of all truck-loads of cold mix shall be measured on a registered weighbridge.

3.9 DELIVERY

Times

Unless otherwise specially requested, deliveries shall reach the site of the work between the hours of 7.30 a.m and 3.30 p.m Mondays to Fridays inclusive.

As much preliminary notice as possible will be given before the first deliveries are required, and thereafter advice of delivery requirements for particular locations will be given not later than 10.00 a.m. on the day preceding the delivery.

The Contractor shall comply with all reasonable delivery instructions meeting these guidelines.

Cancellation of deliveries by Principal

The Principal reserves the right to cancel deliveries other than loads premixed actually being mixed or in transit.

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this worksection in accordance with Pay Items 1142.1 and 1142.2 inclusive.

The quantities shown in the Schedule of Rates are estimated total requirements and are not to be taken as actual or correct for the period of contract.

4.2 PAY ITEMS

1142.1 Supply cold mix (ex bins)

The unit of measurement shall be the tonne.

The quantity shall be determined from weighbridge dockets at the plant, unless an alternative measurement is approved by the Superintendent.

1142.1 Supply and deliver cold mix

1142.1(1) (Depot Site 1)

1142.1(2) (Depot Site 2)

1142.1(3) ……..(job site)

The unit of measurement shall be the tonne.

The quantity shall be determined from weighbridge dockets.

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1143 SPRAYED BITUMINOUS SURFACING

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the supply of materials, design and application of sprayed seals for roads and related applications and includes the following types of sprayed treatments:

- Prime.
- Primerseal.
- Seal:
  - . With conventional bitumen, cutback bitumen or bitumen emulsion binder.
  - . With modified binder, e.g. multigrade binder, polymer modified binder.
  - . Seal incorporating geotextile fabric, with or without modified binder.

The work to be performed under this worksection includes:

- Supply and delivery of materials.
- Storage and handling of raw materials.
- Precoating of aggregate.
- Preparation of pavement surfaces.
- Preparation of bituminous materials.
- Application of primer, primerbinder and binder.
- Spreading and rolling of aggregate.
- Removal of loose aggregate.
- Care of completed work.

The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, shall be as detailed in the Appendix (Schedule of Job Details). For multiple treatments, the binder and aggregate may be required to be laid in one or more separate applications.

This section is to be read in conjunction with the Appendix (Schedule of Job Details). Where there is conflict between the requirements of this section and the Appendix, the requirements of the Appendix shall apply.

1.2 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements:

Worksections

0161 Quality (Construction)

1101 Control of traffic

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.0	List of methods
AS1160	Bituminous Emulsions for Construction and Maintenance of Pavements
AS 1289 Various	Methods of Testing Soils for Engineering Purposes
AS 1742	Manual of uniform traffic control devices,
AS 1742.3	Traffic control devices for works on roads
AS 2008	Residual bitumen for pavements
AS 2157	Cutback Bitumen
AS 2341 Various	Methods of Testing Bitumen and Related Roadmaking Products
AS 2758	Aggregates and rock for engineering purposes
AS 2758.2	Aggregate for sprayed bituminous surfacing

AS 3568 Oils for reducing the viscosity of residual bitumen for pavements

AS/NZS ISO 9001 Quality Management Systems – Requirements

SAA HB 81 Field guide for traffic control.

SAA HB 81.6 Bituminous surfacing on roads.

Other publications

Austroads

Manual of Test Procedures (www.austroads.com.au/tm/testmethods.htm)

AP-T32 Audit and Surveillance of Sprayed Sealing Contract Works

AP-41/06 Specification Framework for Polymer Modified Binders and multigrade bitumens

AP–T42/06 Guide to the selection and use of Polymer Modified Binders and multigrade bitumens

AP–G76/04. Sprayed sealing guide

AP–G41 Bitumen Sealing Safety Guide.

AAPA

Advisory note 7 – Guide to the heating and Storage of Binders for Sprayed Sealing and Hot mixed asphalt.

Project Ref – Project Request for Environmental Factors

EMP – Project Environmental Management Plan

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction).*

1.4 DEFINITION OF TERMS

For the purpose of this worksection, the following definitions apply:

- Cutter Oil: A light petroleum distillate (e.g. kerosene) added to bitumen to temporarily reduce its viscosity.
- Double/double seal: A seal consisting of two successive applications of binder each followed by an application of aggregate.
- Flux Oil: A petroleum distillate (e.g diesel) added to bitumen to produce a long-term reduction in viscosity.
- Prime: An application of a primer to a prepared base, without cover aggregate.
- Primer: A bituminous material of low viscosity and low surface tension used in priming.
- Primerseal: An application of a primerbinder with a cover aggregate to a prepared base.
- Primerbinder: A material, more viscous than a primer, and required to act both as a primer and binder, and used in primersealing.
- Seal: A sprayed application of bituminous binder into which aggregate is incorporated. A sprayed seal may incorporate more than one application of binder and aggregate and may also be combined with a layer of geotextile fabric.
- Reseal: A seal applied to an existing sealed, or asphalt surface.
- Residual Binder: The volume of bituminous binder at 15°C including the volume of any polymer, crumb rubber and flux oil but not including the volume of any cutter oil, water, emulsifier or adhesion agent.
- Single/double seal: A seal consisting of a single application of binder followed by a double application of aggregate.
- Single/single seal: A seal consisting of a single application of binder followed by a single application of aggregate.
- High Stress Seal or Reseal (HSS): The application of a polymer modified binder into which aggregate is incorporated to provide a durable wearing surface.
- Strain Alleviating Membrane (SAM): The application of polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.

- Strain Alleviating Membrane Interlayer (SAMI): The application of a polymer modified binder into which aggregate is incorporated. A SAMI is used as an interlayer between an asphalt wearing course and underlying layers to provide alleviation from tensile strains developed beneath it.
- Geotextile Reinforced Seal (GRS): The applications of C170 tack coat, geotextile or polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.

1.5 TESTING

All laboratory testing of properties required by the worksection shall be undertaken in a laboratory registered by the National Association of Testing Authorities (NATA) or International Accreditation New Zealand (IANZ) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian or New Zealand Standard or Austroads Manual of Test Procedures. Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard/Manual provides a choice of procedures, the method to be adopted shall be that endorsed by the relevant State Road Authority in the State in which the work is being undertaken.

Requirements for NATA or IANZ registration shall not apply to field tests such as surface texture measurements or aggregate spreader calibration undertaken by competent and trained personnel.

1.6 PLANT

All plant shall be registered and insured as appropriate to its use on a public road and shall comply with statutory environmental regulations.

1.7 PROTECTION OF SERVICES AND ROAD FIXTURES

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, bridge or culvert decks, kerb and gutter and other road fixtures.

Immediately after aggregate has been spread, the Contractor shall clean off or remove any sprayed material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

1.8 CONTROL OF TRAFFIC

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work.

Any costs incurred as a result of the supply of labour and materials complying with 1101 *Control of traffic* shall be borne by the Contractor.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users.

2 MATERIALS

2.1 BITUMINOUS MATERIALS

Bitumen

Standard Classes of bitumen shall comply with the requirements of AS 2008.

Multigrade bitumen shall comply with the Austroads AP-T42/06.

Polymer Modified Binders

Polymer modified binder shall comply with the Austroads AP-T41/06.

Bitumen Emulsion

Bitumen emulsion shall comply with the requirements of AS 1160.

Cutback Bitumen

Cutback bitumen shall comply with AS 2157 or may be prepared by the Contractor, in the field, by blending bitumen and cutter oil in proportions specified or selected as appropriate to the particular application. Proprietary grades of cutback bitumen shall comply with the manufacturer's specification.

Adhesion Agent

The type and proportion of adhesion agent to be added to bituminous binder or aggregate precoating material shall be:

- subject to evidence of previous satisfactory performance with the proposed combination of binder, aggregate source and precoating material, or
- selected from materials listed as approved by the relevant State Road Authority (where applicable).

Cutter Oil and Flux Oil

Cutter oil and flux oil shall comply with AS 3568.

Aggregate Precoating Materials

Aggregate precoating materials shall be flux oil, flux oil and bitumen mixture, cutback bitumen, proprietary bitumen emulsion or other proprietary product subject to evidence of previous satisfactory field performance as an aggregate precoating material. All precoating material shall contain a minimum of 1% of an approved adhesion agent.

2.2 AGGREGATE

Where requested, the source of all materials shall be subject to inspection and approval by the Superintendent and only material from a nominated quarry face or location shall be used.

Aggregate shall comply with AS 2758.2 with the following additional requirements. The class of aggregate, resistance to polishing, method of determination of aggregate shape, and combination of hardness and durability test measures shall be specified in the Schedule of Job Details. Only one method of determination of aggregate shape and one combination of hardness and durability shall apply. Where no aggregate details are specified in the Schedule of Details, the particular aggregate class, polishing resistance and combination of test methods shall be selected by the Contractor based on the service conditions and customary test procedures used in the State in which the works are located.

2.3 OTHER MATERIALS

Protective paper

A heavy-duty protective paper, weighing not less than 120 grams per square metre, shall be used for all start, finish and taper operations. The paper shall be of sufficient width to prevent overspray and of sufficient strength to prevent spillage during removal.

Geotextile

Geotextile fabric used in geotextile reinforced seals shall be a non-woven, needle punched fabric with a minimum melting point of 165ºC and a minimum mass of 130 g/m^2.

3 DESIGN OF SPRAYED SEALS

The types of sprayed seal treatment shall be as listed in the schedule of job requirements, or as shown on drawings.

The Contractor shall determine rates of application of binder and aggregate for the nominated sprayed seal treatment types based on Austroads *Sprayed sealing guide.* Where specified , the Contractor's seal design shall be assessed by the Superintendent for compliance with the requirements of this worksection.

The selection of materials and application rates for surfacing treatments not covered by the Austroads *Seal Design Method*, such as priming, primersealing and special treatments, shall be in accordance with guidelines for accepted good practice.

4 APPLICATION OF SPRAYED BITUMINOUS SURFACING

The Contractor shall be responsible for:

- Supply and delivery of materials.
- Storage and handling of raw materials.
- Precoating of aggregate (where aggregates are not purchased suitably precoated).
- Preparation of bituminous materials, including selection and incorporation of appropriate proportions of cutter oil, adhesion agent and any other additives.
- Control of traffic through the works, including recording of traffic control measures.
- Removal and disposal, or protection, of existing raised pavement markers.
- Sweeping and cleaning pavement surfaces prior to spraying.

- Protection of road furniture from spray.
- Supply and placing of geotextile, where specified.
- Application of primer, primerbinder and/or binder, uniformly to the target application rate.
- Spreading of aggregate, uniformly to the target application rate.
- Rolling of aggregate.
- Removal of loose aggregate
- Removal and disposal of all surplus and waste materials.
- Installation of temporary pavement markers.
- Care of completed work.

Sealing work shall be performed in workman-like manner in accordance with recognised industry standards.

Completed and cured primes shall have a uniform appearance.

Completed primerseals and single/single seals with aggregates of 7 mm size, or less, shall have a uniform surface retaining a matrix of aggregate.

Completed single/single seals with aggregates of 10 mm size, or greater, shall have a uniform, single retained layer of aggregate.

Completed single/double seals shall have a uniform layer of retained aggregate with both sizes fitting together to produce a uniform surface texture.

Completed double/double seals shall have uniform double retained layers of aggregate with the second aggregate fitting inside the texture of the aggregate used in the first layer.

Work shall be finished with clean straight edges and no obvious defects related to poorly constructed longitudinal or transverse joins, blocked spray nozzles or any other construction fault.

5 REMOVAL OF LOOSE AGGREGATE

After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10 mm, or larger, aggregates shall not exceed the values specified in Table 5.1.

At all times there shall be no windrow of aggregate on either the sealed surface or shoulder that could constitute a traffic hazard. Where specified, all surplus aggregate shall be uplifted and removed from the works.

Removal of loose aggregate from the trafficked pavement shall be completed within the time specified in Table 5.2.

Table 5.1 Loose stone particles remaining after sweeping

Road type	**Loose stones (particles/m^2) max**
Urban areas	20
Other medium to high traffic (>250 v/l/d)	30
Low traffic (<250 v/l/d)	40

Table 5.2 Time limit for removal of loose aggregate

Traffic volume (vehicles/lane/day)	**Maximum time limits**
> 2000 and all Freeways	Within 8 hours of sealing
1000 to 2000	Within 24 hours of sealing
250 to 1000	Within 48 hours of sealing
< 250	Within 5 days of sealing

6 REMOVAL OF SURPLUS AND WASTE MATERIAL

Prior to leaving the work site, the Contractor shall ensure that all services are uncovered and cleaned, if necessary. All waste paper and rubbish arising from the sprayed sealing operations shall be

removed from site. The stockpile site shall be cleaned and any excess material left in a tidy heap or removed, depending on the requirements of the Principal.

7 PROTECTION AND CARE OF NEW WORK

The Contractor shall provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers. Signs shall be maintained until loose aggregate has been removed and linemarking reinstated. Where linemarking is to be undertaken by others, warning signs indicating the absence of linemarking shall be erected and maintained by the organisation responsible for linemarking.

8 SAMPLING AND TESTING

The Contractor's Quality plan shall nominate the proposed testing frequency including, but not limited to:

- Specification compliance of bituminous materials
- Specification compliance of aggregates
- Measurement of loose aggregate on completed work.

9 PRECOATING OF AGGREGATE

Aggregate coating shall be carried out at the quarry. Precoating at stockpiles shall not be undertaken except in special circumstances approved by Council.

10 STOCKPILE SITES

Only stockpile sites that are approved by Council shall be used. Any new site shall be constructed and maintained so that contamination of the aggregate is prevented and that the site drains. The Contractor shall protect any established bunding and if damaged, shall replace it. All bunding shall be constructed in accordance with the Environmental Protection Requirements of RTA Specification and G5.

Stockpile sites shall be left clean and tidy and all excess aggregate removed at the completion of the project

11 MEASUREMENT AND PAYMENT

11.1 MEASUREMENT BY AREA

Priming, primersealing or sealing shall be measured by area in square metres. No deductions shall be made for openings each not exceeding one square metre.

Removal and disposal of existing raised pavement markers shall be measured by length in kilometres.

11.2 MEASUREMENT BY QUANTITY OF MATERIAL SUPPLIED

Supply and spray primer or primerbinder (including preparation of surface): The unit of measurement shall be litres at 15ºC.

The quantities (in litres) shall be determined by either:

- multiplying the target application rate of the combined mixture of primer or primerbinder (including any cutter or flux oil) at 15ºC (in litres per square metre) by the area of road surface sprayed for each sprayer run (in square metres); or
- measurement of actual volume (at 15ºC) of materials used.

Supply and spray binder (including adhesion agent where required, and preparation of surface)
The unit of measurement shall be litres at 15ºC.

The quantities (in litres) shall be determined by either:

- multiplying the target application rate of the residual (excluding any cutter oil or flux oil) at 15ºC (in litres per square metre) by the area of road surface sprayed for each sprayer run (in square metres); or

- measurement of actual volume (at 15ºC) of materials used.

Supply, incorporate and spray cutter oil, flux oil and adhesion agent in binder

The unit of measurement shall be litre measured at ambient temperature or 15ºC.

The quantities shall be determined from either:

- the target proportion of cutter, oil flux oil, or adhesion agent added to the binder; or
- measurement of actual volume of materials used.

Supply, precoat, apply aggregate

The unit of measurement shall be cubic metre.

The quantity of aggregate (in cubic metres) shall be determined by dividing the area of road surface covered by each sprayer run (in square metres) by the target application rate (in square metres per cubic metre).

Roll and incorporate aggregate

The unit of measurement shall be square metres.

Supply and place geotextile

The unit of measurement shall be square metre of pavement area covered. Payment shall exclude laps and application of binder and aggregate.

11.3 NON COMPLYING MATERIALS

In the event that the work or materials supplied is not within the standards defined for supply and application of sprayed bituminous surfacing, the Superintendent may direct:

- that the reduced service life arising from the non compliance is offset by reducing payment for the non complying portion of work or material by the method defined in the Schedule of Job Details; or,
- with the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.

12 ANNEXURE A

12.1 SCHEDULE OF JOB DETAILS

Table A1 Schedule of Job Details

Item	Road Name	Location			Approx Length m	Approx Width m	Approx Area m^2	Treatment			Aggregate			Traffic		Estimated rates of application		Other requirements (1)
		Map ref. (1)	Chainage	Distance markers or ref. points				Type (2)	Desc (3)	Apps (4)	Size (s)	Class min (5)	PSV/ PAFV min (6)	veh/lane/day (7)	heavy eh. % (8)	Binder L/m^2 (9)	Agg. m^2/m^3 (10)	

1. Map references should nominate directory used
2. Treatment type: Prime only (PO), Primerseal (PS), Prime and seal (P&S), Reseal (R).
3. Treatment description: Strain alleviating membrane (SAM), Strain alleviating membrane interlayer (SAMI), Geotextile reinforced seal (GRS), Surface enrichment (SE)
4. Number of applications: Single/single (S/S), Single/double (S/D), Double/double (D/D)
5. Aggregate Class: A, B or C (AS 2758.2)
6. Aggregate PSV or PAFV: 48 for Class A aggregates unless otherwise specified.
7. Veh/lane/day (v/l/d): Annual Average Daily (24 hr) Traffic / Number of traffic lanes.
8. % Heavy vehicles: Percentage of AADT that are counted as heavy vehicles.
9. Estimated binder application rate for tendering purposes only. Actual rates to be determined after measurement of surface and aggregate properties.
10. Estimated aggregate spread rate for tendering purposes only. Actual rates to be determined after measurement of aggregate ALD.
11. Other requirements may include job specific requirements such as binder type or surface pretreatment.

13 ANNEXURE B

13.1 GUIDELINES FOR PERFORMING SPRAYED SEALING WORKS

Scope

This section provides a guide to good practice to achieve satisfactory outcomes and durable performance from sprayed sealing work. The following procedures may be incorporated in the Contractor's Quality Plan or provide a benchmark for assessing the effectiveness of the process standards adopted by the Contractor.

Storage and handling of raw materials

Aggregates: Aggregate stockpiles shall be arranged and managed in accordance with the following requirements:

- The maximum lot size shall be limited to 250 cubic metres (approximately 300 tonnes).
- Stockpiles shall each be located on a firm level ground and effectively separated to prevent cross-contamination and interfere with the loading and/or precoating operations.
- Siting of stockpiles shall ensure adequate clearance between machinery and overhead power lines.
- Stockpiles shall be managed to avoid environmental damage from dust or run-off of bituminous materials.
- The quantity and type of each stockpile shall be clearly signposted on the stockpile at all times.
- Stockpiles shall be covered, if necessary, to reduce contamination by dust or water.
- Recovery from stockpiles shall be such as to avoid contamination of aggregates.
- Contamination, weathering or reduction in effectiveness of precoating of aggregates in stockpiles shall be rectified or the stockpile replaced.

Binder: Binder shall be heated in accordance with the manufacturer's written recommendations but shall never exceed 200°C.

Binder shall be stored in accordance with the temperature and time combinations specified in the manufacturer's written recommendation.

Any bituminous material that has been overheated shall not be used unless tested for compliance with the relevant specification. Where no specific recommendations are provided, the temperature guidelines set out in AAPA Advisory Note 7 – Guide to the Heating and Storage of Binders for Sprayed Sealing and Hot mixed Asphalt, shall be adopted.

The Contractor shall implement procedures for storage and handling of binder that ensure prevention of segregation and contamination of the binder by flushing liquids or other materials. Straining devices shall be used at all times when transferring binders into sprayers to avoid particles of hardened bituminous material or other contaminants that could cause blockages in spraying jets.

Condition for commencement

Acceptance of Surface Condition: Prior to commencing sprayed sealing work the Contractor shall make an inspection to determine any pavement defects that could adversely affect the quality of the finished work. Sprayed sealing work shall not proceed until defects have been corrected or agreement reached with the Superintendent's Representative on responsibility for consequences of any recorded defects.

Defects requiring correction may include, but are not limited to:

- Excessive moisture in unbound granular base to be primed or primersealed.
- Loose, poorly bonded, or inadequately compacted materials in the surface of unbound granular base to be primed or primersealed.
- Poorly shaped unbound granular base to be primed or primersealed.
- Presence of soft, fatty or bleeding patches in pavements to be resealed.
- Presence of uncured patching materials, crack sealing, etc.
- Presence of porous patches in surface to be resealed.
- Significant variations in surface texture requiring corrective treatment before resealing.
- Inadequate repair of weak or cracked pavements.
- Inadequate curing of primed surfaces prior to sealing.
- Inadequate curing of primersealed pavements (generally a minimum of 12 months for cutback bitumen primerbinders) prior to resealing.

Preparation of Pavement Surface: Before the application of primer, primerbinder or binder, the pavement surface shall be swept by the use of a rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff brooms. Sweeping shall extend at least 300 mm beyond each edge of the area to be sprayed. Where sealing work is carried out on localised areas and/or half pavement widths, any remaining loose material immediately adjacent to the swept areas shall be removed from the pavement surface.

Adherent patches of foreign material shall be removed from the surface of the pavement. Raised pavement markers shall be removed.

Pavement Temperature and Weather Conditions: The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work using appropriate equipment and measurement procedures.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded. The lower recorded temperature shall be used as a basis for decisions on suitability for spraying and selection of cutter oil proportions.

Spraying primers, primerbinders and binders should only be undertaken if the pavement temperature has been at or above for the temperature shown in Table B1 at least one hour before commencement of spraying and does not fall below the recommended minimum pavement temperature during the period of spraying. Spraying at temperatures below that recommended shall only be undertaken where the risk of poor bitumen adhesion can be adequately managed through suitable type and proportion of cutter oil, traffic control, speed of aggregate covering, rolling and aftercare of completed work.

Spraying shall not be carried out on a wet pavement, while rain appears imminent or during strong winds or dust storms.

Surfaces to be primed should be surface dry, and no more than damp to the depth of pavement penetration.

Surfaces to be primersealed should be damp, but not wet. If necessary, the pavement surface may be lightly watered shortly before applying the primerbinder.

Surfaces to be sealed should be dry and clean.

Environmental Risk: The risk of environmental damage due to primer or primerbinder being washed off into adjacent drains and open watercourses as a result of rain on uncured materials must be considered as an element of an overall risk management plan. A guide to the risk of primer or primerbinder wash-off as a result of rain within stipulated periods after spraying is shown in

Table B1 Minimum pavement temperature

Type of work	**Minimum pavement temperature**
Priming	10°C
Primersealing	10°C
Sealing: – Class 170, Class 320 bitumen, Multigrade binder or bitumen emulsion – PMB binder (hot)	 15°C 20°C

Table B2 Priming Primersealing Risk Assessment

(From: Guidelines for Environmental Management when Spraying Bituminous Materials, AAPA HS&E Guide No 8)

(a) Cutback bitumen				
Weather conditions (Note 2)	**Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)**			
	0–12 hours	**12–24 hours**	**24–48 hours**	**Over 48 hours**
Fine, sunny, warm/hot	Moderate	Moderate	Low	Low
Fine, overcast, cool/warm	High	Moderate	Low	Low
Damp, overcast, warm	High	High	Moderate	Moderate
Damp, overcast, cool	Unacceptable	High	High	Moderate
Wet, overcast, warm	Unacceptable	Unacceptable	High	High

(a) Cutback bitumen				
Weather conditions (Note 2)	**Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)**			
	0–12 hours	**12–24 hours**	**24–48 hours**	**Over 48 hours**
Wet, overcast, cool	Unacceptable	Unacceptable	Unacceptable	Unacceptable
(b) Bitumen emulsions				
Weather conditions (Note 2)	Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)			
	0–12 hours	12–24 hours	24–48 hours	Over 48 hours
Fine, sunny, warm/hot	Moderate	Low	Low	Low
Fine, overcast, cool/warm	Moderate	Low	Low	Low
Damp, overcast, warm	High	Moderate	Low	Low
Damp, overcast, cool	High	Moderate	Moderate	Moderate
Wet, overcast, warm	Unacceptable	High	High	Moderate
Wet, overcast, cool	Unacceptable	Unacceptable	Unacceptable	High

1. The risk levels reflect the likelihood of a wash-off from granular pavements on moderate grades with typical crossfall. For roads on steep grades, or with abnormal crossfall, or with low porosity base course, the risk of wash-off is higher than that shown.
2. Typical temperatures associated with different weather conditions are: Hot = 25ºC, Warm = 15–25ºC, Cool = 15ºC.
3. Where risk is classified as unacceptable, application should be delayed until conditions improve.
4. Where risk is classified as high, application should be delayed or the application and curing supervised continuously until dry. Precautionary measures include blocking of stormwater entry points, placing of spill response equipment, regular weather checks and frequent inspections.
5. Where risk is classified as moderate, inspections must be frequent enough to respond to rain events. Stormwater entry points should be blocked and spill response equipment available on site.
6. Where risk is classified as low, inspections may be less frequent but weather should be monitored to ensure prompt response to rain events.

Preparation of aggregates

Precoating of Aggregate: Aggregate shall be either:

- Precoated at the quarry, or on site, and stockpiled for later use, or
- Precoated on site, immediately prior to use.

Advance precoating is preferred and shall be done with a bitumen-based material that leaves a thin film of bitumen adhering to the aggregate. Bitumen based materials may be a mixture of bitumen, flux oil/cutter oil and adhesion agent or bitumen emulsion specifically formulated for use as aggregate precoating material. Bitumen/flux oil mixtures shall be cured for a minimum of one week before use. Precoated aggregates that have been stockpiled for more than one month shall be re-assessed for effectiveness of precoating and possible rejuvenation before use.

Precoating on site, for immediate use, shall be done with either flux oil, flux oil/cutter oil mixture, cutter oil or bitumen emulsion specifically formulated for use as aggregate precoating material. Adhesion agent shall be added to oil based precoating materials at the rate of 1% by volume when aggregates are damp or the weather conditions are unfavourable with rain threatening or humid conditions.

The aggregate precoating 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.

A guide to rates of application on clean, dry aggregates is given in Table B3. Dusty or dirty aggregates require a heavier rate of precoating than clean dry aggregates of the same type and size. For porous aggregates, rates may need to be increased by up to 2 L/m^3, and for smooth, hard aggregates, reduced by up to 2 L/m^3, from the values shown in Table B3. Generally, bitumen based materials and emulsions require heavier rates of application than oil based precoating materials.

Field precoating of aggregate for immediate use shall not be carried out when rain is imminent. If aggregate has been precoated and rain appears imminent, the aggregate shall be adequately covered to prevent the fresh precoating material being washed from the aggregate particles.

The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the precoating material on the stockpiled aggregate.

Table B3 Typical precoating rates (L/m^3)

Aggregate Condition	**Precoating material**	
	Bitumen based, including bitumen emulsions	**Oil based**
Clean	6 to 12	4 to 10
Dirty	8 to 14	6 to 12

PREPARATION OF BITUMEN BINDER

Proportion of Cutter Oil: The Contractor shall determine and record the proportion of cutter oil required for each sprayer load. Tables B4 and B5 provide a guide to the proportions of cutter oil for Class 170 or 320 bitumen, multigrade binder and polymer modified binders, respectively.

Adding Cutter Oil: Binder shall be within the temperature range shown in Table B6 when cutter oil is incorporated. The sprayer load of cutback bitumen shall be circulated at a rate of at least 700litres/min (approximately 350 rpm) for a minimum of twenty minutes before spraying.

Care shall be taken to ensure that any material that is to be added to hot binder is free of moisture. Materials considered at risk from moisture contamination, for example drummed materials stored in the open, should be checked with a water-finding paste before use. When adding cutter oil to standard bitumen binders, risks associated with moisture can be reduced by placing the cutter oil, without being previously heated, into the sprayer, followed by the hot bitumen.

When adding cutter oil to polymer modified bitumen binders, including crumb rubber binder, the cutter oil shall be added to the hot binder.

If a part sprayer load of field prepared cutback bitumen is unused on the day of mixing, and needs to be returned to the heater tanks, it shall be placed in a tank reserved for that purpose. No bitumen or cutter oil shall be added to the returned cutback bitumen unless the tank is fitted with an effective circulation 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.

Cutback bitumen shall be within the temperature range shown in Table B7 at the time of spraying. Spraying temperatures for proportions of cutter oil between those shown in the table may be established by interpolation.

Adding Flux Oil: Where flux oil 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/min for 20 minutes before spraying. Care shall be taken to ensure that flux oil that is to be added to hot binder is free of moisture.

Adding Bitumen Adhesion Agent

Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the entire mixture circulated at a rate of at least 700 litres/min for 20 minutes, after addition of the last component, before spraying.

Where bitumen containing adhesion agent is not used within 8 hours of mixing with hot bitumen, the active contribution of adhesion agent shall be ignored in subsequent use of the bitumen material. Allowance shall, however, be made for the oil component of the adhesion agent in the returned bitumen.

Table B4 Basic Cutting Practice for Class 170 Bitumen and Multigrade Binder
(Parts by volume of cutter oil to be added to bitumen measured at 15ºC)

Aggregates of 10 mm nominal size or larger				**Aggregates of 7 mm nominal size or smaller**			
Pavement temperature (ºC)	**Traffic (vehicles/lane/day)**			**Pavement temperature (ºC)**	**Traffic (vehicles/lane/day)**		
	<100	100–1500	>1500		<100	100–1500	>1500
15-19	10	8	6	15-19	12	10	8
20–25	8	6	4	20–25	10	8	6
26–32	6	4	2	26–32	8	6	4
33–38	4	2	0	33–38	6	4	2
39–45	2	0	0	39–45	4	2	0
>45	0	0	0	>45	2	0	0

1. Rates are based on fine, stable weather conditions and active, freshly applied or partially dried oil or bitumen precoating.
2. For dry or inactive precoating, add 2 parts except for heavy traffic and high pavement temperatures.
3. For damp aggregates, add 2 parts, except for heavy traffic and high pavement temperatures.
4. For periods of falling temperatures, add 2 parts or up to 4 parts if very cold overnight temperatures are expected to follow.
5. Add a further 2 parts of cutter oil for pavement temperatures below 15ºC, provided that sprayed sealing work should not be carried out at temperatures below 10ºC.
6. Subtract 5ºC from measured pavement temperature for wind chill and fresh breeze. Cease spraying in strong winds.
7. In double/double seals, where the second application is to be applied the same day, or without any significant period of trafficking, it is undesirable to include any cutter oil in the first binder application. If cutter oil is considered necessary, it should be a maximum of 2 parts.
8. Where cutter proportions are added as percentage of total binder, the proportions shown here as parts per 100 parts of bitumen may be taken as a reasonable approximation of percentage by volume.
9. Where pavements are not intended to carry normal design traffic for a period of time after sealing, the proportion of cutter oil may be varied to reflect the conditions likely to prevail at the time of opening to traffic.

Table B5 Guide to Cutting Practice for PMBs used in SAM and HSS Applications 1, 2
(Parts by volume of cutter oil to be added to 100 parts by volume of PMB-measured at 15°C) (Note 3)

Pavement Temperature4 (°C)	**Traffic (veh/lane/day)**	**Class of PMB**				
		S15E	**S20E S25E**	**S35E**	**S45R S50R5, 6**	**S55R5, 6**
20 to 25	<1000 ≥1000	6-8 6	8 6-8	6 4	10 8	12 10
26 to 32	<1000 ≥1000	4-6 4	6 4-6	4 2	8-10 6-8	10-12 8-10
33 to 38	<1000 ≥1000	4 2	4-5 3-4	2 2	6-8 6	8 6-8
39 to 45	<1000 ≥1000	Min 2	Min 3	0-2	4-6 4-6	6 4-6
> 45	All	Min 2	Min 3	0-2	Min 4	Min 5

1. In SAMI applications, where the seal is to be covered by asphalt within a short period, it is undesirable to include any cutter oil at all. If cutter oil is considered necessary, it should be a maximum of 2 parts of cutter oil to 100 parts of PMB. Similar provisions apply to the first binder application of a double/double seal where the second application is to follow the same day, or within a short period.
2. In aggregate retention applications using lower levels of polymer modification ie. S10E, S40R, and some proprietary blends of PBD, the binder should be cut back as per normal Class 170 bitumen
3. Where cutter proportions are added as percentage of total binder, the proportions shown here as parts per 100 parts of PMB may be taken as a reasonable approximation of percentage by volume.
4. Pavement temperature should generally be based on the worst condition, i.e., shaded areas.
5. Pre-blended crumb rubber grades may contain process oil used in their manufacture. This oil will most likely reduce the viscosity compared to field blended grades, and may allow a small reduction, say 2 parts, in added cutter oil compared to field produced grades.
6. At high rates of application of binder (greater than say 2 L/m^2) the proportion of cutter oil may be reduced by 2 parts.

Table B6 Binder Temperature

Binder	**Temperature range (°C)**
Bitumen Class 170, Multigrade 600/170	160–180
Bitumen Class 320	170–190
PMB	Within a range of 10°C below the maximum recommended application temperature

Table B7 Cutback Bitumen Spraying Temperature

AS Grade (if applicable)	**Equivalent Cutter Oil (%)**	**Temperature Range (°C)**
AMC 00	56	ambient
AMC 0	44	35–55
AMC 1	34	60–80
AMC 2	27	75–100
AMC 3	21	95–115
AMC 4	16	110–135
AMC 5	11	120–150
	9	130–155
AMC 6	7	135–160
	5	145–170
AMC 7	3	150–175
	2	155–180

Application of primer, primerbinder and binder

General: The area to be sprayed with primerbinder or binder shall be limited to the area that can be covered with aggregate within fifteen minutes of spraying.

Primer and Primerbinder: The class and grade of primer and primerbinder shall be as specified in the Schedule of Details.

Application rates and quantities of primer and primerbinder shall apply to the mixture, including cutter oil or the water content of bitumen emulsion, measured at 15°C.

After application of a primer, a period of at least forty-eight hours, 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.

Where it is necessary to give traffic limited access to the primed surface, the surface shall have a light layer of grit applied to avoid pickup. Gritting shall not be applied until a substantial proportion of the primer has been absorbed into the pavement.

Binder: The class or type of bitumen, modified bitumen, cutback bitumen, or bitumen emulsion shall be as specified in the Schedule of Details.

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 adhesion agent and/or cutter oil or the water content of emulsions. If flux oil has been added to the bitumen, the quantity of flux oil shall be included as part of the binder.

Where 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 adhesion agent and/or cutter oil in the mixture.

The Contractor shall determine the forward speed of the bitumen sprayer based on either:

- the hot application rate of total binder, including adhesion agent and/or cutter oil, or
- allowances for temperature and proportion of adhesion agent and cutter oil, measured at 15°C.

Volume correction factors for converting volume of bituminous binders from 15ºC to elevated temperature, or from elevated temperature back to 15ºC are shown in Tables B8 and B9.

Table B8 Volume Conversion Table – Bitumen (Including cutback bitumen)

MULTIPLY BY "A" TO REDUCE VOLUME AT To TO VOLUME AT 15o MULTIPLY BY "B" TO INCREASE VOLUME AT 15oC TO VOLUME AT To					
Multiplier A	**Temp. °C T**	**Multiplier B**	**Multiplier A**	**Temp. °C T**	**Multiplier B**
.9856	38	1.0146	.9537	90	1.0486
.9844	40	1.0158	.9524	92	1.0500
.9831	42	1.0172	.9512	94	1.0513
.9819	44	1.0184	.9500	96	1.0526
.9806	46	1.0198	.9488	98	1.0540
.9794	48	1.0210	.9476	100	1.0553
.9782	50	1.0223	.9464	102	1.0566
.9769	52	1.0236	.9452	104	1.0580
.9757	54	1.0249	.9440	106	1.0593
.9745	56	1.0262	.9428	108	1.0607
.9732	58	1.0275	.9416	110	1.0620
.9720	60	1.0288	.9404	112	1.0634
.9708	62	1.0301	.9392	114	1.0647
.9695	64	1.0315	.9380	116	1.0661
.9683	66	1.0327	.9368	118	1.0675
.9671	68	1.0340	.9356	120	1.0688
.9659	70	1.0353	.9344	122	1.0702
.9646	72	1.0367	.9332	124	1.0716
.9634	74	1.0380	.9320	126	1.0730
.9622	76	1.0393	.9308	128	1.0743
.9610	78	1.0406	.9296	130	1.0757
.9597	80	1.0420	.9284	132	1.0771
.9585	82	1.0433	.9272	134	1.0785
.9573	84	1.0446	.9260	136	1.0799
.9561	86	1.0459	.9249	138	1.0812
.9549	88	1.0472	.9237	140	1.0826
.9225	142	1.0840	.9049	172	1.1051
.9213	144	1.0854	.9037	174	1.1066
.9201	146	1.0868	.9025	176	1.1080
.9189	148	1.0883	.9014	178	1.1094
.9178	150	1.0896	.9002	180	1.1109
.9166	152	1.0910	.8990	182	1.1123
.9154	154	1.0924	.8979	184	1.1137
.9142	156	1.0939	.8967	186	1.1152
.9130	158	1.0953	.8956	188	1.1166
.9119	160	1.0966	.8944	190	1.1181
.9107	162	1.0981	.8933	192	1.1195
.9095	164	1.0995	.8921	194	1.1209
.9084	166	1.1009	.8909	196	1.1224
.9072	168	1.1023	.8898	198	1.1239
.9060	170	1.1038	.8886	200	1.1253

Table B9 Volume Conversion Table – Bitumen Emulsion

HOT LITRES x A = COLD LITRES (at 15°C) COLD LITRES x B = HOT LITRES (T°C)								
60% BITUMEN EMULSION			**70% BITUMEN EMULSION**			**80% BITUMEN EMULSION**		
A	**TEMP (T°C)**	**B**	**A**	**TEMP (T°C)**	**B**	**A**	**TEMP (T°C)**	**B**
1.0000	15	1.0000	1.0000	15	1.0000	1.0000	15	1.0000
.9998	16	1.0002	.9977	20	1.0023	.9974	20	1.0026
.9989	18	1.0011	.9951	25	1.0049	.9948	25	1.0052
.9980	20	1.0020	.9924	30	1.0076	.9921	30	1.0079
.9971	22	1.0029	.9899	35	1.0102	.9895	35	1.0106
.9962	24	1.0038	.9872	40	1.0129	.9868	40	1.0134

HOT LITRES x A = COLD LITRES (at 15°C) **COLD LITRES x B = HOT LITRES (T°C)**								
60% BITUMEN EMULSION			**70% BITUMEN EMULSION**			**80% BITUMEN EMULSION**		
A	**TEMP (T°C)**	**B**	**A**	**TEMP (T°C)**	**B**	**A**	**TEMP (T°C)**	**B**
.9953	26	1.0047	.9840	46	1.0162	.9837	46	1.0166
.9944	28	1.0056	.9830	48	1.0172	.9826	48	1.0177
.9935	30	1.0065	.9819	50	1.0184	.9816	50	1.0187
.9926	32	1.0074	.9809	52	1.0194	.9805	52	1.0199
.9917	34	1.0083	.9798	54	1.0206	.9794	54	1.0210
.9908	36	1.0092	.9788	56	1.0216	.9783	56	1.0222
.9899	38	1.0102	.9777	58	1.0228	.9773	58	1.0232
.9890	40	1.0111	.9767	60	1.0238	.9762	60	1.0244
.9881	42	1.0120	.9752	62	1.0254	.9751	62	1.0255
.9872	44	1.0129	.9746	64	1.0260	.9740	64	1.0267
.9863	46	1.0138	.9736	66	1.0271	.9730	66	1.0277
.9854	48	1.0148	.9725	68	1.0282	.9719	68	1.0289
.9845	50	1.0157	.9715	70	1.0293	.9709	70	1.0300
.9836	52	1.0166	.9704	72	1.0305	.9698	72	1.0311
.9827	54	1.0176	.9693	74	1.0316	.9687	74	1.0323
.9818	56	1.0185	.9683	76	1.0327	.9677	76	1.0334
.9809	58	1.0194	.9672	78	1.0339	.9667	78	1.0344
.9800	60	1.0204	.9662	80	1.0349	.9656	80	1.0356
.9791	62	1.0213	.9651	82	1.0361	.9643	82	1.0370
.9782	64	1.0222	.9640	84	1.0373	.9630	84	1.0384
.9773	66	1.0232	.9630	86	1.0384	.9616	86	1.0399
.9764	68	1.0241	.9619	88	1.0396	.9603	88	1.0413
.9755	70	1.0251	.9608	90	1.0407	.9590	90	1.0427

Application of sprayed bituminous surfacing

Plant: A mechanical sprayer shall be used to apply primer, primerbinder and binder. The sprayer shall have a current Sprayer Certificate issued by a NATA accredited testing authority. A copy of the test certificate shall be kept with the sprayer.

A register of accredited sprayers is maintained by AAPA and available on the AAPA Web Site (www.aapa.asn.au).

The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles that may be damaged or become unduly worn or defective shall be replaced.

Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform spread rate.

Rollers shall be pneumatic tyred multi-wheel rollers with a minimum mass of 7 tonnes, smooth tyres and a minimum tyre pressure of 550 kPa, or combination rollers having a rubber coated, vibratory drum on one axle and pneumatic tyres on the other.

Rollers must be capable of achieving effective incorporation of aggregate into the binder without breakdown or crushing of the cover aggregate.

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 Worksection.

Operation of the Sprayer: 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.

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 or jig set intermediate nozzles. Where intermediate nozzles, set in the normal manner, are to be used to overlap adjacent longitudinal sprays, the overlap shall be 300 mm.

The spraying of primer, primerbinder or binder for each run of the sprayer shall commence on a protective strip of heavy paper 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.

The sprayer shall maintain a constant road speed throughout the length of each sprayer run.

The spraying for each run shall terminate on protective paper laid across, and held securely, to the pavement surface beforehand.

Spraying shall cease immediately any defect develops in the spraying equipment and the fault rectified before further spraying.

Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. Spraying shall not recommence until the cause of the blockage is identified and rectified.

Areas not within 5 percent of the target application rate of primer, primerbinder or binder shall constitute a 'Non-conformance' under the Contract.

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.

After each sprayer run, the quantity of binder sprayed shall be checked against the area covered. If the actual application rate is not within specified limits, adjustments shall be made to ensure that the target application rate is achieved in subsequent runs.

Temperature: The Contractor shall measure and record the temperature of the binder.

If the temperature of the bituminous material is below the applicable lower limit from Tables B6 or B7, the bituminous material may be heated provided that safe heating practices are adopted. All heating activities shall comply with the Austroads *Bitumen Sealing Safety Guide*.

Burners shall not be used unless the level of the material in the heating tank is at least 150 mm above the tops of the heating tubes, or as indicated by the manufacturer of the equipment. 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.

During heating, the temperature of the bituminous material shall not exceed the applicable upper limit from Tables B6 or B7. The rate of heating shall not exceed the rate shown in Table B10. Materials shall be circulated at all times while heating and for a further minimum of 15 minutes after burners are turned off.

Table B10: Maximum Heating Rate for Bituminous Materials

Material	**Maximum Heating Rate (°C/hr)**
Bitumen & Multigrade binder	40
Cutback Bitumen: – Priming grades – Primersealing grades – Sealing grades	 30 30 30
Crumb rubber bitumen	40
Polymer modified binder	Refer manufacturer’s recommendations
Bitumen emulsion	15

Geotextile: Geotextile shall be applied where nominated in the Schedule of Details. The geotextile shall be fixed to the pavement smoothly and without wrinkles, using a tack coat of up to 0.8 L/m^2 (residual) of Class 170 bitumen. The rate of application of tack coat is included in, and not additional to, the overall design binder application rate for the geotextile reinforced seal (including allowances for surface texture and absorption by the fabric).

Joins shall be butt joined or overlapped by a minimum of 200 mm as specified in the schedule of details. Longitudinal joins shall not be placed in wheel paths.

Work Records: The Contractor shall record details of the work performed. 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.

Control of Traffic: The Contractor shall provide for traffic in accordance with the requirements of AS 1742.3 and SAA B 81.6 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. 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.

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 sidetracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.

If facilities for the diversion of traffic are not available, the Contractor shall spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway or schedule spraying operations in such a manner so as to restrict traffic delays to a maximum of 15 minutes. All traffic movement through the work shall cease during the actual spraying operation.

Detailed records of traffic control including control device type, precise location of device and the time at which such device was installed and removed; should be maintained throughout the works and then kept on file.

Spreading and rolling of aggregate: Spreading of aggregate shall proceed as close as practical after spraying of the binder has commenced and shall be completed within fifteen minutes of spraying.

The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. The method to determine the actual aggregate spread rate shall be detailed in the Quality Plan. Sufficient loaded and measured trucks of aggregate shall be at the site to provide full cover for the area sprayed.

The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Spreaders should be calibrated with aggregate from the stockpile to be used for the work. Calibration is best done off-road. A calibration site needs to be of sufficient length to allow the aggregate spreading unit to reach normal operational speed before applying the aggregate. Calibration can be done with standard calibration mats or by painting 1 m^2 areas on the test site. The total width of the aggregate spreader must be calibrated.

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 local excess of aggregate shall be removed before rolling is commenced.

Sufficient rollers shall be supplied to ensure that total area sprayed receives the minimum coverage (roller hours) derived from Table B11. Adequate time must be allowed at the end of the day's work to ensure that the last materials spread receive the same amount of rolling as that placed earlier in the day.

After the aggregate has been applied to each section of the work, initial rolling shall be carried out with one or more rollers complying with Application of primer, primerbinder and binder.

Initial rolling shall continue until the aggregate is firmly adhered to the primerbinder or binder.

The amount of rolling shall be reduced while the aggregate is wet, but normal rolling resumed as soon as aggregate dries. Trafficking during this period must be avoided, or kept to a minimum speed, until aggregate has dried sufficiently for adhesion to be established.

Table B11 Area that can be effectively rolled, per hour, with each pneumatic tyred multi-wheel roller.

Aggregate size (mm)	**Traffic Volume (vehicles per lane per day)**		
	< 300	**300–1200**	**> 1200**
	Area – m^2 per roller hour		
7 or smaller	4500–5000	5000–5500	5500–6000
10	3000–3500	3500–4000	4500–5000
14	2500–3000	3000–3500	3500–4000

If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom 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. Where drag brooming is eliminated, the Contractor may substitute light hand brooming.

Backrolling shall then be carried out until the effective amount of rolling in terms of roller hours for the total area sprayed achieves that shown in Table B11.

When the aggregate has been evenly distributed and adhered to the binder, any remaining loose particles of aggregate shall be removed from the pavement.

Variation to spreading and rolling procedures shall be applied to different types of seals as follows:

- Single/single seals A single application of aggregate shall be applied on a single application of binder and then the seal is rolled and, where necessary, brooming shall be carried out as described above.
- Single/double seals In a single/double seal, the second application of aggregate is applied after initial rolling of the first application, and before final rolling and trafficking.
- Double/double seals Where both applications of binder and aggregate are to be applied on the same day, the first application of binder and aggregate shall be completed as described above, except that the aggregate application is reduced by approximately 10% compared to that required for a single/single seal. The second application of aggregate, following the second application of binder, shall be applied at a rate that is just sufficient to fill the voids in the first application, and rolling and removal of any remaining loose aggregate completed as described above. Where the binder in the first application is a bitumen emulsion, the second application must not be applied until the binder in the first coat is completely broken to form a stable seal.

Where the first application of a double/double seal is to be trafficked for a short period of time, generally not exceeding several weeks, the first application shall be completed as a single/single seal and the aggregate in the second application reduced by about 30% to occupy the voids in the first application.

Where the second application is applied after a significant period of trafficking, both applications shall be completed as single/single seals.

14 ANNEXURE C

14.1 NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

HEADINGS BELOW INCLUDE CLAUSE NUMBER AND CLAUSE TITLE OF CLAUSE IN THE MAIN BODY OF THE WORKSECTION BEING DISCUSSED.

Scope

General: The worksection covers the supply of materials and application of sprayed sealing. It is generally applicable to contract works where the Principal defines the type of treatment required and the Contractor undertakes those activities associated with supply of materials, determination of application rates of binder and aggregate, preparation and spraying of binder, preparation and application of aggregates, rolling of aggregates and clean-up of completed work. Where some of the activities described in this worksection are undertaken by others, responsibility for the relevant items must be clearly defined in the scope of works.

This worksection will normally be used as contract documentation in conjunction with a standard General Conditions of Contract such as AS 2124. Contract documentation may also include other works. The terms used in the worksection guidelines are generally consistent with AS 2124, and include Principal, Superintendent, and Superintendent's Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Schedule of Details: The type of seal, class and nominal size of aggregate and any special binder requirements should be specified in the Schedule of Job Details – See Annexure A.

Careful consideration of the Schedule of Job Details is required to ensure that the sprayed seal is of the appropriate type and quality, and provided in a cost effective manner.

Surface Preparation: Preparation of surfaces under this worksection is limited to preliminary sweeping and cleaning of surfaces immediately prior to spraying of bituminous material. The scope of work does not include preparation of granular pavements for priming or primersealing, rectification or maintenance of surfacings prior to resealing or the reinstatement of linemarking, raised pavement markers, etc.

Surface preparation is extremely important to the success of sprayed sealing work. Granular pavements should be prepared to a smooth dense surface and dried back to a suitable moisture content (typically 70% of saturation level) to avoid weakening of the granular pavement with trapped moisture. Preliminary work for retreatment of existing surfacings should be carried out well in advance of sealing work (typically six weeks or more). Embedment of aggregate and variable texture of patches is a major cause of blemishes in finished work. Effective application of sprayed seals requires an

underlying surface of uniform texture. Corrective treatments may be required for variable surfaces prior to, or in conjunction with sprayed sealing treatments.

Notes on the preparation of pavements are provided in Annexures A and B. Further detailed guidance for the selection of sprayed seal treatments and preparation of surfaces is provided in the Austroads *Guide to the Selection of Road Surfacings*, Austroads *Sprayed Sealing Guide*, Austroads *Specification Framework for Polymer Modified Binders,* Austroads *Provisional Specification for Multigrade Binders,* Austroads *Guidelines for the Selection and Use of Modified Binders and various* Austroads/AAPA *Pavement Work Tips.*

Quality Systems

The quality requirements of Quality are design to apply the AUS-SPEC quality system requirements.

The following paragraphs may be substituted if desired:

'The Contractor shall establish, implement and maintain a Quality System in accordance with this worksection and the requirements of AS/NZS ISO 9001:2000, or a recognised equivalent.'

'Where required in the Contract general clauses, the Contractor shall submit a Quality Plan prior to commencement of any works. The Quality Plan shall take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. Appendix B provides Guidelines for process items which may be included in the Quality Plan. No part of the Quality System shall be used to pre-empt or otherwise negate the technical requirements of the Contract Documents.'

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor's Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

14.2 MATERIALS

Bituminous materials: The type and/or grade of primer, primerbinder or binder should be specified in Annexure A Schedule of Details.

Cutback bitumen for priming and primersealing (and occasionally for sealing) may be specified in terms of the following alternatives:

- standard grades of cutback bitumen manufactured to comply with AS 2157 – Cutback Bitumen;
- cutback bitumen produced in the field by blending Class 170 bitumen with an appropriate type and proportion of cutter oil in a bitumen sprayer, tanker, etc.;
- proprietary grades of cutback bitumen;
- standard grades of bitumen emulsion complying with AS 1160 – Bitumen Emulsions for Construction and Maintenance of Pavements;
- proprietary grades of bitumen emulsion.

Suppliers of proprietary products should be required to submit their own product specifications for use as a basis for quality control.

Depending on their viscosity, standard grades of cutback bitumen are classified as follows:

- Priming classes (AMC00, AMC0, AMC1);
- Primersealing classes (AMC2, AMC3, AMC4);
- Sealing classes (AMC5, AMC6, AMC7).

When used for primersealing, an adhesion agent (usually 1%) should be added to cutback bitumen primerbinders. Adhesion agents may also be added to priming classes, although this is not mentioned in AS 2157.

A guide to the properties of cutback bitumen is provided in Tables C1 and C2. Table C1 provides a guide to the proportions of cutter oil required for field preparation of cutback bitumen. Table C2 provides a guide to practical grades of cutback bitumen primer and primerbinder for various applications based on the viscosity of the binder.

The selection of particular priming and/or primersealing products should be based on field trials or experience. Guidance on the selection of grade and application rate of primer and primerbinder is given in Design of spray seals.

Generally, Class 170 (also Class 320) bitumen is used as the binder for sprayed sealing work with the addition of cutter oil as required, depending on ambient conditions. Modified binders, as well as

bitumen emulsion, may also be used. Guidance on the selection of modified binders and other binders for special application is provided in the references outlined in Scope, above.

The use of standard grades of cutback bitumen for sealing is uncommon, as sealing binders are generally prepared at the time of application with the proportion of cutter oil adjusted to the ambient conditions at that time.

Table C1 Field preparation of medium curing cutback bitumen

Class (AS 2157 designation)		**Approx. parts kerosene per 100 parts bitumen (vol. at 15°C)**	**Equivalent percent of kerosene (vol. at 15°C)**	**Viscosity at 60°C (Pa.s)**
Precoating and priming classes	AMC00	127	56	0.008–0.016
	AMC0	78	44	0.025–0.05
	AMC1	51	34	0.06–0.12
Primersealing classes	AMC2	37	27	0.22–0.44
	AMC3	27	21	0.55–1.10
	AMC4	19	16	2.0–4.0
Sealing classes	AMC5	12	11	5.5–11.0
	AMC6	7	7	13.0–16.0
	AMC7	3	3	43.0–86.0

Table C2 Grades of primers and primerbinders

Grade	**Viscosity Range Pa.s @ 60°C**
Primer:	
– Very light	0.010–0.020
– Light	0.025–0.050
– Medium	0.050–0.080
– Heavy	0.080–0.200
– Very Heavy	0.200–0.400
Primerbinder:	
– Light / Medium	1.0–3.0
– Heavy	4.0–7.0

Aggregate: The worksection refers to AS 2758.2, which requires the user to select from a number of options for determination of aggregate hardness and soundness. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards are applied on a State by State basis as follows:

- Soundness based on Los Angeles Abrasion and Unsound Stone Content – Victoria and Western Australia.
- Soundness based on Ten Percent Fines Value and Wet/Dry Strength Variation – All other States.

AS 2758.2 provides for three classes of aggregate based on the following pavement classifications:

- Class A – premium quality aggregates suitable for freeways, highly trafficked highways or pavements carrying a high volume of heavy vehicles.
- Class B – aggregates suitable for highways or main roads carrying medium traffic volumes, medium to lightly trafficked pavements, general parking areas and similar.
- Class C – aggregates suitable for lightly trafficked roads.

The class of aggregate should be nominated in the schedule of details as well as the minimum value of polishing resistance (PSV or PAFV), if required. For general application, a minimum value of 48 should be specified for applications where Class A aggregates are required. No minimum value of PSV or PAFV is usually required for Class B or Class C applications. Surface friction requirements will vary according to the risks associated with operating environment or particular sites, which will also influence design factors associated with surface texture. This may lead to the adoption of higher or lower minimum polishing resistance values for some applications.

14.3 DESIGN OF SPRAY SEALS

General: A distinction is made between selection of treatment type and determination of application rates of binder and aggregate for a selected sprayed seal treatment type. The worksection requires the Contractor to determine rates of application using Austroads *Sprayed Seal Design Method Revision 2000.*

In the context of this worksection the Principal is required to nominate the treatment type as well as provide sufficient information for an accurate assessment of traffic volume for determination of binder application rates.

The traffic volume should be based on actual traffic counts, including the proportion and distribution of heavy vehicles. Where actual traffic counts are not available, or difficult or impractical to measure, a reasonable estimate should be made based on expected usage. Estimates of traffic should only be used for low volume roads. Actual measurement of traffic volumes is particularly important at high traffic volumes or where there is a large proportion of heavy vehicles. Traffic counts should also take into account seasonal variation such as local events, crop harvesting or seasonal tourist traffic. Generally, summer traffic volumes are more critical to design of application rates than winter traffic volumes.

Further critical inputs to determination of application rates using the Revision 2000 Method include condition and texture of the existing surface and measurement of aggregate properties.

Estimates of existing surface conditions and aggregate average least dimension (ALD) may be made by the Principal as a basis for determining nominal rates of application for tendering purposes. Before commencing spraying operations, nominal rates of application must be checked by the Contractor, and adjusted as necessary, based on actual measurement of surface texture and aggregate grading, shape and ALD determined from testing of materials sampled from stockpiles of the aggregates to be used on the work. Variations to texture within the job and use of corrective treatments must be noted. Aggregate properties must be determined on current materials and not be based on assigned values or estimates from previous work.

Geotextile Reinforced Seals: Binder application rates for geotextile reinforced seals should be determined in accordance with standard procedures (Revision 2000 Method) with an additional allowance for binder retained by the fabric. The amount of additional binder required will depend on the grade or thickness (mass) of the fabric and may vary between different manufacturers. Preferably, the amount of binder retained in the fabric should be determined by test. The Roads and Traffic Authority of New South Wales have developed a draft test method (T654) that details this process. An Austroads Test Method is also in the course of preparation. Typical allowances are shown in Table C3.

A minimum fabric mass of 130 g/m^2 is used for general sealing applications. On soft substrates, such as initial treatment on low quality granular base materials, heavier grades of fabric (175 g/m^2 to 200 g/m^2) should be used to minimise the potential for aggregate to puncture the fabric, particularly when using aggregates of 14 mm nominal size, or greater.

Austroads *Guide to Geotextile Reinforced Seals*, covering both design and field procedures, is in course of preparation.

Priming: A guide to selection of grade of cutback bitumen primer and primer application rates is shown in the Table C4.

Standard grades of bitumen emulsion are generally not suitable for priming but proprietary grades have been developed that should be used in accordance with manufacturer's guidelines.

Primersealing: A guide to the selection of type and grade of primerbinder is shown in Table C5.

The aggregate size will depend on traffic and climatic conditions. For less than 1200 vehicles/lane/day, 5 mm or 7 mm size aggregate is appropriate, and for higher traffic situations use 7 mm or 10 mm size aggregate. However, if the conditions are either very hot or wet and the traffic is in excess of 600 v/l/d, a 10 mm size aggregate may be used. The use of 10 mm aggregate may, however, result in a coarse texture that requires extra consideration in the placing of the subsequent seal.

There are no formal design procedures for primerbinder application rates for primerseals. Table C6 offers some practical guidelines. The basic primerbinder application rates shown may need to be adjusted in line with allowances for absorption, existing surface condition and embedment. Austroads Test Method SDT 05 – Penetration of road bases by bituminous primers or primerbinders, may also provide assistance in estimating pavement absorption.

The primerbinder application rates shown refer to the total volumes of the mixtures (i.e., including cutter oils and/or water content) expressed at 15°C.

Aggregate spread rates should be about 130 m^2/m^3 to 150 m^2/m^3 for 5 mm and 7 mm aggregates and 110 m^2/m^3 to 130 m^2/m^3 for 10 mm aggregates.

Table C3 Typical Geotextile Retention Allowances

Geotextile Grade	**Retention Allowance (L/m^2)**
130 - 140g/m^2	0.9 to 1.0
175 - 200g/m^2	1.1 to 1.3

Table C4 Guide to grade and rates of application of primer

Pavement	**Primer**	
	Grade	**Rate of Application L/m^2**
Tightly bonded	Light	0.6–1.1
Medium porosity	Medium	0.8–1.1
Porous	Heavy to Very heavy	0.9–1.3
Limestone	Heavy to Very heavy	2 applications: – 1st @ 0.7–0.9 – 2nd @ 0.5–0.7
Sandstone	Heavy to Very heavy	2 applications: – 1st @ 0.7–0.9 – 2nd @ 0.5–0.7
Hill gravels, granitic sands	Light	0.8–1.1
Stabilised	Very light to Light	0.5–0.8
Concrete	Very light	0.2–0.4

Table C5 Selection of type and grade of primerbinder

Primerbinder	**Recommended Use**
Light-medium grade of cutback bitumen	– Cool and/or damp conditions. – Tightly bonded or medium porosity type pavements.
Heavy grade of cutback bitumen	– Warmer and/or dry conditions – Porous type pavements.
Bitumen Emulsion (60% and 67% bitumen content)	– All year, but more suited to cool and/or damp conditions – Porous type pavements – When final surfacing is to be applied immediately or within 3 months.

Table C6 Basic primerbinder application rates

Traffic (v/l/d)	**Aggregate Size**	**Total Primerbinder Application Rate (L/m^2 @ 15°C)**		
		Cutback Bitumen	**Bitumen Emulsion**	
			60%	**67%**
≤ 150	7 or 5 10	1.3 1.4	1.6 1.8	1.4 1.6
151–1200	7 or 5 10	1.2 1.3	1.5 1.6	1.3 1.4
> 1200	7 or 5 10	1.1 1.2	1.4 1.5	1.2 1.3

14.4 APPLICATION OF SPRAYED SEALING

The worksection does not include detailed procedures for carrying out sprayed sealing work. A general guide to good practice is provided in the Appendix to the worksection. The detailed provisions of are not mandatory but it is expected that the Contractor will adhere to the principles described and

incorporate relevant procedures in his own Quality Plan. A guide to evaluating and auditing of quality plans and surveillance of contract activity is provided in a separate document prepared jointly by Austroads and AAPA (AP-T32 – *Audit and Surveillance of Sprayed Sealing Contract Works*).

14.5 REMOVAL OF LOOSE AGGREGATE

Removal of loose aggregate can generally commence when initial aggregate adhesion and interlock has been completed by rolling and traffic, the binder has hardened to a state where no more aggregate can be pressed into it, and the seal is less prone to damage by sweeping.

Factors that influence the timing of aggregate removal include:

- Traffic volume/road class
- Type of binder
- Aggregate size
- Ambient temperature/pavement temperature

High traffic volumes will rapidly fix aggregates into the binder so that removal of surplus stones may commence within a few hours of spreading. High traffic volumes are also often associated with roads in urban areas and other situations where it is important to minimise risks associated with loose aggregate, so that removal is often undertaken within about 12 hours of spreading.

On lighter trafficked roads, a period of up to 48 hours may be allowed to elapse before completing the removal of excess aggregate, provided the safety of the travelling public is appropriately considered.

Polymer modified binders develop cohesion more rapidly, particularly at higher ambient temperatures, so that aggregate removal can often be undertaken on the same day.

Emulsion binders develop cohesion more slowly. Up to 48 hours curing may be necessary, in some circumstances, before sweeping can be undertaken without a high risk of damage to the seal.

Extra care is required at higher temperatures, particularly in sunny conditions and air temperatures of 30°C or more. In such circumstances it is preferable to undertake aggregate removal at night or early morning, when air and pavement temperatures are lower.

In urban areas, the use of a vacuum broom or suction sweeper to uplift and remove aggregate from site as well as removal from kerb and channel, adjoining paved areas, etc. should be specified. In rural areas, where loose aggregate can be safely swept onto unpaved verges, uplifting and removal of aggregate from site is generally not necessary.

14.6 REMOVAL OF SURPLUS AND WASTE MATERIAL

Special requirements for disposal of surplus aggregate at stockpile sites should be specified in additional clauses or included in the schedule of job details.

14.7 PROTECTION AND CARE OF NEW WORK

Generally the Contractor is responsible for protecting the new work and correction of any defects occurring within the defects liability period with the exception of damage caused by accident and other events outside the control of the Contractor.

14.8 SAMPLING AND TESTING

The worksection requires the Contractor to prepare a schedule for the nominated items. The Principal may, however, choose to specify test methods and minimum frequency of sampling and testing.

14.9 MEASUREMENT AND PAYMENT

The worksection provides for two alternatives, measurement by area only, or measurement of actual quantities used.

Measurement and payment by area may be used for straightforward works where conditions are readily identifiable at the time of tender.

Measurement by quantity of material supplied allows for variation in the design rates of application of binder and aggregate and compensation for actual amounts of cutter oil based on the conditions at the time of spraying. In such cases, the schedule may nominate provisional rates of application or quantities for tendering purposes, but incorporate schedule items for actual quantities or variations to rates of application. This type of payment schedule is particularly applicable to contracts incorporating a range of types or location of works.

Schedule items may also be included for other special items such as geotextiles, and for additional works such as reinstatement of raised pavement markers and linemarking, if required.

A typical schedule of rates is shown in Table C7.

Table C7 Typical Schedule of Rates

Activity	**Unit**	**Rate**
Control traffic to worksite	m^2	
Sweep surface prior to seal: – Gravel pavements – Sealed pavements	 m^2 m^2	
Supply and spray binder @ 15o C	Litre	
Supply, incorporate and spray cutter oil @ 15o C	Litre	
Supply, incorporate & spray Adhesion agent @ 15o C	Litre	
Remove existing raised pavement markers	each	
Protect existing raised pavement markers	each	
Supply and install temporary raised pavement markers	each	
Supply, load, haul and spread precoated aggregate	m^3	
Roll and incorporate aggregate	m^2	
Post-sweep of seal including stone counts: – With rotary broom – With suction broom as stipulated	 m^2 m^2	
Supply and place geotextile	m^2	
Load, haul and spread additional where closest available stockpile greater than 5 Km from jobsite	m^3 /Km > 5Km	

Annexure C Schedule of job details

The following actions should be taken in the preparation of the schedule of job details and price schedule:

- Define scope of work. In addition to a description of location, the limits of work should also be clearly marked on the road pavement.
- Define type of sprayed seal treatment(s).
- Define aggregate Class and minimum PSV or PAFV, if required.
- Define binder type or grade.
- Include details of traffic for design purposes.
- Include any special design requirements, if applicable.
- Prepare and insert special clauses for submission of sprayed seal design details in advance of sprayed sealing work, if applicable.
- Prepare price schedule based on the scope of work and method of measurement and payment.
- Prepare a schedule for sites available for the stockpiling of aggregates, if applicable.
- Prepare and insert special clauses for test methods and frequency of testing, if applicable.
- Prepare and insert special clauses for payment for non complying materials, if applicable.
- Prepare and insert special clauses for removal of loose aggregate by suction broom, if applicable.
- Prepare and insert special clauses for reinstatement of line marking, if applicable.
- Prepare and insert clauses for any other special job requirements, if applicable.

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1144 ASPHALTIC CONCRETE (ROADWAYS)

1 SCOPE

1.1 SCOPE

This worksection covers hot mixed, dense graded, open graded, stone mastic and fine gap graded asphalt for roads and related applications. The areas covered by this worksection include:

- Asphalt materials
- Asphalt mix design requirements
- Process control in manufacture and placement of asphalt
- Acceptance criteria for asphalt
- Quality systems, minimum process standards, plant requirements and sampling and testing frequencies.

This section is to be read in conjunction with the Appendix (Schedule of Job Details). Where there is conflict between the requirements of this section and the Appendix, the requirements of the Appendix shall apply.

1.2 REFERENCED DOCUMENTS

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

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Method 11: Particle size distribution by sieving
AS 1141.14	Method 14: Particle shape, by proportional calliper
AS 1141.18	Method 18: Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Method 22: Wet/dry strength variation
AS 1141.42	Method 42: Pendulum friction test
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones
AS 1672.1	Lime for Buildings
AS 2008	Residual bitumen for pavements
AS 2150	Hot mix asphalt—Guide to good practice
AS 2758	Aggregates and rock for engineering purposes
AS 2758.5	Asphalt aggregates
AS 2891	Methods of sampling and testing asphalt
AS 2891.1	Method 1: Sampling of asphalt
AS 3972	Portland and Blended Cements
AS 3582	Supplementary Cementitious Materials for use with Portland Cement,
AS 3582.1	Fly Ash
AS 3582.2	Slag – Ground Granulated Iron Blast-Furnace.
AS/NZS/ISO 9001	Quality Management Systems – Requirements

Other publications

NSW RTA Test Methods

QA Specification 3253 Bitumen for Pavements

T640 Resistance to Stripping Test

R101 Cold Milling of Pavements

R116 Dense Graded and Open Graded Asphalt

Austroads

AP-T41/06 Specification framework for polymer modified binders and multigrade bitumens

AST04 Asphalt binder content (Ignition oven method)

AST05 Sample preparation–compaction of asphalt slabs suitable for characterisation

AST06 Asphalt binder drain-off

AST07 Asphalt particle loss

AST08 Binder film index

AAPA

Advisory note 7 – Guide to the heating and Storage of Binders for Sprayed Sealing and Hot mixed asphalt.

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.4 ASPHALT MIX TYPES

For the purposes of this worksection dense graded asphalt mixes have been classified in terms of position in the pavement (wearing course or base course) and traffic category (Light, Medium, Heavy and Very Heavy). Where relevant, the same traffic categories shall apply to other mix types. The particular mixes to be used shall be nominated in the Annexure A.

Dense graded hot mix asphalt is also known as asphaltic concrete and designated by the abbreviation 'AC'.

Other mixes are designated:

- Open Graded Asphalt (OGA)
- Ultra Thin Asphalt (UTA)
- Stone Mastic Asphalt (SMA) and
- Fine Gap Graded Asphalt (FGGA).

1.5 TESTING

All testing of properties required by the worksection shall be undertaken in a laboratory registered by the National Association of Testing Authorities (NATA) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian Standard or Austroads *Manual of Test Procedures.*

Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard or Manual provides a choice of procedures, the method to be adopted shall be that endorsed by the relevant State Road Authority in the State in which the work is being undertaken.

1.6 PLANT

All plant shall be registered and insured as appropriate to its use on a public road and shall comply with statutory environmental regulations.

1.7 PROTECTION OF SERVICES AND ROAD FIXTURES

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, access chamber 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.

1.8 CONTROL OF TRAFFIC

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work. Any costs incurred as a result of the supply of labour and materials complying with 1101 *Control of traffic* shall be borne by the Contractor.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users.

1.9 WORK RECORDS

Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Appendix B or as per the Contractor's own procedures where equivalent. 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.

Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.

1.10 PLANT

Contractor to provide

The Contractor shall provide all the plant and equipment and labour necessary for carrying out the work in accordance with this worksection.

Plant to be suitable

All plant and equipment used on the work shall be in accordance with the Contractor's submitted quality documentation and kept in good operating condition.

The Contractor shall not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant shall be registered and insured as appropriate to its use on a public road and shall comply with statutory environmental regulations.

1.11 PROTECTION OF SERVICES AND ROAD FIXTURES

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, access chamber 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.

1.12 CONTROL OF TRAFFIC

Provision for traffic

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work. Any costs incurred as a result of the supply of labour and materials complying with 1101 *Control of traffic* shall be borne by the Contractor.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

1.13 WORK RECORDS

Asphalt work record

Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Annexure A or as per the Contractor's own procedures where equivalent.

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.

Delivery dockets

Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.

2 MATERIALS

All materials shall comply with RTA specification R116 Dense Graded and Open Graded Asphalt

Reclaimed asphalt pavement

Reclaimed asphalt pavement (RAP) shall be obtained from milling or excavation of existing asphalt. RAP shall be crushed and screened as necessary to ensure a maximum size no greater than the maximum size of asphalt being produced and to achieve a reasonably well graded, free flowing, and consistent product.

RAP shall be free of foreign material such as unbound granular base, broken concrete, crumbed rubber or other contaminants. Asphalt containing tar shall not be used.

RAP shall be placed in separate stockpiles prior to use.

3 MANUFACTURE AND STORAGE

3.1 GENERAL

Asphalt manufacturing plant shall be of sound design and construction and capable of consistently producing asphalt mixes with the properties specified and at a rate suitable for smooth, continuous asphalt placing.

3.2 STORAGE OF RAW MATERIALS

Raw materials shall be stored at the mixing site in sufficient quantities to ensure continuity of production and enable effective sampling and testing prior to use. The facilities for handling particular materials shall comply with the following:

- Aggregates shall be handled and stored in such a manner as to prevent contamination and avoid segregation.
- Filler shall be handled and stored in such a manner as to keep it dry and free flowing at all times. Where more than one type of filler is to be used, each shall be handled and stored separately.
- Additives, including cellulose or mineral fibre, shall be protected from moisture or contamination. Materials that have become wet shall not be used.
- Binder tanks for heating and storage of binder shall be thermostatically controlled and each shall be fitted with a thermometer that is located so that the temperature can be read conveniently.

A sampling cock shall be provided in the outlet pipe from each tank.

Bitumen binder shall not be heated to more than 185°C. Multigrade and Polymer Modified binders shall not be heated or stored contrary to the temperature and time combinations specified by the manufacturer's written instructions.

3.3 MIXING TEMPERATURES

Temperature of bitumen and aggregates at the mixing plant, and the temperature of asphalt as it is discharged from the asphalt plant, shall not exceed the limits specified in Table 4.1.

Table 4.1 Mixing temperatures

Material	**Maximum Temperature (°C)**
Class 400, Class 320, Class AR450 Bitumen delivered into mixer	165
Class 600 Bitumen delivered into mixer	175
Aggregates before mixing with binder	200
Asphalt at discharge from asphalt plant	1751

3.4 MOISTURE CONTENT

After completion of mixing the moisture content of the mix shall not exceed 0.5%.

3.5 PRODUCTION TOLERANCES

Production tolerances on grading and binder content shall comply with Table 4.2.

Table 4.2 Production Tolerances

Description	Maximum Tolerance on Job Mix Percentage
Grading: Sieve size one size larger than nominal size	Nil
4.75 mm sieve and larger	± 7
2.36 mm sieve	± 5
1.18 mm sieve	± 5
0.600 mm sieve	± 4
0.300 mm sieve	± 4
0.150 mm sieve	± 2.5
0.075 mm sieve	± 1.5
Binder Content: Percent by mass	± 0.3

3.6 STORAGE OF MIXED ASPHALT

Asphalt may be stored prior to delivery to the purchaser, subject to the following requirements being observed:

- The mix is consigned to and deposited in the storage bins in such a manner as to minimise segregation.
- The storage bin shall be insulated.
- The method of discharge shall be such as to minimise segregation. Any caked or segregated portions of mix shall be discarded.
- Asphalt with polymer modified binders shall not be stored in plant silos for a period longer than eight hours or that recommended by the manufacturer of the polymer modified binder.
- Stone mastic asphalt shall not be stored in plant silos for periods in excess of four hours.
- The total time of storage shall be limited to 24 hours unless otherwise approved.

3.7 MANUFACTURE OF STONE MASTIC ASPHALT

The following particular requirements shall apply to the production of stone mastic asphalt:

- Filler systems shall be designed or modified to provide for the appropriate quantity of added filler. In drum mix plants, loss of filler shall be minimised by feeding direct into the mixer alongside addition of binder.
- Fibre shall be added in a manner that ensures good dispersion of fibres, avoids loss of fibre through dust collection systems and avoids damage to fibre by overheating.
- Mixing times shall be increased, where necessary, to ensure adequate dispersal and mixing of fibre.

3.8 ASPHALT MIXES INCORPORATING RECLAIMED ASPHALT PAVEMENT (RAP)

RAP shall only be used from stockpiles that have been tested for consistency in grading and binder content with materials used in mix design.

In batch mixing plants, the RAP shall be either:

- Metered into the asphalt plant after heating and drying of aggregates
- Added directly to the weigh hopper with the other aggregate materials, for each batch.
- Weighed separately and added direct to the pugmill.

Batch mixing time shall be increased, if necessary, to ensure adequate heat transfer and dispersion of RAP.

In drum mix plants, RAP shall be protected from excessive temperatures by a combination of entry point to the drum and shielding from direct flame contact.

4 SAMPLING AND TESTING OF ASPHALT PRODUCTION

4.1 GENERAL

The Contractor shall arrange for all relevant testing.

Samples from asphalt production shall be randomly selected (random sampling) by a recognised statistical technique from fresh production asphalt at the asphalt plant. Samples shall not be mixed. In addition, each loaded truck shall be visually inspected for segregation, uncoated particles, excess bitumen or overheating, before dispatch from the plant.

Production asphalt shall be tested for the following:

- Grading
- Binder content
- Maximum density
- Temperature.

4.2 FREQUENCY OF SAMPLING AND TESTING

Frequency of sampling and testing shall be not less than that shown in Tables 5.1 and 5.2. Table 5.1 provides for two levels of minimum frequency. The reduced frequency may only be adopted where the process is demonstrated to be under statistical control as specified in **Process control**.

Where a non-conformance occurs in any test requirement, the frequency of sampling and testing for that particular property shall be increased to the normal level until conforming results have been obtained on five consecutive samples.

Table 5.1 Frequency of Sampling and Testing of Production Asphalt

Test	Normal Minimum Frequency	Reduced Minimum Frequency
Grading	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Binder Content	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Maximum density	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Temperature	Each loaded truck	Lesser of each loaded truck or one per 15 minutes

Table 5.2 Frequency of Testing of Component Materials

Test	Minimum Frequency
Los Angeles Abrasion (where applicable)	3 Monthly
Unsound and marginal stone content (where applicable)	3 Monthly
Wet Strength (where applicable)	3 Monthly
Wet/Dry Variation (where applicable)	3 Monthly
Flakiness index of coarse aggregate	Monthly
Dry compacted voids of combined filler	Monthly
Added filler (Tables 2.2.2 and 2.2.3)	Certification of each delivery
Binder viscosity	Certification of each delivery
RAP grading and binder content	One test per 500 t of RAP

4.3 PROCESS CONTROL

The Contractor shall implement suitable measures for control of the asphalt process. Process control measures may include the use of statistical process control charts for some, or all, of the tests

required in **Frequency of sampling and testing** and suitable decision rules for determining that the process is under statistical control and therefore subject to reduced minimum frequency of test.

Elements of the process control system that incorporate the application of statistical process control shall be included in the Contractor's Quality Plan.

5 DELIVERY

5.1 GENERAL

Asphalt shall be transported to the point of delivery in vehicles complying with the following requirements:

- The inside of vehicle bodies shall be kept clean and coated with a thin film of an appropriate release agent to prevent asphalt sticking to the body of the vehicle. Care shall be taken to remove surplus release agent before loading asphalt into the vehicle.
- After loading with asphalt, the body of the vehicle shall be covered to prevent contamination and reduce the rate of cooling of the mix.
- Where the length of the haul or the weather is such that the temperature of the asphalt may drop below a suitable placing temperature, or where excessive local cooling of the mix may occur, the vehicles shall be suitably insulated.

6 PLACING

6.1 PREPARATION OF SURFACE

Prior to tack coating and placing of asphalt, the surface shall be free of all deleterious material. Where required, the Contractor shall sweep clean the area on which asphalt is to be placed in accordance with R101 Cold Milling of Pavements.

6.2 PROTECTION OF SERVICES

The Contractor shall prevent tack coat, binder, aggregate, asphalt or other material used on the work from entering, adhering or obstructing gratings, hydrants, valve boxes, inspection pit covers, kerbs and other road fixtures.

6.3 PRIMING

Where specified separately, crushed rock and gravel pavements shall be primed.

6.4 TACK COATING

Tack coat shall be applied to the cleaned surface prior to placing asphalt.

Tack coat shall consist of bituminous emulsion complying with AS 1160. The type and breaking rate shall be suitable to the climatic and surface conditions of use such that it is fully broken, free of surface water and intact before the commencement of asphalt spreading.

Unless otherwise directed, tack coat shall be applied to provide a uniform application rate of residual binder of between 0.15 L/m^2 and 0.30 L/m^2 of residual bitumen

Tack coat shall be applied by spray bar fitted to a mechanical sprayer. Hand spraying shall be carried out only in those areas where it is impracticable to use a spray bar.

Precautions shall be taken to protect kerbs, gutters, adjoining structures, traffic and parked vehicles from tack coat spray.

Where asphalt is to be spread over clean, freshly placed asphalt, or over a clean primed surface, the Superintendent may direct the Contractor to omit the tack coat.

When placing ultra-thin surfacing materials, and unless otherwise specified or directed, the tack coating procedure shall be modified to provide a bond coat consisting of 0.9 L/m^2 (total) of 62% binder content polymer modified bitumen emulsion. Bitumen emulsion application rates of more than 0.5 L/m^2 shall be applied through a spray bar mounted directly on the asphalt paver, immediately ahead of the spreading of asphalt.

6.5 SPREADING

General

Unless otherwise specified, self-propelled mechanical pavers shall be employed to place asphalt except for areas where the use of a paver is impracticable.

Ambient Conditions for Placing

The surface on which the asphalt is to be placed shall be essentially dry and free from free-standing water.

Asphalt shall not be placed when the pavement surface temperature is less than 5°C.

Wearing course asphalt shall not be placed when the pavement surface temperature is less than 10°C except that placing at lower temperatures may be permitted subject to agreement on procedures used to compensate for rapid cooling of asphalt materials.

Layer Thickness

Asphalt shall be spread in layers at the compacted thickness shown on the drawings, or as specified.

Level Control

The method of paver level control shall be as specified in the Schedule of Job Details. If no method is specified in the Schedule of Job Details, the Contractor shall apply suitable automatic or manual screed level controls to achieve the standards specified in **Measurement and payment**.

Spreading

Asphalt shall be spread without tearing or segregation.

The Contractor shall conduct spreading operations to ensure that the paver speed matches the rate of supply so that the number of paving stops is minimised.

The paver shall not be left stationary for prolonged periods with the screed box in contact with either the previously placed asphalt or loose asphalt in front of the screed.

6.6 COMPACTION

Asphalt shall be uniformly compacted to the standards specified in **Density** as soon as the asphalt has cooled sufficiently to support the rollers without undue displacement. Compaction shall be achieved using suitable sized steel wheeled or vibratory rollers or combination of steel wheeled or vibratory rollers and pneumatic tyred rollers.

Pneumatic tyred rollers shall not be used in the compaction of stone mastic asphalt. The method of compaction of open graded and stone mastic asphalt shall avoid damage to aggregate or drawing of binder to the surface of stone mastic asphalt. Generally no more than two vibratory passes using high frequency and low amplitude shall be applied.

6.7 JOINTS

General

Joints shall be provided as follows:

- Longitudinally, if the width of the pavement is such that more than one paving run is necessary.
- Transversely, after the completion of a day's paving operations, or where a delay in paving operation allows asphalt to cool and adversely affect placing, and elsewhere if a break in a longitudinal run is required.
- The location of joints shall be planned before work commences.
- The number of joints shall be minimised by adopting good asphalt paving practices.
- All joints shall be well constructed and comply with the shape requirements specified in **Measurement and payment**.

Longitudinal Joints

Longitudinal joints in the wearing course shall coincide with traffic lane lines unless otherwise specified or agreed. Longitudinal joints shall be offset from layer to layer by not less than 150 mm provided that no joint is placed directly below a trafficked wheel path.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 100°C it shall be considered a hot joint. Hot joints shall be constructed by leaving a 150 mm strip of asphalt unrolled along the free edge until the adjoining lane is placed, and then compacting the unrolled strip simultaneously with the material in the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 60°C it shall be considered a warm joint. Warm joints shall be constructed by rolling the full width of the first lane being placed, prior to placing the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has cooled below 60°C it shall be considered a cold joint. Asphalt placed against a cold edge should overlap the previous edge by 25 mm to 50 mm. The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

Transverse Joints

Transverse joints shall be offset by not less than 2 m in adjoining paver runs and from layer to layer.

7 FINISHED PAVEMENT PROPERTIES

7.1 LEVEL

The level at the top of each course of asphalt shall not differ from the specified level by more than 10 m, except that where asphalt is placed against kerb and channel, the surface at the edge of the wearing course shall be flush with, or not more than 5 m above, the lip of the channel, unless otherwise specified or shown on the Drawings.

7.2 ALIGNMENT

The horizontal location of any point on the pavement shall not vary by more than ±50 m from the corresponding points shown on the documents, except where alignment with an existing pavement structure is necessary, when the new work shall be joined to the existing work or structure in a smooth manner.

7.3 THICKNESS

The average total compacted thickness of the combined asphalt courses shall be not less than the specified thickness. The average thickness of any individual course shall be not less than the specified thickness by more than 10%. Where confirmation of asphalt thickness is required, it shall be determined by coring to a recognised random sampling plan.

7.4 SHAPE

Surface

No point on the finished surface shall deviate below a 3 m straightedge, measured between any two points, by more than the tolerances specified in Table 8.1.

Table 8.1 Permissible tolerances in surface shape

Layer	**Deviations below 3 m straightedge, mm**					
	Freeways and Highways With High Speed Traffic		**Heavy and Very heavy Traffic Roads**		**Medium and Light Traffic Roads**	
	Parallel to centreline	**Transverse to centreline**	**Parallel to centreline**	**Transverse to centreline**	**Parallel to centreline**	**Transverse to centreline**
Wearing course	3	5	5	7	7	10
Inter-mediate and base	6	10	8	12	12	16

Ride Quality

Where ride quality is specified in the Schedule of Job Details it shall be determined from the average of three replica runs with a calibrated roughness car, laser profiler or ARRB TR Walking Profiler.

Each lane shall be divided into homogenous sections 100 m long. Any length less than 100 m 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, and bridge expansion joints, shall not be included in any section.

Roundabouts shall not be measured under **Shape**.

7.5 DENSITY

Compliance testing of asphalt shall be undertaken on a lot-by-lot basis. A pavement lot shall be an essentially homogeneous section of work completed within a shift of production, unless otherwise specified in the Schedule of Job Details.

Density testing shall not be performed on lots of less than 30 t, layers with a nominal thickness less than 30 mm, layers with a nominal thickness less than 2.5 times the nominal mix size, or open graded asphalt.

The location of each insitu density test shall be chosen by a method of random stratified sampling. For core sample tests, the layer thickness is the mean thickness of the core samples and for nuclear and impedance density gauge tests, the layer thickness is the nominal thickness. All core holes shall be repaired by an appropriate method that is compatible with the pavement from which cores have been taken.

Density testing shall be carried out as soon as practicable after completion of work.

Relative compaction is the percentage ratio of the insitu density of the compacted asphalt and the reference density of the asphalt of a particular lot. The reference density shall be the mean of the five most recent maximum density measurements of the same mix, provided that:

- The tests have been completed within the previous 4 weeks
- The binder content of samples tested is within ±0.3% of the job mix binder content
- There has been no change in the mix components or proportions.

Where 5 tests complying with the above conditions are not available, the Contractor shall carry out a minimum of 5 tests in order to establish the reference density.

The characteristic value of relative compaction is calculated as (Mean – KS)

where:

Mean = The mean of the relative compaction results.

S = The sample standard deviation of the relative compaction results.

K = A factor that depends on the number of tests as shown in Table 8.2.

Table 8.2 Acceptance Constant

Number of Tests or Measurements	Acceptance Constant (K)
6	0.719
7	0.755
8	0.783
9	0.808
10	0.828

The work represented by a lot shall be assessed as the characteristic value of insitu voids where:

Characteristic value of insitu air voids (%) = 100 – Characteristic relative compaction.

The value of characteristic voids shall comply with the maximum characteristic values specified in Tables 8.3 and 8.4.

Table 8.3 Characteristic Value of Insitu Air Voids for Wearing Course Asphalt

Asphalt Type and Thickness (mm)	Maximum Characteristic Value (%)
All heavy and very heavy traffic asphalt wearing courses	8
Medium traffic wearing course.	9
Light traffic wearing course	7

Table 8.4 Characteristic Value of Insitu Air Voids for Base Asphalt

Asphalt Type and Thickness (mm)	Maximum Characteristic Value (%)
Heavy and very heavy traffic mixes in layers ≤ 40 mm	8
Medium and light traffic mixes in layers ≤ 40 mm	9

Asphalt Type and Thickness (mm)	**Maximum Characteristic Value (%)**
Heavy and very heavy traffic (except high fatigue base) mixes in layers > 40 mm	7
Medium and light traffic mixes in layers > 40 mm	8
High fatigue base	6

8 MEASUREMENT AND PAYMENT

8.1 GENERAL

Payment for tack coat shall be included in payment for asphalt.

Payment for asphalt shall be by mass for quantities determined in accordance with **Measurement by mass** or **Measurement by area and thickness** as appropriate.

Measurement for payment will include all works shown on the plans or as specified but will not include asphalt lost in transit, works not shown on the plans and variations in quantities due to variations in actual thickness exceeding the specified tolerances.

8.2 MEASUREMENT BY MASS

Unless otherwise specified in the Schedule of Job Details, the quantity of asphalt shall be measured by mass.

The quantity of asphalt shall be determined from dockets supplied by the Contractor and issued at a certified weighing system unless measurement by batch weights using certified scales is approved by the Superintendent.

Separate pay items shall be included in the Schedule of Rates for each nominal course thickness and each nominal size and type of asphalt specified.

8.3 MEASUREMENT BY AREA AND THICKNESS

Where specified in the Schedule of Job Details, the quantity of asphalt shall be determined from measurement of area and thickness.

The area and thickness shall be determined from the dimensions on the plans or as specified for the work being measured.

The density of asphalt in a lot shall be taken as the arithmetic mean of the insitu densities of the lot.

Separate pay items shall be included in the Schedule of Rates for each nominal course thickness and each nominal size and type of asphalt specified.

8.4 NON COMPLYING MATERIALS

In the event that the material supplied is not within the tolerances and standards defined for manufacture or placing of asphalt, the Superintendent may direct:

- That the reduced service life arising from the non complying material is offset by reducing payment for the non complying material by the method defined in the Schedule of Job Details; or,
- The removal of non complying material; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.

9 ANNEXURE A

9.1 SCHEDULE OF JOB DETAILS

Asphalt mix requirements
(Quality, Binder, Aggregate grading and binder content, Mix properties)

Item	**Layer/Course**	**Asphalt Mix**	**Binder**	**Nominal Size**	**Layer Thickness**

		Type/ Traffic Category	Class/Type		

Measurement and payment
(**Measurement and payment**)
Measurement and payment shall be by: Mass/ Area and Thickness
Any Special Job Requirements listed below shall be additional separate Payment Items
Special job requirements (Optional)
Special Design Criteria: [complete/delete]

Approval of Job Mix: [complete/delete]

Submission of Samples: [complete/delete]

Method of level Control: [complete/delete]

Measurement of Ride Quality: [complete/delete]

Density Testing: [complete/delete]

Non Complying Materials: [complete/delete]

Removal of Thermoplastic or Other Line Marking: [complete/delete]

Additional Pavement Preparation: [complete/delete]

Other: [complete/delete]

10 ANNEXURE B – ASPHALT WORK RECORD

CLIENT:

Date: _____ Contract No:_____ Work Location: _____km to: _____ km

Road Name: _____ Supplier: _____ From: _____towards: _____
(Crossroad or landmark)

Road No: _____ Job No: _____ PMS/MMS Segment Numbers: _____

Plan No: _____ Mix Type: _____ New Surfacing ☐ Resurfacing ☐ Existing Surface Type: _____

Delivery								Paving										Remarks
Load No.	Time			Truck Reg'd No.	Docket No.	Net Mass (t)	Mix Temp Ex paver °C	Chainage		Paved Width (m)	Direction with or against chainage	Dist. from left edge to centre of run (m)	Thickness (mm)	Layer			Sample No. & Lot Size (tonnes) if sampled	Weather Work Stoppages, Start & Finish etc.
	Depot Plant	Arrive Job	Depart Job					From	To					1st	2nd	3rd		

Remarks: _____

Penciller: _____ Sampling by: _____ Superintendent's Representative: _____ (Signature) Contractor's Representative: _____ (Signature)

Affiliation: _____ Affiliation: _____

11 ANNEXURE C

NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

11.1 SCOPE AND GENERAL

Scope: The specification has been prepared for the manufacture, supply and placing of dense graded hot mix asphalt (also referred to as asphaltic concrete or AC), stone mastic asphalt (SMA) and fine gap graded asphalt (FGGA) for roadworks and related applications. Different criteria apply to quality of components and asphalt mix design according to the application. The nominal size and types of mixes to be used should be specified in the Schedule of Job Details.

The intended use of the materials may also involve the application of different construction requirements and these should also be nominated in the Schedule of Job Details. Guidelines for the application of such requirements are given in the notes to the relevant worksection clauses.

Careful consideration of the Schedule of Job Details is required to ensure that asphalt is fit for purpose, of the appropriate type and quality, and provided in a cost effective manner.

The terms used in the worksection guidelines are generally consistent with AS 2124, and include Principal, Superintendent, and Superintendent's Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Quality: The quality requirements of **Quality (Scope and General)** are design to apply the AUS-SPEC quality system requirements.

The following paragraphs may be substituted if desired:

'The Contractor shall establish, implement and maintain a Quality System in accordance with this worksection and the requirements of AS/NZS ISO 9001(Int), or a recognised equivalent.'

'Where required in the Contract general clauses, the Contractor shall submit a Quality Plan prior to commencement of any works. The Quality Plan shall take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. No part of the Quality System shall be used to pre-empt or otherwise negate the technical requirements of the Contract Documents.'

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor's Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

11.2 MATERIALS

Aggregate

The worksection refers to AS 2758.5, which requires the user to select from a number of options for determination of aggregate durability. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards are applied on a State by State basis as follows:

- Soundness based on Los Angeles Abrasion and Unsound Stone Content (Table 2.1) – Victoria and Western Australia.
- Soundness based on Ten Percent Fines Value and Wet/Dry Strength Variation (Table 2.2) – All other States.

Minimum values of polishing resistance (PSV or PAFV) are provided as default values for general application. Surface friction requirements will vary according to the risks associated with operating environment or particular sites, which will also influence the choice of type of asphalt mix and other design factors associated with surface texture. Availability may also be a consideration. This may lead to the adoption of higher or lower minimum polishing values for some applications.

Mineral Filler

Some asphalt specifications show confusion over the role and specification of filler in asphalt mixes. By strict definition, filler is that mineral matter passing the 75 micron sieve and includes filler sized particles derived from aggregates as well as added fine materials such as lime, fly ash, etc. In practice, materials used as added filler are comprised predominately of particles smaller than

75 microns but may also contain a proportion of coarser particles. Tests applied to added filler materials apply to the complete sample, not just that portion passing the 75 micron sieve.

Binder

A guide to selection of binder type is provided in the notes to **Mix design**.

Reclaimed Asphalt Pavement (RAP)

A guide to the application of design and manufacturing requirements for RAP in asphalt is provided in the notes to **Mix design**.

11.3 MIX DESIGN

General

Gyratory compaction enables ready selection of different compaction levels to match expected service conditions as well as being able to simulate long term heavy traffic loadings by extended compaction. Gyratory compaction is also considered to achieve particle alignment that is a better representation of field compaction of asphalt. The specification also provides for the use of Marshall compaction where that method of compaction is preferred. It is important that only one set of criteria are applied, either Marshall or gyratory compaction. In due course it is expected that gyratory compaction will become more common than Marshall.

The mechanical properties of Marshall 'Stability' and 'Flow' do not directly measure fundamental properties but provide empirical relationships that have been found to correlate with asphalt mixes that provide suitable levels of field performance.

Several relatively new performance-based design criteria have been developed through the national research programs of AAPA, Austroads and ARRB Transport Research. The outcome of that research program has been published as Austroads Pavement Research Group Report No. 18 - Selection and Design of Asphalt Mixes: Australian Provisional Guide. The provisional status of the Guide reflects the tentative nature of aspects of the performance criteria and are not included here as the Provisional Guide is the subject of a review in 2006/07.

Aggregate Grading and Binder Content

The aggregate grading and binder content ranges shown in Tables 3.1, 3.2, 3.3, 3.4 and 3.5 of the worksection are targets for design purposes. Application of production tolerances may result in actual production being outside those limits. Table 3.1 restricts the proportion of finer materials in order to provide good texture for dense graded wearing course mixes for medium and heavy traffic and increased deformation resistance in heavier trafficked applications. Table 3.2 allows increased proportions of finer materials in dense graded mixes for all lesser trafficked applications.

The Superintendent may approve the use of asphalt mixes with a design target outside the ranges shown where it can be shown that all the other performance requirements can be adequately met.

Mix Properties - Selection of Mix Type, Binder Type, and Layer Thickness

The principal factors influencing the performance characteristics of asphalt mixes are the selection and quality of components, the volumetric properties of the mix (nominal size, grading, binder content and voids relationships) and the layer thickness.

The worksection provides for different criteria for aggregate quality and voids relationships for dense graded mixes based on traffic categories. A guide to selection of traffic category is shown in the Table C1 below. The relevant traffic category should be nominated in the Schedule of Job Details.

The mix type, nominal mix size, binder type and layer thickness should also be nominated in the Schedule of Job Details.

For most wearing course and structural asphalt applications, dense graded asphalt mix types are used. Other mix types are used as wearing course to provide particular surface characteristics for particular applications as follows:

- Ultra thin asphalt (UTA) is a specialty asphalt mix for placing in thin layers (12–15 mm compacted thickness). It uses a modified grading to improve resistance to surface shearing forces, which reduces porosity but still provides coarse textured surface. UTA must be placed in conjunction with a heavy tack coat (see notes to Section 7.3), sprayed seal or strain alleviating membrane interlayer (SAMI) to ensure strong bond to underlying surface.
- Stone mastic asphalt (SMA) is used to provide good surface texture and good deformation resistance on heavily trafficked roads. Smaller nominal sizes can also be used as a durable, well-textured surface in lightly trafficked applications.

- Fine gap graded asphalt (FGGA) provides a very fine textured surface in a mix that can be readily compacted to low air voids thereby providing good durability in lightly trafficked pavements. The grading envelope for FGGA provides for a wide choice of grading target but there is a design intent to produce a gap grading with limited intermediate sized aggregate fractions as described in Chapter 6 of APRG 18. While the grading and binder content produces a more workable mix, it can be more susceptible to deformation and is not appropriate for heavily trafficked or highly stressed areas.

A detailed guide to selection of different wearing course asphalt mixes for particular surface characteristics is provided in Austroads *Guide to selection of road surfacings*.

The nominal size may be determined as a function of the layer thickness or the layer thickness selected on the basis of the nominal size required for a particular application. A guide to selection of layer thickness and nominal size is shown in Table C2.

Guides to selection of binder types for dense graded wearing and base course applications are shown in Tables C3 and C4. Not all binder types may be available in all locations and AR450 has only recently been introduced in NSW. Modified binders require delivery in minimum quantities and special handling and storage requirements. The specification of modified binders may, therefore, not be practical for small projects or remote locations. Before specifying a particular binder, the designer should ascertain the availability in the project location.

It should be noted that the design air voids targets for gyratory compaction of dense graded mixes are different to those for Marshall compaction. The limits for gyratory compaction are based on different compactive effort (cycles) for different traffic applications. The design air void targets for Marshall compaction provide the option of varying compactive effort for different traffic levels, or choosing different air voids targets based on a single 50-blow compactive effort. The use of 50-blow compaction enables mixes of different applications and voids targets to be selected from the one set of laboratory test data. If mixes are to be designed for different Marshall compactive effort, the target air voids and VMA should be reduced by up to 1% for 75-blow compaction and increased by up to 1% for 35-blow compaction. Where different design air voids criteria are required, a special clause should be inserted in the schedule of details.

Table C1 Guide to Traffic Category

Indicative Traffic Volume		**Traffic Category**	
Commercial vehicles/lane/day	**Structural design level**	**Free flowing vehicles**	**Stop/start OR climbing lane OR slow moving**
< 100	< 5x105 ESAs	Light	Medium
100–500	5x105–5x106 ESAs	Medium	Heavy
500–1000	5x106–2x107 ESAs	Heavy	Very Heavy
> 1000	> 2x107 ESAs	Very heavy	Very Heavy

Table C2 Guide to selection of nominal size of dense graded mixes

Nominal size (mm)	**Typical Layer thickness (mm)**	**Typical Use**
5	15–20	Very thin surfacing layer with fine surface texture. May not be available in all locations
7	25–30	Commonly used for surfacing residential streets and foot traffic areas where thin layers and fine surface texture are required.
10	30-45	General purpose wearing course in light and medium traffic applications
14	40–55	Wearing course mix for heavier traffic applications. Also some intermediate course applications depending on layer thickness
20	60-90	General purpose base and intermediate course mix for wide range of use.
28	85-120	Base and intermediate course but less commonly used than 20 mm. Control of segregation can sometimes be an issue.
40	120–160	Occasionally used as heavy duty base. Control of segregation can

Nominal size (mm)	Typical Layer thickness (mm)	Typical Use
		be a significant issue.

Table C3 Selection of binder type for dense graded wearing course applications

Traffic Category	Binder Class/Type	Recommended use
Light	320 or 450	Residential streets, car parks and foot traffic
	AR450	Alternative to 320, particularly in warmer climates
Medium	320 or AR450	Normal conditions and lower traffic ranges, particularly in cooler conditions
	320 or AR450	Good general purpose mix for wide range of applications
Heavy	320 or AR450	General purpose mix for heavily trafficked applications.
	600, AR450, Multigrade or PMB	Higher performance mixes for more critical traffic applications or where elastomeric polymers are required to improve flexibility. Stiffer binders require strong, stiff base.
Very Heavy	320 or AR450	Heavily trafficked intersections and slow moving traffic
	600, AR450, Multigrade or PMB	Special applications such as very heavily trafficked intersections and heavy-duty industrial pavements.

Table C4 Selection of binder type for dense graded intermediate and base course applications

Traffic Category	Binder Class/Type	Recommended use
Light and Medium	320	General purpose mixes for cooler conditions
	320 or AR450	General purpose mixes for most light and medium traffic applications
Medium/ Heavy (high fatigue base)	320 or AR450	Special high bitumen content sub-base layer providing high fatigue resistance. To avoid rutting, this mix should not be used within 125 mm of surface. The layer thickness should not generally exceed 70 mm or one third of the structural pavement depth.
Heavy	320 or AR450	General purpose mix for heavy traffic applications.
	600	High stiffness base for use in heavy duty pavements.
Very Heavy	320, 450, 600, Multigrade or PMB	Special applications such as heavy-duty industrial pavements and hard standing areas.

Table C4 Selection of binder type for other mix types

Mix Type	Traffic Category	Binder Class/Type	Recommended use
Stone Mastic Asphalt	Light or medium	320 or 450	Wearing course for light and medium trafficked roads where well textured mix is required.
	Heavy or Very Heavy	320, 450 or Multigrade	Wearing course for heavily trafficked roads providing high levels of texture and rut resistance.
	Very Heavy (Special applications)	PMB	Enhanced wearing course performance in heavily trafficked applications.
Fine Gap Graded Asphalt	Light	320 or 450	Fine textured, durable wearing course for use in residential streets, pedestrian areas, and other light traffic applications

Design and Manufacture of Asphalt Mixes Incorporating Reclaimed Asphalt Pavement (RAP)

As a general rule, no special requirements need apply to the use of RAP in hot mix asphalt where the percentage of RAP does not exceed 15% of the total mix, provided that separate designs are prepared for such mixes, the proportions used in manufacture are not substantially altered from that used in design, and that the Quality Plan includes a reasonable management plan for monitoring incoming RAP materials.

Where RAP is to be added in proportions greater than 15%, but not more than 30% of the total mix, the use of bitumen binder of one class softer than that otherwise specified will generally provide suitable compensation for the influence of hardened binder in the RAP and produce asphalt mixes of comparable stiffness, fatigue resistance and deformation resistance to mixes manufactured with virgin materials.

Alternative procedures include the use of rejuvenators or a softer class of binder tailored to tests on actual penetration or viscosity of binders recovered from stockpiled RAP materials. The latter approach is appropriate where it is believed that accurate prediction of binder stiffness is critical to the long term performance of the asphalt, e.g. Heavy traffic base applications and Very Heavy traffic base and wearing course applications. A further option is to accept the material without adjustment to the grade of fresh binder. In such cases the asphalt may have slightly higher flexural stiffness that could reduce fatigue resistance in thin surfacing applications when the proportion of RAP approaches 25 or 30%.

The specifier may also restrict use of more than 15% RAP to particular mix types or project applications. Mixes that are not permitted to contain more than 15% RAP should be listed in the Schedule of Job Details. The use of RAP in proportions greater than 15% should not be allowed where polymer modified binders are specified but should be satisfactory for use with multigrade binder and most applications with standard classes of bitumen binder.

The use of RAP in proportions greater than 30% of the total mix should only be permitted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures. Manufacture should only be carried out in asphalt plants specifically designed to handle such proportions of RAP without overheating and damage to binder in the RAP or new mix. The quality plan should indicate the procedures for monitoring the consistency of grading and binder properties of incoming RAP materials, the use of softer binders or rejuvenating agents to achieve a binder of comparable performance to that otherwise specified, and testing to validate the properties of the manufactured asphalt.

A guide to blending of binders or rejuvenating agents to achieve a target binder viscosity is provided in *the Austroads Asphalt Recycling Guide (AP-44/97) and Austroads Framework Specifications for Asphalt Recycling (AP-T02).* Caution must be used in determining targets for blending of binders as fresh binder or rejuvenator may not be fully combined with the aged binder during the asphalt manufacture process. Consequently, mix performance characteristics imparted by binder stiffness, particularly fatigue and rutting resistance, may be somewhat intermediate between that of the fresh binder and that predicted from the stiffness or viscosity calculated or determined by extraction and testing of the blended binder.

11.4 MANUFACTURE AND STORAGE

Guidance for binder storage and mixing temperatures may be obtained by reference to AAPA *Advisory Note 7: Guide to the Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt.* The length of time that manufactured asphalt may be held in hot storage bins will vary according to the type of mix, type of binder and construction of storage bins. Maximum storage times (24 h) are generally applicable to standard dense graded asphalt mixes, standard bitumen binder and well insulated bins that may also include supplementary heating. Shorter storage periods apply to high binder content mixes, polymer modified binders and poorly insulated bins. Additional guidelines for storage of polymer modified binders at elevated temperatures may be provided by the manufacturers of polymer modified binders. Other potential deleterious influences of extended storage may be assessed by monitoring mix temperature variation and segregation.

The addition of fibre to stone mastic asphalt is generally undertaken by one of the following alternative methods:

- Addition of loose or pelletised fibre direct to the pugmill of a batch mixer in meltable pressed packs
- Metering of loose or pelletised fibre direct to pugmill of batch mixing plant
- Metering of pelletised fibre through system designed for addition of RAP to drum mixing plant.

- Metering of loose or pelletised fibre direct to drum mixing plant through line that merges fibre with binder at point of addition to aggregates.

11.5 SAMPLING AND TESTING OF ASPHALT PRODUCTION

General

The purpose of inspection and testing is to provide reasonable assurance to the purchaser that the quality of component materials comply with the standards specified, and that the manufactured asphalt is in accordance with the designated job mix design.

Manufacturing compliance may be assessed at two levels:

- Verification that the job mix has been replicated, i.e. use of conforming components and combination in the design proportions to achieve the job mix grading and binder content.
- Verification that the design targets have been met, i.e. testing of compacted samples for volumetric properties and other specified properties.

For many applications, compliance with the job mix grading and binder content is adequate. If production is controlled within the tolerances specified, it is neither necessary nor cost effective to perform further testing for conformity to mix design criteria as a routine measure of quality. In fact, the variability inherent in such sampling and testing may lead to misleading interpretation of quality variation where no such variation really exists.

Where confirmation of volumetric properties is required, an additional clause should be inserted to require compaction of samples taken from production to be compacted using the same procedures as that specified for the design of the relevant mix. The sampling frequency should be the same as that applied to testing of grading and binder content and the tolerance on air voids should be $\pm$ 1.5% of the design target.

Compacted samples may also be assessed for other design properties such as Marshall Stability and flow or resilient modulus. The Marshall test properties should meet the specified design criteria.

The manufacturer should not rely solely on the sampling and testing done for compliance purposes as the measures of process quality control. The worksection provides an incentive to the manufacturer to undertake suitable measures to improve the level of conformity and consistency of manufactured product by reducing the frequency of testing for compliance purposes where the manufacturer is using a suitable statistical process control system and where the results of compliance tests show an appropriate level of consistency in meeting the worksection requirements.

A guide to statistical process control systems is provided in AAPA *Implementation Guide IG-3: Asphalt Plant Process Control Guide*. Further guidance to the application of statistical techniques is provided in AS 3940 *Quality control – Guide to the use of control charts* including Cusum techniques and AS 3942 *Quality control – Variables charts – Guide*.

A typical statistical process control system that would be suitable for this application is one that incorporates the following elements:

Process control charts for the compliance tests for grading (one sieve below mix nominal size, 2.36 mm and 0.075 mm sieves), binder content, and maximum density.

Process charts should show:

- Actual individual sample test results plotted against the target value and specified tolerances.
- Five point rolling mean, with the target value, warning and control limits.
- Five point rolling range (the maximum of five points)

Corrective action should be taken when any of the following occur:

- One point lies outside the control limits
- Two out of three points lie outside the warning limits. Investigation of possible assignable causes, and need for corrective action, should be undertaken if:
- Five consecutive points in the rolling mean are above or below the target
- Five consecutive increasing points occur in the range
- Two out of three points lie outside the warning limits

The use of statistical process control measures are strongly encouraged as a means of reducing the uncertainties associated with interpretation of test results from single samples. The use of risk assessment procedures to define where variation may occur is also recommended.

11.6 DELIVERY

The rate of delivery should be matched to paving output to maintain consistent spreading to achieve good ride quality and uniform compaction and to avoid unnecessary delays in spreading operations and loaded asphalt being held on site for long periods.

Asphalt should arrive on site at a suitable temperature for spreading. The actual temperature will depend on mix type, layer thickness, ambient conditions and equipment available for compaction. Generally, compaction should be completed before the mix temperature falls below about 90°C (slightly higher for modified binders). A guide to temperature of dense graded asphalt mixes, at the time of spreading, to provide adequate time for compaction using typical equipment, is shown in

Table C6 Asphalt Spreading Temperatures (Dense Graded Asphalt)

Road surface temperature1 (°C)	**Minimum mix temperature2 (°C)**			**Range of mix temperature3 (°C)**
	Thickness of layer, mm			
	<30	**30 – 40**	**41 – 100**	**>100**
5 – 10	See note 4	See note 4	145	135 – 150
10 – 15	150	145	140	130 – 145
15 – 25	150	145	135	125 – 140
> 25	150	145	130	120 – 135

Notes:
1. Surface temperature should be generally that applicable to the coolest area of the pavements, e.g., shade areas, if applicable.
2. Mix temperatures apply to Classes 170, 320 and AR450 bitumen binder. Use of Class 600, Multigrade, or PMBs may require minimum temperatures 5°C to 10°C higher than those shown.
3. Maximum temperatures apply when placing thick layers, to avoid excessive displacement under rolling.
4. Placing asphalt in thin layers under cool conditions may adversely affect the result due to the increased difficulty in achieving proper compaction, effective joints and good surface finish. Additional attention should be paid to issues of mix workability, asphalt temperature, compaction techniques and any influence from additional cooling due to wind or moisture.
5. Placing of asphalt over a previous layer that has not cooled below about 65°C requires special consideration and mix temperatures should be adjusted accordingly.

11.7 PLACING

Preparation of Surface

Road surfaces must be clean to ensure good bond between new asphalt and the existing surface.

Priming

Crushed rock and gravel surfaces should be primed with a suitable application of primer, prior to placing asphalt, particularly where the total thickness of asphalt is 50 mm or less. Priming the surface assists in:

- Achieving a strong bond between asphalt and granular layers.
- Reducing the permeability of the surface of the granular layer.
- Stabilising the pavement moisture content and assisting in the curing of cement stabilised layers.
- Preserving the integrity of the granular surface after completion of preparation and before placing asphalt.

If priming is required, it must be included as a separate worksection and schedule item.

Tack Coating

Tack coating for normal asphalt applications comprises a light application of bitumen emulsion to ensure adequate adhesion between layers. The placing of ultra thin asphalt is a specialty process that requires a higher application rate of tack coat (up to 0.9 L/m^2) to increase the surface bond. The type of bitumen emulsion used in such applications generally contains a polymer modifier and must be placed with a special integrated paving machine that sprays tack coat immediately ahead of depositing asphalt so that the tack coat is not damaged by spreading equipment.

The type of bitumen emulsion for normal applications should suit the conditions of use. Generally, rapid setting cationic emulsion is used in cooler regions where damp conditions may be encountered. In warmer or drier conditions, slower setting cationic emulsions and anionic emulsions may combine easier handling with satisfactory performance. Bitumen emulsion used for tack coating may be diluted with water to assist uniform coverage, provided that the residual binder application rate is achieved.

Tack coating is generally not necessary when placing over clean, freshly applied primed surfaces or newly placed, untrafficked asphalt.

Spreading

The specification provides for asphalt to be placed when pavement surface temperatures are as low as 5°C. Placing in cool conditions increases the difficulty in obtaining good standards of work and, where practicable, work involving thin layers (40 mm or less) or PMB binders should be programmed to be done when such conditions are less likely to occur.

The selection and use of automatic level control for asphalt paving should normally be determined by the Contractor, taking into account the applicability to site conditions and the geometric requirements of the finished result. The use of automatic level controls will usually only be applicable to larger jobs and heavier traffic. The Schedule of Job Details provides for specification of particular level control devices, if required.

Compaction

Selection of compaction equipment is the responsibility of the Contractor, provided that it is capable of achieving the required standards of compacted density, surface shape and finish.

Joints

Joints are the weakest part of the pavement. Cold joints should be minimised by planning of works to achieve a minimum number of construction joints and, where practicable, maximum use of hot or warm joints.

11.8 FINISHED PAVEMENT PROPERTIES

For general asphalt work, the application of shape standards as specified in **Shape**, together with the use of good placing practices as outlined in the notes to **Placing**, should provide adequate surface smoothness and ride quality.

The standard of ride quality that can be achieved will depend on the roughness of the surface on which the asphalt layer is to be placed, and the extent of shape correction and additional asphalt layers that may be applied prior to the final layer. Ride quality will also be influenced by restrictions such as intersecting streets, road fixtures (e.g., manholes), and the need to match kerb and channel. Specifiers should avoid potential conflicts in requirements by simultaneously trying to control thickness, level and ride quality.

Achievement of specified densities will depend upon the provision of a stiff base and a workable mix.

11.9 MEASUREMENT AND PAYMENT

Payment is normally on the basis of mass determined from an approved weighing system. Alternatively, on new works where asphalt is being placed to a specified thickness, the mass may be determined on the basis of measured area, thickness and density.

Additional clauses may also be inserted to apply a scheduled rate of reduction in payment for failure to comply with manufacturing targets, compacted density and ride quality requirements to compensate for reduced service life.

Annexure A – Schedule of job details

A1 ASPHALT MIX REQUIREMENTS: See **Quality**, **Binder**, **Aggregate grading and binder content**, **Mix properties**. Insert type/traffic category of mix, binder type, nominal size and thickness, where applicable.

A2 MEASUREMENT AND PAYMENT: See **Measurement and payment**. Indicate the method of measurement applicable.

A3 SPECIAL JOB REQUIREMENTS: Where required, special clauses should be prepared and inserted in the schedule of job details for the following.

- Special Design Criteria: See **Mix properties**. Insert any special design requirements, if applicable.
- Use of Reclaimed Asphalt Pavement (RAP): See **Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP)**. Insert any particular conditions or restrictions to mix types or applications of RAP in asphalt.

- Submission of Samples: See **Approval of job mix**. Insert details for delivery of samples (if relevant).
- Automatic Paver Level Control: See **Tack coating**. Insert any special requirements for use of automatic paver control, if applicable.
- Measurement of Ride Quality: See **Non complying materials**. Insert special requirements for measurement of ride quality, if applicable. A separate schedule item should be provided for the cost of testing, where testing is to be provided by the Contractor.
- Non Complying Materials: See **Non complying materials**. Insert special requirements for payment for non complying materials, if applicable.

1145 SEGMENTAL PAVING

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.

The work to be executed under this worksection consists of the supply, placement and compaction of segmental pavers including the provision of a sand bedding course and joint filling sand, over mass concrete subbase, bound or unbound base and/or subbase layer/s.

This worksection should be read in conjunction with the appropriate worksections for the construction of the base and subbase layers beneath the segmental paving, i.e., 1113 *Stabilisation*, 1141 *Flexible pavements* and 1132 *Mass concrete subbase*.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality(Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1112 Earthworks (Roadways)

1121 Open drains, including kerb and channel (gutter)

1113 Stabilisation

1141 Flexible pavements

1132 Mass concrete subbase

Standards

AS 1141 Methods for sampling and testing aggregates

AS 1141.11 Particle size distribution by sieving

AS/NZS 4455 Masonry units and segmental pavers

AS/NZS 4456 Masonry units, segmental pavers and flags—Methods of test

AS/NZS 4456.3 Determining dimensions

AS/NZS 4456.5 Determining the breaking load of segmental pavers and flags

AS/NZS 4456.9 Determining abrasion resistance

AS/NZS 4586 Slip resistance classification of new pedestrian surface materials

Other publications

Concrete Masonry Association of Australia Specifications

T44 Concrete segmental pavements—Guide to specifying

T45 Concrete segmental pavements—Design guide for residential access ways and roads

T46 Concrete segmental pavements—Detailing guide

Clay Brick and Paver Institute Specifications

Manual 1 Clay paving design and construction

1.4 TERMINOLOGY

Size

Concrete segmental pavers are units of not more than 0.10 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.

Concrete pavers

Concrete pavers are identified by shape as being one of the following types:

- 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.

Clay pavers

Clay 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 2 mm.

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.

Pattern

Laying patterns of pavers are identified as being either Herringbone, Basket-weave, or Stretcher as shown in Annexure 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 A.

1.5 CHOICE OF PAVER TYPE, SHAPE, CLASS AND LAYING PATTERN

Type

The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern shall be as shown on the Drawings for each area of application.

Concrete

Unless otherwise specified, concrete pavers for road pavements shall be placed in herringbone laying pattern and shall be in accordance with the requirements for the appropriate road application shown in Table 2.1.

Clay

Unless otherwise specified, clay pavers for road pavements shall be Class 4, minimum 65 mm nominal thickness, and placed in a herringbone laying pattern.

2 MATERIALS

2.1 APPROVAL

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 worksection.

No pavers shall be delivered until the Superintendent has approved the type and quality of the pavers and noted the source of supply as compliant to the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the pavers' sources of supply is required prior to the release of the **Hold Point**.

Such approval shall not relieve the Contractor of any responsibility for supplying materials that comply with this worksection.

2.2 SLIP RESISTANCE

All pavers shall have suitable 'slip resistance' for pedestrian traffic and vehicular traffic with a classification 'W' according to AS/NZS 4586 for the Wet Pendulum Test.

Where specific localities or levels of usage require a higher slip resistance classification, this classification shall be indicated on the Drawings.

2.3 CONCRETE SEGMENTAL PAVERS

Concrete segmental pavers shall comply with the requirements of T44, T45, T46 and AS/NZS 4455 for each area of application.

The material requirements for concrete pavers for each application, derived from T44, are shown in Table 2.1 The pavers shall meet the requirements for the relevant application given in Table 2.1 when tested in accordance with the following test methods:

- Characteristic breaking load: AS/NZS 4456.5
- Characteristic flexural strength: AS/NZS 4456.5
- Minimum thickness: Not Applicable
- Shape type: Not Applicable
- Dimensional deviations: AS/NZS 4456.3
- Abrasion resistance: AS/NZS 4456.9

Table 2.1 Material requirements for concrete segmental pavers

Application	**Characteristic breaking load[3] (kN)**	**Characteristic flexural strength[3] (MPa)**	**Minimum Thickness (mm)**	**Shape[4] (type)**	**Dimensional deviations (Category— AS 4455)**	**Abrasion resistance (mean abrasion index)**
Residential driveways						
Light traffic Medium traffic[1]	3 5	2 3	No limit No limit	Any Any	DPA1 or DPB1 DPA1 or DPB1	7 7
Public footpaths						
Low volume High volume and Pedestrian Malls[1]	5 5	3 3	No limit No limit	Any Any	DPB2 DPB2	5 3.5
Roads[4]						
Minor Local & Collector Distributor	5 5 5	3 3 3	60 80 80	Any Any A	DPB2 DPB2 DPB2	5 5 5
Industrial pavements[2]	10	4	80	A	DPB3	7

NOTES:
[1] Capable of taking occasional 8.2 tonne axle loads.
[2] The resultant joint width is a combination of paver dimensional deviation and laying procedures.
[3] At 28 days.
[4s] Interlocking shapes offer superior performance in road applications.

2.4 CLAY SEGMENTAL PAVERS

Specification

Clay segmental pavers shall comply with the requirements of CBP1 Manual 1 *Clay paving design and construction* and with the requirements of AS/NZS 4455.

Classification

Clay pavers shall be classified as Class 1, 2, 3 or 4 in accordance with Paver Note 1.

Roadways
Unless otherwise indicated, Class 4 pavers shall be used for all road and driveway pavements, medians and traffic islands.

Footpaths
Class 2 or 3 pavers may be used for footpaths, cycleways, and other pedestrian areas, except where they are subject to vehicular traffic with axle loads greater than 2.7 tonnes, in which case Class 4 pavers shall be used.

Class 1 pavers shall only be permitted for low-volume pedestrian applications not subject to any vehicular traffic.

Abrasion resistance
The abrasion resistance as determined by the SCC Abrasion Test (Paver Note 1) shall conform to the recommended characteristic abrasion losses contained in Paver Note 1.

2.5 BEDDING SAND

Grading
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:

AS Sieve	% Passing
9.52 mm	100
4.75	95–100
2.36	80–100
1.18	50–85
600 µm	25–60
300	10–30
150	5–15
75	0–10

Protection when stored
It shall be covered when stored on site to protect it from rain penetration.

Moisture content
The sand shall be of uniform moisture content when spread.

Cleanliness
The bedding sand shall be free of deleterious soluble salts or other contaminants which may cause, or contribute to, efflorescence.

2.6 JOINT FILLING SAND

Grading
The joint filling sand shall be well graded passing a 2.36 mm sieve, and when tested in accordance with AS 1141.11, having the following grading:

AS Sieve	% Passing
2.36 mm	100
1.18	90–100
600 µm	60–90
300	30–60
150	15–30
75	5–10

Protection when stored
It shall be covered when stored on site to protect it from rain penetration.

Moisture content
The sand shall be dry when spread.

Cleanliness
The joint filling shall be free of deleterious soluble salts or other contaminants.

Sand used for bedding is not suitable for joint filling.

2.7 CONCRETE FOR EDGE RESTRAINTS

Specification
Concrete supplied and placed for the construction of edge strips shall comply with 0310 *Minor concrete works*.

Strength
Unless otherwise indicated on the Drawings, or where the edge restraint is provided by kerb and/or gutter (channel), the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 32 MPa for edge restraints for pavers on road pavements and 25 MPa for edge restraints for pavers on footpaths, cycleways, medians and driveways.

3 CONSTRUCTION

3.1 SUBGRADE PREPARATION

Dimensions and specification
The subgrade shall be formed to the required depth below finished surface level as shown on the Drawings, or as directed by the Superintendent, in accordance with 1112 *Earthworks (Roadways)*.

The finished subgrade foundation for the provision of subbase and/or base shall be presented for the approval of the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the subgrade foundation is required prior to the release of the **Hold Point**.

3.2 SUBBASE

Specifications
Where shown on the Drawings or as directed by the Superintendent a subbase or working platform shall be constructed in accordance with 1113 *Stabilisation*, 1141 *Flexible pavements* and

1132 *Mass concrete subbase*, as appropriate.

Dimensions
The subbase shall be constructed to the specified thickness, compaction and depth below finished surface level and to the design grade and crossfalls of the finished surface.

Superintendent's approval
The finished subbase shall be subject to the approval of the Superintendent.

3.3 BASE

Dimensions and specification
The base shall be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the Drawings or as directed by the Superintendent in accordance with 1141 *Flexible pavements*.

The base course shall extend in width to at least the rear face of all new edge restraints.

Tolerances for base overlain with segmental paving
Notwithstanding the finished level tolerances contained within 1141 *Flexible pavements* for base of ±10 mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving shall be trimmed to within +10 mm or –0 mm of design levels.

The deviation from a 3 m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 10 mm.

Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances.

Free drainage
The finished surface of the base shall drain freely without ponding.

Approval of base
The finished base shall be presented for the approval of the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the finished base is required prior to the release of the **Hold Point**.

3.4 EDGE RESTRAINTS

Requirements

Edge restraints in the form of kerb and/or gutter or edge strips shall be constructed along the perimeter of all segmental paving as shown on the Drawings or as instructed by the Superintendent.

Concrete kerb and/or gutter (channel) and edge strips shall be constructed in accordance with 1121 *Open drains, including kerb and channel (gutter)* and 0310 *Minor concrete works*.

Faces of edge restraints abutting pavers shall be vertical.

Support

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 100 mm adjacent to road pavements and medians, and 50 mm adjacent to footpaths, cycleways and driveways.

Joints

Unless otherwise shown on the Drawings, contraction joints of 20 mm depth shall be formed every 5 m of edge restraint length.

Backfilling

After placing, the concrete shall be left to harden for at least 3 days unless otherwise directed by the Superintendent.

The spaces at the back of the edge restraint shall then be backfilled with earth, compacted in layers not greater than 150 mm thick, then topsoiled to meet surrounding of design levels.

3.5 SAND BEDDING COURSE

Allowance levels

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 20–25 mm layer following final compaction of the segmental paving.

Depressions

Any depressions in the screeding sand exceeding 5 mm shall be loosened, raked and rescreeded before laying paving units.

Compaction

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.

Screeding

Screeded sand left overnight and subject to rain shall be checked for level and rescreeded where necessary before pavers 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.

3.6 LAYING PAVERS

Placement and jointing

Pavers shall be uniformly placed on the screeded sand bedding to the nominated laying pattern.

Pavers shall be placed so that they are not in direct contact with each other and shall have uniform 3 mm nominal joint widths.

The pavers shall be mixed between various pallets to ensure that any colour variation from one pallet of pavers to the next is evenly distributed over the entire paved area.

Joint tolerance

On completion of subsequent bedding compaction and joint filling operations, all joints shall have widths within the range 2–4 mm.

Sequence

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 pavers in the completed pavement.

Odd shapes

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.

Cut pieces of pavers which are smaller in size than one quarter of a full block shall not be used.

Penetrations

Access chambers, drainage gullies and similar penetrations in the pavement shall be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

Paving over joints in underlying concrete pavement

Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, a joint is to be provided in the pavers.

The joint shall consist of 10 mm thick preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

Construction traffic

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.

3.7 BEDDING COMPACTION

Compaction

After laying the pavers 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 all pavers form a smooth surface with adjacent paver edges matching.

The level difference between the adjoining edges of any two pavers shall be a maximum of 2 mm, to avoid trip hazards, unless approved otherwise by the Superintendent for rough textured pavers.

Damage

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.

Progressive compaction

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.

Finished levels

The finished surface level shall not vary from the design level at any point laid in any direction, by more than ±6 mm for all areas with Class 4 clay or 80 mm thick concrete segmental pavements and ±8 mm for all other areas of segmental paving.

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 3 metre straight edge laid in any direction, except at grade changes, by more than 6 mm for road pavements and 8 mm for all other areas of segmental paving.

Drainage inlets

The channels formed between abutting chamfered units shall finish with their inverts not less than 5 mm nor more than 10 mm above adjacent drainage inlets.

Work sequence

All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.

3.8 FILLING JOINTS

Timing

As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.

Sand moisture content
To ensure complete filling of the joints, both the filling sand and pavers shall be as dry as practicable when sand is spread and broomed into the joints.

Process
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.

3.9 PROTECTION OF WORK

Other than foot and barrow traffic, wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until compaction and joint filling operations have been completed.

3.10 OPENING TO TRAFFIC

Traverse greatest area
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 of pavement to assist in the development of 'lock-up'.

Excess sand
Excess joint filling sand shall be removed prior to opening to traffic.

Inspections joint filling until expiry of defects liability period
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.

4 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this worksection are summarised in Table 4.1.

Table 4.1 Summary limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Base		
- Surface Level	Finished level of base for road pavements to be within +10 mm or –0 mm of design levels.	**Base**
	Finished level of base other than for road pavements, to be within ±10 mm of design levels.	**Base**
	The top surface of the base for all segmental paving shall not deviate from a 3 m straight edge, laid in any direction, by more than 10 mm.	**Base**
Laying paving units		
- Joint widths	Within the range 2–4 mm.	**Laying pavers**
Completed segmental paving		
- Surface level	Finished surface level of pavers shall not vary from design levels by more than ±6 mm for road pavements and ±8 mm for other than road pavements.	**Bedding compaction**
	Finished surface of pavers shall not deviate from a 3 m straight edge, laid in any direction, by more than 6 mm for road pavements and 8 mm for other than road pavements.	**Bedding compaction**
- Level adjacent to drainage inlets	Invert level of channels between abutting chamfered units shall be not less than 5 mm and not more than 10 mm above the level of adjacent drainage inlets.	**Bedding compaction**
- Difference in level of adjacent pavers	≤2 mm	**Bedding compaction**

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in the Worksection on a schedule of rates basis in accordance with Pay Items 1145.1 to 1145.3 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Excavation and preparation of subgrade is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

Subbase and Base are measured and paid in accordance with 1113 *Stabilisation*, 1141 *Flexible pavements* and 1132 *Mass concrete subbase*, as appropriate.

Kerb and/or gutter is measured and paid in accordance with 1121 *Open drains, including kerb and channel (gutter)*.

Edge strips are measured and paid in accordance with this Worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with 0310 *Minor concrete works*.

5.2 PAY ITEMS

1145.1 Edge strips

The unit of measurement shall be the linear metre measured along the length of the edge strip.

The schedule rate shall include all activities involved in the excavation, forming, concreting, contraction joints, backfilling and compaction adjacent to the completed edge strip.

1145.2 Segmental paving—Road pavements

The unit of measurement shall be the square metre of surface of segmental paving for road and driveway pavements.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate shall include all activities involved in the supply, laying and compaction of segmental paving units, bedding sand and joint filling sand, including any cutting of units, joints overlying concrete pavement joints, and concrete surrounds or aprons around surface penetrations.

1145.3 Segmental paving—Other than road pavements

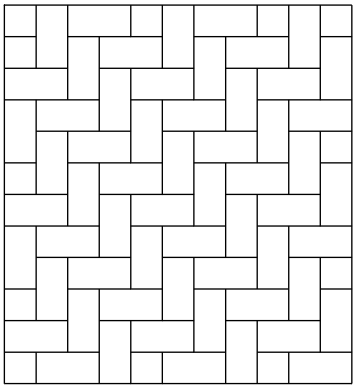
The unit of measurement shall be the square metre of surface of segmental paving for other than road pavements, including medians, traffic islands, footpaths, cycleways and other pedestrian areas.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

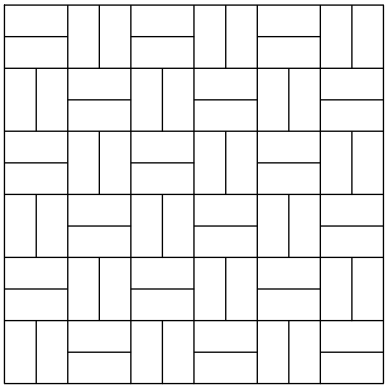
The schedule rate shall include all activities involved in the supply, laying and compaction of segmental paving units, bedding sand and joint filling sand, including any cutting of units, joints overlying concrete pavement joints, and concrete surrounds or aprons around surface penetrations.

6 ANNEXURE A

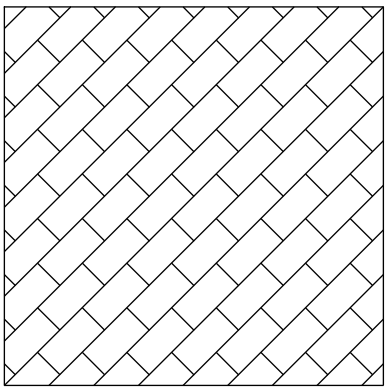
6.1 LAYING PATTERNS



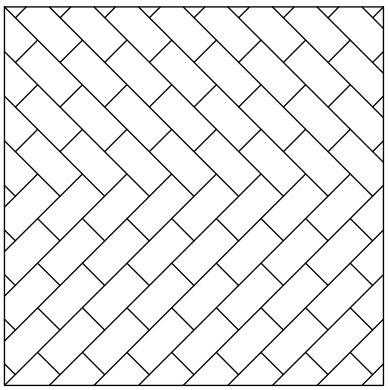
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond

1146 BITUMINOUS MICROSURFACING

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carparks, cycleways and footpaths.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

1143 Sprayed bituminous surfacing

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.12	Materials finer than 75 μm in aggregates (by washing)
AS 1141.22	Wet/dry strength variation
AS 1141.23	Los Angeles value
AS 1141.25.1	Degradation factor—Source rock
AS 1141.25.2	Degradation factor—Coarse aggregate
AS 1141.25.3	Degradation factor—Fine aggregate
AS 1141.42	Pendulum friction test
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.7.1	Soil classification tests—Determination of the sand equivalent of a soil using a power-operated shaker
AS 1348	Glossary of terms—Roads and traffic engineering
AS 2008	Residual bitumen for pavements
AS 2350 (various)	Methods of testing Portland and blended cements
AS/NZS 2891	Methods of sampling and testing asphalt
AS/NZS 2891.3.1	Bitumen content and aggregate grading—Reflux method

Other publications

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

1.4 TERMINOLOGY

Default terms
Users of this worksection should be aware that where terms are not specifically defined in the following section, AS 1348 should be the default Standard.

Polymer modified binder
Bituminous microsurfacing is one of two types of bituminous slurry surfacing. It is distinguished from the other type, slurry seals, by the incorporation of polymer and other additives to the bituminous binder to improve the performance of the slurry surfacing.

Proprietary names
Bituminous microsurfacing is also commonly known under various proprietary names such as 'cold overlay', 'microsealing', 'paveseal', 'microasphalt', etc.

Size
The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this worksection, the size shall be either Size 5 or Size 7.

1.5 BITUMINOUS SLURRY

Materials
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.

Size and extent
The size, nominal thickness, and extent of bituminous microsurfacing shall be as shown on the Drawings or as directed by the Superintendent.

Preceded by sprayed bituminous seal
For all new works on road and carpark pavements, this worksection should be read in conjunction with 1143 *Sprayed bituminous surfacing*.

For new works on road and carpark pavements, bituminous mircrosurfacing 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.

2 MATERIALS

2.1 BINDER

Polymer Modified Bitumen Emulsion
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 **Mix properties** and **Surface texture**.

Specification
Prior to emulsification, incorporation of polymer and additives, the bitumen shall comply with AS 2008.

Verification
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.

2.2 MINERAL AGGREGATES

Material
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 form clay, dirt, organic material or other deleterious matter.

Aggregate properties
The aggregate from each source shall comply with the requirements given in Table 2.1.

Table 2.1 Aggregate properties

Property	Test method	Requirement
Degradation factor	AS 1141.25.1	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

Grading limits

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 2.2.

Table 2.2 Grading limits for combined aggregate/filler

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

Aggregate source and test reports submission

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.

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.

2.3 MINERAL FILLER

Material

Mineral filler shall consist of hydrated lime, flyash, portland cement, or other material approved by the Superintendent.

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 2350.

Proportion

The quantity of filler added to the bituminous microsurfacing during placement shall not vary by more than 1% of the total aggregate (by mass) from the filler content nominated in the mix design.

2.4 WATER

Water added to the bituminous microsurfacing shall be potable and shall be compatible with the component materials.

2.5 ADDITIVES

Details of the type, source and nominal proportions of additives shall be submitted to the Superintendent with the mix design.

2.6 SAMPLING AND TESTING OF MATERIALS

Sampling and testing of materials shall be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods.

All costs associated with sampling and testing of materials shall be borne by the Contractor.

3 MIX DESIGN

3.1 MIX PROPERTIES

The nominated mix design shall satisfy the properties given in Table 3.1.

Table 3.1 Mix properties

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 6 day	800 g/m^2 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)

3.2 APPROVAL

Nominated mix

At least seven days before commencing bituminous microsurfacing work, the Contractor shall submit to the Superintendent for approval, details of the nominated bituminous mircrosurfacing mix design for the work including the target application rate (m^3 of mix/m^2 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 Worksection.

Nominated mix details

The details of the nominated mix design shall include the following:

- Bitumen emulsion content of the mix, and the residual binder content of the emulsion;
- Target combined aggregate/filler grading;
- Proportions of constituent materials used; and
- Type and sources of aggregates, filler and binder.

Approved mix

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 grading and approved binder content

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.

4 PRODUCTION AND PAVING

4.1 PRODUCTION MIX

Bituminous microsurfacing produced in the paving unit at the site shall be known as the ‘production mix’.

The production mix shall comply with the requirements given in Table 4.1.

Table 4.1 Maximum permitted variations from approved mix

Production mix properties	Maximum permitted variations from approved mix (by mass)	
	Size 5	Size 7
Grading*		
Passing 9.50 mm AS sieve and larger Passing 6.70 mm Passing 4.75 mm Passing 2.36 mm and 1.18 mm Passing 0.600 mm Passing 0.300 mm Passing 0.150 mm Passing 0.075 mm	Nil Nil ±6% ±5% ±4% ±3% ±2% ±1.5%	Nil ±7% ±6% ±5% ±4% ±3% ±2% ±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 2.2.		

4.2 PAVING UNIT CALIBRATION

Calibration

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.

Documentation

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.

Approval by Superintendent

No paving unit shall be allowed on the work until the calibration has been verified and approved by the Superintendent.

4.3 PREPARATION FOR APPLICATION AND CLEANUP

Cleaning

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 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.

Protection of other surfaces and services

The Contractor shall take all necessary precautions to prevent the bituminous microsurfacing or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, bridge or culvert decks or other road fixtures.

Cleanup

After the bituminous microsurfacing has been spread the Contractor shall clean off any such material and leave such gratings, access chamber covers and other road fixtures, in a clean and satisfactory condition.

4.4 WEATHER LIMITATIONS

Temperature

Bituminous microsurfacing shall not commence if either the pavement or air temperature is below 10°C and falling.

Bituminous slurry may be applied when both pavement and air temperatures are above 7°C and rising, or above 10°C.

Rain
Spreading shall not proceed during rain or when rain appears imminent.

4.5 SPREADING

Water fog spray
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.

Applicator
Bituminous microsurfacing shall be mixed and applied using a purpose built paver.

Mix consistency and water addition
The 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 microsurfacing in the corners of the spreader box.

Mixing time and rate
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.

Application rate
The strike-off 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.

Rolling
After the emulsion has broken and the mix is sufficiently stable, rolling shall be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface where there is insufficient local traffic to achieve satisfactory compaction across the mat.

Cleanup
After the bituminous microsurfacing has been spread, the Contractor shall ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, etc are uncovered and left in a clean and satisfactory condition.

Traffic
Bituminous microsurfacing shall be capable of carrying slow moving traffic (<40 km/h) within one hour of application without permanent damage occurring, such as rutting or ravelling. When the time before the microsurfacing is capable of carrying traffic exceeds one hour, work shall cease unless specifically approved by the Superintendent.

4.6 SURFACE TEXTURE

Uniform texture
The resulting surface after spreading shall be uniform in appearance, and free of areas exhibiting segregation or excessive or insufficient binder.

Test run
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.

Increased texture
Where increased surface texture is required, a fabric skirt may be trailed behind the spreader box.

4.7 JOINTS

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.

4.8 SAMPLING AND TESTING OF PRODUCTION MIX

Lots

Compliance sampling and testing of bituminous microsurfacing shall be undertaken on a lot by lot basis.

For this purpose, 50 m3 or one day's production (whichever is the lesser), or such smaller quantity which is considered as representative of consistent production of the paving unit, shall be considered as representative of consistent production of the paving unit.

Responsibility for sampling

The Contractor shall be responsible for taking samples and shall supply all facilities, equipment and labour for that purpose.

The costs associated with taking samples of production mix shall be borne by the Contractor.

Frequency of sampling

For the testing of production mix, two 1.5 kg representative samples of bituminous microsurfacing shall be taken from each lot at random intervals. The samples shall be taken from the discharge of the paving unit and the sample containers immediately sealed.

For the testing of the binder, two 2 L samples of bitumen emulsion shall be taken from each bulk delivery in accordance with AS 1160.

Mix tests

The samples of bituminous microsurfacing shall be treated and tested at a NATA registered laboratory to confirm compliance with Table 4.1.

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.

Emulsion tests

Each delivery of emulsion shall be tested for residual binder content in accordance with AS 1160 Appendix D and accompanied by a certification of worksection compliance traceable to the relevant batch at the suppliers storage tank.

4.9 LEVEL AND SHAPE TOLERANCES

Level

Where a correction and wearing course have been placed, the finished surface level shall not vary from the design level at any point by more than ±10 mm.

Additionally immediately adjacent to any kerb and/or gutter the finished surface level shall not be below nor more than 10 mm above the level of the lip of the adjacent gutter.

Shape

Notwithstanding the above, the deviation from a 3 m long straight edge placed anywhere on the top of the finished surface shall not exceed 10 mm when assessed within 24 hours of work completion.

4.10 NONCONFORMANCE OF MATERIALS AND FINISHED SURFACING

If any materials supplied fail to conform to the requirements in this worksection or if any section of bituminous microsurfacing fails to conform to the requirements of this worksection, 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.

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 worksection.

4.11 CONTROL OF TRAFFIC

The Contractor shall provide for traffic in accordance with 1101 *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 work has developed sufficient strength to carry normal traffic without damage.

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.

5 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 5.1.

Table 5.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection reference**
Mineral aggregate	As per Table 2.1	**Mineral aggregates**
Combined aggregate/filler	As per Table 2.2	**Mineral aggregates**
Mineral filler	> 85% passing a 75 μm sieve	**Mineral filler**
Mix properties		
- Design properties	As per Table 3.1	**Mix properties**
- Permitted variations	As per Table 4.1	**Production mix**
Surface preparation	Sweeping shall extend at least 300 mm beyond edge of area to be surfaced	**Preparation for application and cleanup**
Weather limitations	Microsurfacing shall not commence if either air or pavement temperature is below 10°C and falling, and shall only commence if both air and surface temperature is above 7°C and rising or above 10°C	**Weather limitations**
Shape and levels		
- Finished levels	Shall not vary at any point by more than ±10 mm from design levels. Immediately adjacent to kerb and/or gutters, levels shall not be below nor more than 10 mm above design level	**Level and shape tolerances**
- Finished shape	Deviation from the bottom of a 3 m straight edge shall not vary by more than 10 mm	**Level and shape tolerances**

6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this worksection in accordance with Pay Items 1146.1 and 1146.2.

A lump sum price for any of these items will not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

6.2 PAY ITEMS

1146.1 Size 5 bituminous microsurfacing

The unit of measurement shall be the cubic metre of the combined mix as spread on the road surface.

The volume of the combined mix in cubic metres shall comprise the volume of the dry mineral aggregate (excluding filler) used in completing the works recorded by the paving unit.

Documentation of the calibration of this measure shall be made available to the Superintendent and shall be subject to Superintendent's approval.

The schedule rate shall include preparation of the surface, mix design, all sampling and testing, supply of all materials to site, and loading, mixing and spreading the bituminous microsurfacing including finishing, joint treatment and clean-up.

1146.2 Size 7 bituminous microsurfacing

The unit of measurement shall be the cubic metre of the combined mix as spread on the road surface.

The volume of the combined mix in cubic metres shall comprise the volume of the dry mineral aggregate (excluding filler) used in completing the works recorded by the paving unit.

Documentation of the calibration of this measure shall be made available to the Superintendent and shall be subject to Superintendent's approval.

The schedule rate shall include preparation of the surface, mix design, all sampling and testing, supply of all materials to site, and loading, mixing and spreading the bituminous microsurfacing including finishing, joint treatment and clean-up

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1151 ROAD OPENINGS AND RESTORATION

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the clearing, excavation, backfilling and restoration activities associated with the installation of Council and/or public utility services within public road reserves or other reserves under the control of the Council.

The worksection shall apply to Works under Contract where the Principal to the Contract is either:

- The Council.
- The relevant Public Utility Authority for the works under execution.

This worksection excludes the installation activities of the relevant public utility service.

1.2 DEFINITIONS

For the purposes of this worksection the definition of terms used to define the components of the road reserve shall be in accordance with AS 1348.

The terms are:

- Carriageway: That portion of a road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes.
- Clearing: The removal of vegetation or other obstacles at or above ground.
- Footpath: The paved section of a pathway used exclusively by pedestrians.
- Pathway: A footpath, bicycle path, or other area constructed or developed by Council for use by members of the public other than with a motor vehicle.
- Pavement: That portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
- Shoulder: The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
- Verge: That portion of the formation not covered by the carriageway or footpath.

1.3 UTILITY SERVICES UNDER CONCRETE PAVEMENTS

Installation of utility services by open trenching methods in carriageway concrete pavements shall not be permitted without the prior approval of the Superintendent, or Council in the case where the Utility Authority is the Principal in the Contract.

Utility services under carriageway concrete pavements shall be installed in accordance with 1392 *Trenchless conduit installation*.

1.4 ADDITIONAL WORK ADJACENT TO THE WORKS

The Council may require removal and restoration to footpaths and/or carriageway pavements, adjacent to the Works, in addition to the removal and restoration requirements of the scope of this worksection.

Such additional work shall be identified and defined by Council's Restoration Officer at the Set Out Inspection and Approval **Hold Point** of the Contract.

In this case, payment for the additional removal and restoration activities shall be made as a Variation to the Contract at the schedule rates for the particular activities.

1.5 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.6 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0179 General Requirements (Construction)

1101 Control of traffic

1141 Flexible pavements

1142 Bituminous cold mix

1143 Sprayed bituminous surfacing

1144 Asphaltic concrete (Roadways)

1145 Segmental paving

1392 Trenchless conduit installation

Standards

AS 1289	Methods for testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 1289.6.1.2	Soil strength and consolidation tests—Determination of the California Bearing Ratio of a soil—Standard laboratory method for an undisturbed specimen
AS 1348	Road and traffic engineering—Glossary of terms
AS 1742	Manual of uniform traffic control devices
AS 1742.3	Traffic control devices for works on roads

Other publications

Street Openings Conference

Guide to codes and practices for street openings, 2007

1.7 PROVISION FOR TRAFFIC

Safety and traffic obstruction

The Contractor shall construct the Works in a safe manner with the least possible obstruction to traffic, both vehicular and pedestrian.

Guidance scheme

The Contractor shall submit a Traffic Management Plan and carry out all activities for controlling traffic, both vehicular and pedestrian, in accordance with 1101 *Control of traffic*.

Access to properties adjacent to the works

Safe, all weather vehicular and pedestrian access to properties shall be maintained wherever possible.

Notice of 48 hours shall be provided to property owners whose access will be restricted.

2 SET OUT OF WORKS

2.1 INITIAL LIMITS

The Contractor shall set out the limits of the proposed excavation for trenches, pits and chambers required for the utility service installation. The set out shall be in chalk or crayon so as to be readily understandable by Council's Restoration Officer and will not permanently deface any surface.

2.2 ADJUSTED LIMITS

In order to minimise or eliminate residue small portions of paving slabs the set out shall be adjusted as necessary. Any adjustments will be with respect to the existing paved surfaces and joint patterns. Adjustments shall be in accordance with **Pathways** and **Carriageways**.

2.3 PATHWAYS

The set out line shall be varied in accordance with the reinstatement requirements of the Street Opening Conference's publication Guide to codes and practices for street openings

Codes and Practices as follows:

- Bitumen and concrete paving—In accordance with the reinstatement provisions and sketches of the above guide.
- Segmental paving units—The set out line shall be at least one whole unit clear of both sides of the minimal alignment of the trench.
- Textured or patterned concrete—The set out line shall be as determined by Council's Restoration Officer in conjunction with the Contractor's surveyor.

Where the Superintendent directs that driveways are not to be disturbed, the utility services under driveways shall be installed in accordance with 1392 *Trenchless conduit installation*.

2.4 CARRIAGEWAYS

Minimum width

In asphalt pavements, the proposed trench set out shall be at the minimum width for the depth of service and, wherever possible, shall be at right angles to the road reserve boundary.

Survey marks

Any trench or surface work proposed in the vicinity of Permanent or State Survey Marks shall be referred to the Land Information Centre of the Department of Land and Water Conservation, prior to commencement or Work, to obtain protection or relocation requirements.

Approval of set out

The set out line shall be presented to the Superintendent for approval prior to the commencement of any surface clearing work.

The Superintendent and Council's Restoration Officer shall inspect and approve the set out, and define any additional removal and restoration work required by Council.

3 SURFACE TREATMENT REMOVAL

3.1 SAWCUT OF CONCRETE AND ASPHALT PAVEMENTS

Trench set out lines located on concrete or asphalt footpaths, and asphalt carriageway pavements, shall be sawcut for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Where a concrete subbase is found, upon removal of segmental pavers, it shall also be sawcut along the trench set out lines.

3.2 REMOVAL OF CONCRETE AND ASPHALT

Concrete or asphalt footpath and carriageway pavement material shall be broken out, between the trench set out lines, removed and legally disposed of off-site by the Contractor or stockpiled at a site nominated by the Superintendent.

3.3 PAVERS

Segmental paving units both full and cut, between the trench set out lines, shall be taken up by hand and neatly stacked on wooden pallets at locations as directed by the Superintendent.

Any dimension stone kerb and gutter units within the set out lines shall also be taken up and stacked in a similar manner.

3.4 PAVER EDGING

Concrete edging, associated with the lifted segmental pavers, shall be broken out, removed and legally disposed of off-site by the Contractor or stockpiled at a site nominated by the Superintendent.

3.5 GRASS

Grass turf, between trench set out lines, shall be neatly cut into squares of approximately 300 mm square, taken up and stored at locations as directed by the Superintendent and shall be watered as directed during the storage period.

If the grass is considered by the Superintendent to be unsuitable for reuse, it shall be removed and legally disposed of off-site by the Contractor.

3.6 PLANTS, SHRUBS, TREES

Small plants, shrubs and trees, between the set out lines, identified as being suitable for replanting shall be taken up and stored at locations nominated by the Superintendent.

The root ball of such plants, shrubs and trees shall be wrapped in a hessian or plastic bag with drain holes and shall be watered as directed during the storage period.

3.7 UNSUITABLE VEGETATION

Other plants, shrubs and trees deemed unsuitable for replanting shall be removed and legally disposed of off-site by the Contractor.

3.8 HOUSE STORMWATER PIPES DISCHARGING TO GUTTERS

House stormwater pipes discharging into carriageway gutters shall be maintained at all times.

Any damage to these pipes caused by the Contractor's activities shall be repaired or replaced to the satisfaction of the Superintendent. The costs of such rectification works shall be borne by the Contractor.

4 EXCAVATION

4.1 TOPSOIL

Before undertaking trench excavation, topsoil which is considered by the Superintendent to be suitable for reuse in the restoration work, shall be removed and stockpiled at a site nominated by the Superintendent.

4.2 TRENCH EXCAVATION

In accordance with drawings

Trenches shall be excavated to the standard widths and depths for the particular utility service installation or to dimensions as shown on the Drawings.

Safety

In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

Approval by other public utility authorities

Where other public utilities exist in the vicinity of the Works, the Contractor shall obtain the approval of the relevant authority to the method of excavation before commencing excavation.

The locations of existing underground services shall be established by exploratory excavation prior to the principal trench excavation.

Proof of approval of the relevant authority shall be provided to the Superintendent, if requested.

Location of services

The 'Dial Before You Dig' Service, telephone 1100, shall be contacted to obtain locations of water, sewer, stormwater, gas, electricity and telephone services.

Services verification

The Utility Authorities' contact names listed in 0179 *General Requirements (Construction)* shall also be contacted to verify the location of services.

Retired services

Existing retired services shall be excavated and removed off-site and legally disposed of by the Contractor. The resulting excavation shall be backfilled in accordance with **Trench backfill**.

Excavation level

Trench or foundation excavation shall be undertaken to the planned level for the bottom of the specified bedding or foundation level or such other depth as directed by the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the trench or foundation level is required prior to the release of the **Hold Point**.

Excavated material stockpiles

The excavated earth and rock material shall be segregated and stockpiled, at sites nominated by the Superintendent, for reuse in backfilling operations.

Excavated material shall not, at any time, be stockpiled against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Where stockpiling is not permitted the excavated material shall be legally disposed of off-site.

Disposal of unsuitable material

Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable shall be removed and legally disposed of off-site by the Contractor and replaced with backfill material in accordance with the requirements of this worksection.

The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be aligned at the specified level and slope of the utility service.

4.3 PROTECTION OF TREES

Protected during works

Existing trees shall be protected from all damage during the Works.

Materials clear of trees

The Contractor shall not store, stockpile, dump or otherwise place under or near trees bulk materials and harmful materials including oil, waste concrete, clearings, boulders and the like and shall prevent wind blown materials from harming trees and plants.

No attachments

The Contractor shall not attach stays, guys and the like to trees and shall prevent damage to tree bark.

Work near trees

When working near trees the Contractor shall not remove topsoil from within the drip line of trees unless otherwise specified or directed.

Where it is necessary to excavate within the drop line, hand methods or trenchless methods, such that root systems are preserved intact, shall be used.

The duration of open excavations under tree canopies shall be determined by the Superintendent at the time of the excavation and shall comply with the requirements of the Superintendent.

Tree roots

The Contractor shall not cut tree roots exceeding 50 mm in diameter without the approval of the Superintendent.

Where it is necessary to cut tree roots, a saw or similar means shall be used such that the cutting does not unduly disturb or rock the remaining root system.

Immediately after cutting, an approved bituminous fungicidal sealant shall be applied to the cut to prevent the incursion of root disease.

5 BACKFILL

5.1 BEDDING, HAUNCH, SIDE AND OVERLAY ZONES

Bedding material for the bed, haunch, side and overlay zone shall be to the requirements, and shall be installed in accordance with the worksection, for the particular utility service being installed.

The overlay zone is defined as that part of the trench backfill immediately over the utility service for a maximum of 300 mm. With the side zones material, overlay zone material typically comprises selected backfill compacted in accordance with **Compaction**.

5.2 TRENCH BACKFILL

Approved material

Between the overlay zone and the top of subgrade, the trench shall be backfilled with 14 to 1 moist sand/cement mix using washed river sand or non-cohesive backfill material approved by the Superintendent in layers as directed. Backfill material shall be nominated for approval of the Superintendent at least 7 days prior to commencement of work.

Imported material

Where the trench excavation material has been disposed of off-site, the trench shall be backfilled with imported backfill material, from a source approved by the Superintendent, free of tree stumps and roots and capable of being compacted in accordance with **Compaction**.

Selected material zone

Where excavation is through a selected material zone below the subbase layer, the section of trench within the select material zone shall be backfilled with selected material free from stone larger than 100 mm maximum dimension and the fraction passing a 19 mm AS sieve shall have a 4 day soaked CBR value, in accordance with AS 1289.6.1.2, not less than that of the adjacent selected material zone.

Tree roots

Except in carriageway pavements, backfilling, for a minimum 300 mm thickness, around tree roots shall consist of a topsoil mixture approved by the Superintendent, placed and compacted in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Backfill at trees

The Contractor shall not place backfill material above the original ground surface around tree trunks or over the root zone unless approved by the Superintendent.

Watering of root zone

Immediately after backfilling the tree root zone shall be thoroughly watered.

5.3 COMPACTION

Criteria

Backfill shall be compacted to the requirements of Table 5.1 when tested in accordance with AS 1289.5.4.1 for modified compactive effort:

Table 5.1 Compaction

Layer	Relative compaction
Foundations or trench base to a depth of 150 mm below foundation levels	92%
Material replacing unsuitable material	92%
Bedding material	92%
Selected backfill and ordinary backfill material	
– below 1.5 m of finished surface	92%
– within 1.5 m of finished surface	97%
Backfill material within the selected material zone	97%

Layers

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

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (modified compaction).

Testing

The Contractor shall arrange for compaction testing in accordance with AS 1289.5.7.1 on the completed backfill and shall submit the results of such tests to the Superintendent within 2 weeks of

the tests being performed. Compaction tests shall be undertaken by the Contractor at a minimum frequency of 1 per every second layer per 50 square metres of backfill surface area.

Precautions

When compacting adjacent to utility services, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any utility service.

6 RESTORATION

6.1 GENERAL

Equivalent condition

Carriageway pavements and pathways shall be restored in a continuous manner to a condition equivalent to that existing at the commencement of the Works as determined by Council's Restoration Officer.

Surface pits, etc

Utility service surface pits, access chamber frames and lids, etc, shall be set such that carriageway pavements and footpaths can be restored to original levels.

The Contractor shall liaise with other utility authorities should any other utility service surface box be required to be adjusted or replaced prior to restoration.

Approval before paving

The Contractor shall form up and prepare the areas for paved restoration and present the prepared areas to the Superintendent for approval prior to the commencement of any paving restoration work.

This action constitutes a **Hold Point**.

The Superintendent and Council's Restoration Officer shall inspect and approve the prepared areas, and verify any additional restoration work required by Council, prior to the release of the **Hold Point**.

6.2 TEMPORARY PAVEMENT

Carriageways

Immediately after backfilling to subgrade level the carriageway pavement shall be temporarily restored and re-opened to traffic, if the planned date for final restoration exceeds 5 days.

Temporary restoration shall consist of either:

- Bituminous cold mix, of a maximum thickness 50 mm, on a base of compacted crushed stone, gravel or other material approved by the Superintendent.
- Steel plating, over the trench, of sufficient thickness to support traffic loadings and suitably secured with pins or bituminous cold mix to the satisfaction of the Superintendent.

Where steel plating is used, advance warning signs shall be provided in accordance with AS 1742.3.

Footpaths, including driveways

Immediately after backfilling to subgrade level the footpaths, including driveways, shall be temporarily restored and re-opened for pedestrian use, if the planned date for final restoration exceeds 2 days.

Temporary restoration shall consist of bituminous cold mix, of maximum thickness 50 mm, or other material approved by the Superintendent.

6.3 CARRIAGEWAY SUBBASE AND BASE

Remove Temporary Pavement

Prior to final carriageway pavement restoration, the temporary pavement material shall be removed and disposed of off-site by the Contractor.

If approved by the Superintendent, the temporary base material may remain in place and be incorporated into the final pavement. In any case the asphaltic material shall be removed and disposed of off-site by the Contractor.

Material

Subbase and base shall consist of crushed rock, DGS20 or DGB20 material, from a source approved by the Superintendent and configured in layers and depths as indicated in Annexure A. Subbase and base layers shall be supplied and installed in accordance with 1141 *Flexible pavements*.

Uniform compaction

Each layer of the subbase and base courses shall be uniformly compacted over the full area and depth within the trench to a relative compaction of 100 per cent when tested in accordance with AS 1289.5.4.1.

Compaction tests shall be undertaken by the Contractor at a minimum frequency of 1 per every second layer per 50 square metres of restoration surface area.

6.4 CARRIAGEWAY BITUMINOUS WEARING SURFACE

Specification

The bituminous wearing surface shall meet the requirements set out in Annexure A. Bituminous wearing surface shall also be supplied and laid in accordance with 1143 *Sprayed bituminous surfacing* or 1144 *Asphaltic concrete (Roadways)*, as applicable.

Surface tolerance

The evenness of the resulting restored surface shall be such that when tested with a 3 m straightedge, seven to ten days after completion, departures from the straightedge are less than ±5 mm and the surface is such that an impact is not transmitted to traffic passing over the restoration.

Tack coat limits

The bituminous surfacing tack coat for asphalt or seal coat for sprayed bituminous seals shall present a waterproof surface at application.

This bituminous surfacing shall extend a minimum dimension of 100 mm beyond the perimeter of any trench excavation.

Asphalt limits

Asphalt placed as restoration shall extend in plan a minimum dimension of 100 mm beyond the perimeter of any trench excavation.

Joint

The joint between new and existing asphalt shall be vertical and cut by diamond saw or milling machine.

The vertical face and subgrade surface of the old asphalt shall be treated by bituminous tack coating.

Thickness tolerance

The thickness of asphalt at any point shall not vary from the specified layer thickness by more than +10 mm or less than –0 mm.

6.5 PATHWAYS

Materials

Pathways, and other public areas, shall be restored with materials consistent with the existing surface before commencement of the Works, or as directed by the Superintendent.

Remove temporary material

Prior to final footpath restoration, the temporary pavement material shall be removed and disposed of off-site by the Contractor. If approved by the Superintendent, the temporary material may remain in place and be incorporated into the final subbase.

Subbase Material

All paved footpaths, and paved areas, shall be constructed on a subbase of 150 mm crushed stone DGB20 compacted to 100 percent relative compaction in accordance with AS 1289.5.4.1.

Patches

For restoration patches in footpath surfaces, the surface level at any point along the patch's edge shall match the adjoining footpath surface within ±2 mm.

Concrete footpaths, including textured and patterned concrete

Match existing footpaths: Concrete footpaths shall be constructed in 20 MPa concrete to the same thickness (with a minimum of 100 mm), surface finish and pattern as the adjoining footpaths and driveways as appropriate or as directed by the Superintendent.

Expansion joints: In concrete footpaths, expansion joints consisting of a 15 mm thick preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent shall be placed where new concrete abuts existing concrete and in line with joints in existing concrete.

Control joints: The joints shall be formed strictly in line with the control joints in existing concrete.

Electricity supply poles: Around electricity supply poles, the concrete paving shall be terminated 200 mm from the pole and the resulting space filled with cold mix asphalt.

Asphalt footpaths

Asphalt footpaths shall consist of asphalt in accordance with 1144 *Asphaltic concrete (Roadways)*, or 1142 *Bituminous cold mix*, where nominated by Council's Restoration Officer, and shall be constructed to the same thickness as the adjoining footpath and compacted to a smooth even surface.

Segmental paving units

Specification: All activities associated with the restoration of segmental paving units shall comply with 1145 *Segmental paving*.

Match existing: Existing paving units, taken up and stored, shall be relaid to match the pattern and surface levels of the existing paving.

Damaged units replaced: Cut or damaged paving units which are unsuitable for relaying, as determined by the Superintendent, shall be replaced with new units.

Such new paving units shall be supplied by the Contractor and shall be of the same material, type, size and colour as the existing paving units.

Paving: The paving pattern at tree surrounds, service boxes, poles, etc, shall match the pattern at similar existing features in the immediate area or be as directed by the Superintendent in consultation with Council's Restoration Officer.

6.6 GRASS TURF VERGES

Topsoil bed

A bed of stockpiled topsoil, of minimum thickness 50 mm, shall be placed on the subgrade prior to restoration of turfed verges.

Relay grass turf

Existing grass turf, taken up and stored, shall be relaid to conform with the original grassed surface.

Turfs shall be hard butted against each other in rows and the seams topdressed with topsoil.

Turf shall be rolled and watered to ensure direct and uniform contact with the topsoil.

Additional turf

Any additional turf required to fully restore grassed verges shall be supplied by the Contractor and shall be the same type as the existing grass.

6.7 VERGE PLANTS, SHRUBS AND TREES

Topsoil Bed

Stockpiled topsoil shall be placed on the subgrade to the same thickness as the surrounding topsoil, prior to replanting.

Planting holes shall be excavated, at locations determined by the Superintendent in consultation with Council's Restoration Officer, and the material spread evenly around each hole.

Replanting

Existing plants, shrubs and trees, taken up and stored which are suitable for replanting as determined by the Superintendent, shall be replanted in the prepared holes.

Compacted, staked and watered

The planting hole shall be backfilled with topsoil and compacted by foot up to surface level.

The shrubs and trees shall be staked as directed by the Superintendent, watered and maintained for 2 months after the date of formal completion of the restoration works.

6.8 CLEANUP

Upon completion of all restoration Works, the areas affected by the Works and associated construction activities shall be cleaned up and restored to a condition equivalent to that existing at the commencement of the Works.

All formwork, rubbish and residue construction materials, including material left at stockpiles, shall be legally disposed of off-site by the Contractor.

The Contractor shall present the cleaned up restoration works to the Superintendent for approval.

This action constitutes a **Hold Point**.

The Superintendent's approval is required prior to the formal completion of the restoration works.

6.9 WORK-AS-EXECUTED DRAWINGS

The Contractor shall supply the Superintendent with fully marked-up Work-as-Executed Drawings for the whole of the Contract within 2 weeks of approval of the restoration works by the Superintendent.

Prints of the Contract Drawings will be supplied by the Principal free of charge for this purpose.

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1151.1 to 1151.16, inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Provision for traffic, both vehicular and pedestrian, shall be deemed to be included in the schedule rates generally in accordance with 1101 *Control of traffic*.

Segmental paving works are measured and paid in accordance with this worksection and not

1145 *Segmental paving*.

Trenchless installation of utility services under driveways is measured and paid in accordance with 1392 *Trenchless conduit installation*.

7.2 PAY ITEMS

1151.1 Sawcut existing pavement/footpath

The unit of measurement shall be the linear metre measured along the actual line of cut.

Separate rates shall be given for sawcuts in each type of material:

- 1151.1(1) Bituminous carriageway pavement
- 1151.1(2) Bituminous footpath
- 1151.1(3) Concrete footpath, including textured or patterned concrete.

The schedule rate shall include all activities associated with the sawcutting operations including hire of plant and provision of water.

1511.2 Remove existing pavement/footpath

The unit of measurement shall be the square metre of pavement removed including both bituminous and concrete material and including concrete subbase from segmental paving where applicable.

Separate rates shall be given for:

- 1151.2(1) Removal to stockpile and
- 1151.2(2) Disposal off-site.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate, for 1151.2(1), shall include all activities associated with breaking out, removing, carting and placing into stockpile.

The schedule rate, for 1151.2(2), shall include all activities associated with breaking out, removing, transporting off-site, disposal and any tipping fees applicable.

1151.3 Segmental paving units

The unit of measurement shall be the square metre of surface of segmental paving units taken up or laid.

Separate rates shall be given for:

- 1151.3(1) Take up and stack existing units—Carriageway
- 1151.3(2) Take up and stack existing units—Footpath
- 1151.3(3) Lay existing units—Carriageway
- 1151.3(4) Lay existing units—Footpath
- 1151.3(5) Supply and lay new units—Carriageway
- 1151.3(6) Supply and lay new units—Footpath

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate, for items 1151.3(1) and 1151.3(2), shall include all activities associated with taking up and stacking units on pallets at locations as directed. Concrete subbase, where applicable, shall be removed under 1151.2.

The schedule rate, for items 1151.3(3) and 1151.3(4), shall include all activities involved in the laying and compaction of subbase, including concrete subbase where applicable, and existing segmental paving units, bedding sand and joint filling sand, including any cutting of units, concrete edging, joints overlying concrete pavement joints, and concrete surrounds or aprons around surface penetrations.

The schedule rate, for items 1151.3(5) and 1151.3(6), shall include all activities involved in the laying and compaction of subbase, including concrete subbase where applicable, and supply, laying and compaction of segmental paving units, bedding sand and joint filling sand, including any cutting of units, concrete edging, joints overlying concrete pavement joints, and surrounds or aprons around surface penetrations.

1151.4 Remove existing edge strips

The unit of measurement shall be the linear metre measured along the length of the edge strip.

The schedule rate shall include all activities associated with breaking out, removing, transporting off-site, disposal and any tipping fees applicable.

1151.5 Grass turf

The unit of measurement shall be the square metre of surface of grass turf taken up or laid.

Separate rates shall be given for:

- 1151.5(1) Take up and store existing turf
- 1151.5(2) Lay existing turf
- 1151.5(3) Supply and lay new turf

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate, for item 1151.5(1), shall include all activities associated with cutting, taking up and storing turf at locations as directed.

The schedule rate, for item 1151.5(2), shall include all activities associated with the topsoil bedding, rolling, laying of existing turf and topdressing.

The schedule rate, for item 1151.5(3), shall include all activities associated with the topsoil bedding, rolling, supply and laying of new turf and topdressing.

1151.6 Verge plants, shrubs and trees

The unit of measurement shall be each plant, shrub or tree taken up or planted.

Separate rates shall be given for:

- 1151.6(1) Take up and store existing
- 1151.6(2) Replant existing

The schedule rate, for item 1151.6(1), shall include all activities associated with taking up, storing and watering at locations as directed.

The schedule rate, for Item 1151.6(2), shall include all activities associated with topsoil placement, preparatory work, planting, staking and subsequent care of each plant for 2 months after the date of formal completion of the restoration works.

1151.7 Stockpiling of topsoil

The unit of measurement shall be the cubic metre as bank volume.

The volume shall be calculated by multiplying the area, derived from the width and length as shown on the Drawings or as directed by the Superintendent, by the depth of topsoil directed to be removed by the Superintendent.

The schedule rate shall include all activities associated with stripping topsoil, carting and placing into stockpile.

1151.8 Trench excavation

The unit of measurement shall be the cubic metre as bank volume of excavation.

Separate rates shall be given for:

- 1151.8(1) Excavation to stockpile
- 1151.8(2) Excavation to disposal off-site

The volume shall be calculated by multiplying the width by the depth by the length with width, depth and length defined as follows:

- Width—as specified for the particular utility service installation.
- Depth—average actual depth from topsoil stripped ground surface to underside of specified bedding.
- Length—actual excavation length, centre to centre of pits.

The schedule rate shall be an average rate to cover all types of material encountered during excavation. Separate rates shall not be included for earth and rock.

The schedule rate shall include all activities associated with:

- Excavation, including excavation and replacement of unsuitable material.
- Replacement for over-excavation for any reason.
- Excavation, removal and disposal of retired services, and backfilling of the resulting excavations.
- Protection of trees and treatment to cut tree roots.

The schedule rate, for item 1151.8(1), shall include all activities associated with carting and placing into stockpile.

The schedule rate, for item 1151.8(1), shall include all activities associated with transporting off-site, disposal and any tipping fees applicable.

1151.9 Trench backfill

The unit of measurement shall be the cubic metre measured as backfill compacted volume in place in the trench.

Separate rates shall be given for:

- 1151.9(1) From stockpiled material
- 1151.9(2) From imported material

The volume shall be calculated by multiplying the width by the depth by the length with width, depth and length defined as follows:

- Width—average trench width
- Depth—average actual depth from top of subgrade to top of bedding overlay material around the utility service.
- Length—actual trench length, centre to centre of pits.

The schedule rate shall include all activities associated with backfilling, compaction, testing and treatment around tree roots.

The schedule rate, for item 1151.9(1), shall include all activities associated with loading and carting from stockpile.

The schedule rate, for item 1151.9(2), shall include all activities associated with supply and delivery of imported material, including material for a selected material zone where specified.

1151.10 Temporary pavement—Carriageway and footpath

The unit of measurement shall be the square metre of trench area restored with temporary pavement.

The area shall be calculated by multiplying the trench width by the actual length of temporarily restored pavement.

The schedule rate shall include all activities associated with the supply, delivery, placing and compaction of the base material and bituminous cold mix.

It shall include all activities and material necessary for maintenance of the temporary pavement in a safe condition until the permanent restoration is executed.

1151.11 Temporary steel plating

The unit of measurement shall be the square metre of trench area plus adequate allowance for support on both sides of the trench.

The area shall be calculated by multiplying the trench width by the actual length of trench to be covered.

The schedule rate shall include all activities associated with the hire, delivery, placement, securing and subsequent removal and return to depot of the steel plates. It shall include all activities and materials necessary for maintenance of the plating until permanent restoration is executed.

1151.12 Subbase

The unit of measurement shall be the square metre of trench.

The area shall be calculated by multiplying the trench width by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement, supply, delivery, spreading and compaction in accordance with Annexure A.

1151.13 Base

The unit of measurement shall be the square metre of trench.

The area shall be calculated by multiplying the trench width by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement where no subbase is required, supply, delivery, spreading and compaction in accordance with Annexure A.

1151.14 Bituminous wearing surface

The unit measurement shall be the square metre of new surface area in accordance with this worksection.

The area shall be calculated by multiplying the trench width +200 mm by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement or existing pavement to the new perimeter, supply, delivery, spreading and compaction in accordance with Annexure A.

1151.15 Footpath

The unit of measurement shall be the square metre of paved surface, including driveways.

Separate rates shall be given for:

- 1151.15(1) Asphalt/sprayed bituminous seal
- 1151.15(2) Plain concrete
- 1151.15(3) Textured/patterned concrete

The width and length shall be as shown on the Drawings or as Directed by the Superintendent.

The schedule rate, for item 1151.15(1), shall include all activities associated with the forming, compaction of foundations, supply, delivery and compaction of subbase and bituminous material.

The schedule rate, for items 1151.15(2) and 1151.15(3) shall include all activities associated with the forming, compaction of foundations, supply, delivery and compaction of subbase, supply delivery, placing, finishing and curing concrete, including texturing or patterned finish where applicable.

Where shown on the Drawings or as directed by the Superintendent this pay item shall include the supply and placement of reinforcing steel.

1151.16 Cleanup

The unit of measurement shall be the square metre of carriageway and/or footway surface or other surface as applicable.

The lengths and widths shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate shall include all activities associated with the cleaning up of the Work site, and transporting off-site and disposal of material including any tipping fees applicable.

8 ANNEXURE A

8.1 RESTORATION REQUIREMENTS

Description of Location: ……..

Restoration pavement layers:

Wearing surface type	.....	Thickness (mm)	.....	(or nominal stone size)
Base layer type	.....	Thickness (mm)	.....	
Sub base layer type	.....	Thickness (mm)	.....	
Selected material	.....	Thickness (mm)	.....	

Special requirements (e.g. linemarking, traffic signs, advice to adjacent property owners etc.)

.....

.....

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.....

.....

1152 ROAD OPENINGS AND RESTORATIONS (UTILITIES)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the clearing, excavation, backfilling and restoration activities associated with the installation of public utility services within public road reserves or other reserves under the control of Local Government Authorities.

This worksection is consistent with the objectives of the Streets Opening Conference Information Bulletin on Codes and Practices and the Model Agreement for Local Councils and Utility/Service Providers.

The worksection shall apply to Works under Contract where the Principal to the Contract is the relevant Utility Authority for the works under execution. The Utility Authority may be a Local Council, for Council initiated utility works.

This worksection excludes the installation activities of the relevant public utility service.

1.2 QUALITY

Requirements for quality control and testing are given in **Quality assurance** and *0161 Quality (Construction).*

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0179 General Requirements (Construction)

0250 Open space- landscaping

1101 Control of traffic

1132 Mass concrete subbase

1133 Plain and reinforced concrete base

1134 Steel fibre reinforced concrete base

1135 Continuously reinforced concrete base

1141 Flexible pavements

1142 Bituminous cold mix

1143 Sprayed bituminous surfacing

1144 Asphaltic concrete (Roadways)

1145 Segmental paving

1191 Pavement markings

1392 Trenchless conduit installation

Standards

AS 1289	Methods for testing soils for engineering purposes
AS 1289.5.1.1	Determination of the dry density/moisture content relation of a soil using standard compactive effort
AS 1289.5.2.1	Determination of the dry density/moisture content relation of a soil using modified compactive effort
AS 1289.5.6.1	Compaction control test—Density Index method for cohesionless material
AS 1289.6.1.2	Soil strength and consolidation tests—Determination of the California Bearing Ratio of a soil—Standard laboratory method for an undisturbed specimen
AS 1348	Road and traffic engineering—Glossary of terms

AS 1742	Manual of uniform traffic control devices
AS 1742.3	Traffic control devices for works on roads
AS 4000	General conditions of contract
AS/NZS ISO 8402	Quality management and quality assurance - Vocabulary (available superseded)

Other publications

Street Openings Conference

Guide to codes and practices for street openings, 2007

The Utility Authorities' Specifications

The Model Agreement for Local Councils and Utility/Service Providers

Commonwealth Department of Housing and Regional Development

Australian Model Code for Residential Development. (AMCORD). A National Resource Document for Residential Development—1995:

1.4 DEFINITIONS

For the purposes of this worksection the definition of terms used to define the components of the road reserve, quality activities and Contract participants shall be in accordance with the Australian Standards and definitions adopted as given below:

The text in brackets is additional to the referenced definitions.

The terms are:

- **AS 1348.1**
  - Base (Base course): One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed.
  - Carriageway: That portion of a road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes (and inclusive of medians, traffic facilities and heavy duty driveways).
  - Clearing: The removal of vegetation or other obstacles at or above ground.
  - Footpath: The paved section of a pathway used exclusively by pedestrians (or verge).
  - Pathway: A footpath, bicycle path, or other area constructed or developed by Council for use by members of the public other than with a motor vehicle.
  - Pavement: That portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic (including the subbase and base course).
  - Shoulder: The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
  - Subbase (Subbase course): The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required over the subgrade, or to prevent intrusion of the subgrade into the base, or to provide a working surface on which the remainder of the pavement can be constructed. (The subbase course is often a different quality material to the base course.)
  - Subgrade: The trimmed or prepared portion of the formation on which the pavement is constructed. (Subgrade level is the level immediately below the pavement.)
  - Wearing Course (Surface): The part of the pavement upon which the traffic travels.
- **AMCORD**
  - Verge: That part of the road reserve between the carriageway and the road reserve boundary.
- **AS/NZS ISO 8402 (Available suspended)**
  - **Hold Point** (HP): A defined position in the construction/manufacturing stages of the Contract beyond which work shall not proceed without mandatory verification and acceptance by the Superintendent, or other person approved by the Superintendent.
  - Witness Point (WP): A nominated position in the manufacture/construction stages of the Contract where the option of attendance may be exercised by the Superintendent, after notification of the requirement.
  - Quality Check Lists (Contractor's Checklist): Forms completed during the manufacture/construction process verifying key steps, and records required for the Quality Register. Check lists apply to each identified lot of work.

- **AS 4000**
  - Contractor: Means the person bound to carry out and complete work under the Contract. (A Contractor may be internal or external to the Utility Authority).
  - Principal: Means the Principal stated in the Annexure to the General Conditions of Contract. (The Utility Authority or Service Provider for whom the service installation and restoration work is being conducted.)
  - Superintendent: Means the person stated in the Annexure to the General Conditions of Contract as the Superintendent or other person from time to time appointed in writing by the Principal to be the Superintendent and notified as such in writing to the Contractor by the Principal and, so far as concerns the functions exercisable by a Superintendent's Representative, includes a Superintendent's Representative an individual appointed in writing by the Superintendent.
- **Other**
  - Council: The Local Government Authority for the area where the work is being performed.
  - Roads Authority: A person or body that is, by or under Roads Act 1993, declared to be a roads authority and in relation to a particular public road means the roads authority for that road (Road Act 1993).
  - Utility Authority: Refer to Principal.
  - Ancillary road elements: Means road elements including kerb and gutter, drainage pits, drainage lines, subsoil drainage lines, pavement markings, street furniture (ie signs, bins, road safety barriers, etc.)
  - Protected Species: Plants identified by Council or other relevant authorities as protected species.
  - Carriageway Concrete Pavements: Refers to reinforced concrete pavements. Does not include roller compacted concrete bases and subbases.

1.5 UTILITY SERVICES UNDER CONCRETE ROAD PAVEMENTS

Installation of utility services by open trenching methods, in carriageway concrete pavements, full depth asphalt carriageways or regional roads with more than 10,000 AADT, shall not be permitted without the prior approval of the Superintendent.

Utility services under these carriageway pavements shall be installed in accordance with 1392 *Trenchless conduit installation* or the relevant Utility Authority's Specification as directed by the Superintendent.

Maintenance of the Utility Authority's services may require the use of open trenching methods in these carriageway pavements.

This work will only proceed with the Superintendent's approval. In this case restoration shall comply with **Final restoration of carriageway subbase and base (flexible)** or the relevant Road Authorities' requirements.

1.6 ADDITIONAL WORK

The relevant Council may request removal and restoration to footpaths and/or carriageway pavements, adjacent to the Works, in addition to the removal and restoration requirements of the scope of this worksection.

Such additional work shall be identified and defined by Council's Restoration Officer at the Set Out Inspection and Approval **Hold Point** of the Contract.

In this case, payment for the additional removal and restoration activities shall be made as a Variation to the Contract at the agreed schedule of rates for the particular activities.

Additional work shall not proceed without the prior approval of the Superintendent.

1.7 ENVIRONMENTAL CONTROL MEASURES

An Environment Management Plan containing erosion and sedimentation control measures, and noise and dust control measures, shall be implemented as required by the relevant Environmental legislation and in accordance with the requirements of the relevant Statutory Authorities.

This action constitutes a **Hold Point**.

The Superintendent's approval of the Environment management plan is required prior to release of the **Hold Point**.

1.8 MATERIALS DISPOSAL, RECYCLING

All spoil and waste material shall become the property of the Contractor and shall be legally disposed of by the Contractor to either an appropriate recycling facility, disposal site or a legal waste management centre. The costs of disposal, including loading, haulage and any tipping fees, shall be borne by the Contractor.

1.9 PROVISION FOR TRAFFIC

Safety and traffic obstruction
The Contractor shall construct the Works in a safe manner with the least possible obstruction to traffic, both vehicular and pedestrian.

Traffic Management Plan
Two weeks before undertaking work which would involve any obstruction whatsoever to traffic, the Contractor shall prepare a Traffic Management Plan, and submit it to the Superintendent for approval.

This action constitutes a **Hold Point**.

The Superintendent's approval of the Traffic Management Plan is required prior to release of the **Hold Point**.

All activities for controlling traffic, both vehicular and pedestrian, shall be carried out in accordance with AS 1742.3, and the requirements of the relevant Statutory Authorities.

In the case of emergency works a Traffic Management Plan, pre-approved by the Superintendent at the commencement of the Contract, shall be implemented.

Access to properties adjacent to the works
Safe, all weather vehicular and pedestrian access to properties shall be maintained wherever possible.

Notice of 48 hours shall be provided to property owners whose access will be restricted. In the case of emergency works this notice shall be provided as soon as possible upon commencement of such works.

The Contractor is required to consult with the affected property owners to minimise the impact of the Works on the property owners' operation including impacts of the Works and the Traffic Management Plan on businesses and around commercial areas.

State and regional roads
On State Roads, Regional Roads, and in the proximity to certain traffic control devices as determined by the Superintendent, the Contractor shall obtain formal approval of the Traffic Management Plan from the Roads and Traffic Authority, Council and Police.

Local road closures
In the case of full road closures on local roads, the Contractor shall obtain prior approval of its Traffic Management Plan from Council.

In the case of emergency works a Traffic Management Plan, pre-approved by the Superintendent at the commencement of the Contract, shall be implemented.

2 CLEARING

2.1 SET OUT

Initial limits
The Contractor shall set out the limits of the proposed excavation for trenches, pits and chambers required for the utility service installation.

The set out shall minimise damage to existing surfaces.

The set out shall be in chalk or crayon so as to be readily understandable by the Superintendent and will not permanently deface any surface.

Adjusted limits
In order to minimise or eliminate residue small portions of paving slabs the set out shall be adjusted as necessary. Any adjustments will be with respect to the existing paved surfaces and joint patterns.

Adjustments shall be in accordance with the following guidelines:

- Pathways: The set out line shall be varied in accordance with the reinstatement requirements of the Street Opening Conference's publication, Information Bulletin on Codes and Practices:
  . Bitumen and concrete paving—In accordance with the reinstatement provisions and sketches of the above Information Bulletin.
  . Segmental pavers—The set out line shall be at least one whole unit clear of both sides of the minimal alignment of the trench.
  . Textured or patterned concrete—Where practicable trenchless installation methods should be used in preference to disturbing textured or patterned concrete.
  If trenchless installation methods are not practicable the set out line shall be located as approved by the Superintendent to enable an aesthetically acceptable restoration of the pavement.
  Where the Superintendent directs that driveways are not to be disturbed, the utility services under driveways shall be installed in accordance with 1392 *Trenchless conduit installation*, or the Utility Authorities' worksection, as directed by the Superintendent.
- Carriageways: In asphalt pavements, the proposed trench set out shall be at the minimum width to suit the appropriate restoration equipment, work methods for the depth of service and, wherever possible, shall be at right angles to the road reserve boundary.
  The requirements for the width of the final pavement restoration are given in **Final restoration of carriageway subbase and base (flexible)**. In concrete pavements the advice of the appropriate road authority/and or professional engineering advice should be sought regarding the location of trench set out lines, and trench set out lines shall be approved by the Superintendent, and appropriate Road Authority.
  Any trench or surface work proposed in the vicinity of Permanent or State Survey Marks shall be referred to the Land Information Centre of the Department of Land and Water Conservation, prior to commencement or Work, to obtain protection or relocation requirements.
- Inspection and approval: The set out line shall be presented to the Superintendent for approval prior to the commencement of any surface clearing work.
  This action constitutes a **Hold Point**.
  The Superintendent's approval of the set out line is required prior to release of the **Hold Point**.
  The Contractor shall give notice to allow the Superintendent to inspect and approve the set out prior to the release of the **Hold Point**.

2.2 SURFACE TREATMENT REMOVAL

Sawcut

Trench set out lines located on concrete or asphalt footpaths, and asphalt carriageway pavements, shall be sawcut for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Where a concrete subbase is found, upon removal of segmental pavers, it shall also be sawcut along the trench set out lines.

Concrete and asphalt

Concrete or asphalt footpath and carriageway pavement material shall be broken out, between the trench set out lines, removed and legally disposed of off-site by the Contractor in accordance with **Environmental control measures.**

Pavers and dimension stones

Segmental pavers both full and cut, between the trench set out lines, shall be taken up by hand and neatly stacked on wooden pallets at locations as agreed by the Superintendent.

Any dimension stone kerb and gutter units within the set out lines shall also be taken up and stacked in a similar manner.

Decorative pavers

Pavement consisting of decorative pavers laid on a mortar bed and a concrete base shall not be disturbed unless Trenchless Conduit Installation is impractical.

If it is necessary to disturb these surfaces, the decorative pavers shall be carefully removed, stacked and secured against theft, or damage in any form, for reuse.

Sawcutting of decorative pavers shall not be permitted unless the Contractor can provide evidence that replacement pavers, of the same type, size, colour and decoration, are available.

The bedding mix shall be removed and the concrete subbase shall be saw cut along the trench set out lines. If using percussion equipment for removal of the pavement, the Contractor shall ensure that adjacent areas of paving are not disturbed.

Paver edging

Concrete edging, associated with the lifted segmental pavers, shall be broken out, removed and legally disposed of off-site by the Contractor unless agreed otherwise by the Superintendent.

Grass

Grass turf, between trench set out lines, shall be neatly cut out and either stockpiled for reuse or legally disposed of off site by the Contractor.

If grass is stockpiled for reuse it shall be watered as necessary.

If grass is not suitable for reuse it shall be disposed of and replaced by grass turf of the same species.

Plants, shrubs, trees

Small plants, shrubs and trees, and or protected or heritage listed species, between the set out lines, identified by the Superintendent, or appropriately authorised Council Officer, as being suitable for replanting shall be taken up and stored.

The root ball of such plants, shrubs and trees shall be wrapped in a hessian or plastic bag with drain holes and shall be watered as necessary during the storage period.

Unsuitable vegetation

Small plants, shrubs and trees, not being protected species or heritage listed species and not covered by Council tree preservation order, deemed unsuitable for replanting shall be removed and legally disposed of off-site by the Contractor.

Street furniture

Street furniture, including signage, seats, litter bins, etc, between the trench set out lines or likely to interfere with or be damaged by the Works, shall be removed and stored.

House SW and service pipes contractor's cost

House stormwater pipes discharging into carriageway gutters, and house service supply lines, shall be maintained at all times.

Any damage to these pipes, or house service supply lines, caused by the Contractor's activities shall be repaired or replaced. The costs of such rectification works shall be borne by the Contractor.

3 EXCAVATION

3.1 TOPSOIL

Before undertaking trench excavation, topsoil which is suitable for reuse in the restoration work, shall be removed and stockpiled on-site if practicable.

If on-site stockpiling is impracticable, then the topsoil shall be either stockpiled off-site, or legally disposed of off-site, as directed by the Superintendent.

3.2 TRENCH EXCAVATION

In accordance with drawings

Trenches shall be excavated to the standard widths and depths for the particular utility service installation or to dimensions as shown on the Drawings.

Safety

In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the trench necessary to comply with statutory requirements.

Requirements of other public utility authorities

Where other public utilities exist in the vicinity of the Works, the Contractor shall obtain the requirements of the relevant authority to the method of excavation before commencing excavation.

The locations of existing underground services, stormwater and subsoil drainage lines, shall be established by exploratory excavation prior to the principal trench excavation.

Details of the requirements of the relevant authorities, including Council, shall be provided to the Superintendent, if requested.

Location of services

The Contractor shall locate all existing underground services prior to excavations. This shall include contacting the relevant 'Dial Before You Dig' service in the region where the Works are located.

Excavation level

Trench or foundation excavation shall be undertaken to the planned level for the bottom of the specified bedding or foundation level or such other depth as shown on the Drawings.

Stockpiles

The excavated earth and rock material shall be segregated and stockpiled for reuse in backfilling operations.

Excavated material shall not, at any time, be stockpiled against tree trunks, buildings, fences or obstruct the free flow of water in gutters, where stockpiling is permitted along the line of the trench excavation.

Where on-site stockpiling is not practicable or the excavated material is deemed unsuitable for reuse in backfilling, the material shall be legally disposed of off-site.

Disposal of unsuitable material

Any material at the bottom of the trench or at foundation level which is unsuitable, in accordance with the Utility Authorities' worksection, shall be removed and legally disposed of off-site by the Contractor and replaced with backfill material in accordance with the documented requirements of this worksection.

The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be aligned at the specified level and slope of the utility service.

Contaminated, hazardous material

If any excavated material is contaminated or contains Hazardous Material, the Superintendent shall be notified and the material shall be disposed of in accordance with the requirements of the relevant Statutory Authorities.

3.3 PROTECTION OF TREES

Protected during works

Existing trees are legally protected by Council's Tree Preservation Order and shall be protected from all damage during the Works, unless otherwise approved by the Superintendent in consultation with the Council.

Materials clear of trees

The Contractor shall not store, stockpile, dump or otherwise place under or near trees bulk materials and harmful materials including oil, waste concrete, clearings, boulders and the like and shall prevent wind blown materials from harming trees and plants.

No attachments

The Contractor shall not attach stays, guys and the like to trees and shall prevent damage to tree bark.

Work near trees

When working near trees the Contractor shall not remove topsoil from within the drip line of trees unless otherwise specified or directed.

Where it is necessary to excavate within the drop line, approved methods such as hand methods or trenchless methods, such that root systems are preserved intact, shall be used.

The duration of open excavations under tree canopies shall be determined by the Superintendent.

Tree roots

The Contractor shall not cut tree roots exceeding 50 mm in diameter without the approval of the Superintendent in consultation with the Council's appropriately Authorised Council Officer.

Where it is necessary to cut tree roots, a saw or similar means shall be used such that the cutting does not unduly disturb or rock the remaining root system.

Immediately after cutting, an approved bituminous fungicidal sealant shall be applied to the cut to prevent the incursion of root disease.

4 BACKFILL

4.1 BEDDING ZONES

Particular service specification

Bedding material for the bed, haunch, side and overlay zone shall be to the requirements, and shall be installed in accordance with the Worksection for the particular utility service being installed.

Geotextile

A geotextile sheet shall be installed on any coarse overlay material to prevent piping of fines.

Overlay zone

The overlay zone is defined as that part of the trench backfill immediately over the utility service.

The side zone and overlay material shall be installed in accordance with the worksection for the particular utility service being installed, provided that the material has the equivalent performance to the backfill material specified in Clauses 4.2 and 4.3 for that location.

This action constitutes a **Hold Point**.

The Superintendent's approval of the overlay zone backfill is required prior to release of the **Hold Point**.

4.2 TRENCH BACKFILL

General

Seepage zones: Where sand/cement backfill is used, any natural seepage zones shall not be cut off by the impervious sand/cement material. Natural seepage shall be provided for by the provision of a pervious drainage layer or suitable subsoil drainage.

Water in pervious material: When sand, crushed rock or similar pervious materials are used for trench backfill and bedding in a clay subgrade, there is a risk that seepage water will be trapped in the pervious material and then saturate the adjacent clay subgrade, thus weakening it.

If these circumstances occur, the Contractor shall install suitable subsoil drainage for the bedding and backfill, or an impervious layer of material shall be provided between any possible sources of seepage and the pervious backfill material.

Backfill in verge and landscape areas

Material: Backfill material shall be material passing 75 mm sieve and not containing any organic or deleterious material or reactive clay. In landscape areas topsoil shall be placed on the subgrade to the same thickness as the surrounding topsoil.

Tree roots: Backfilling, for a minimum 300 mm thickness, around tree roots shall consist of topsoil mixture, placed and compacted in layers of 150 mm depth to a dry density equal to that of the surrounding soil.

Backfill at trees: The Contractor shall not place backfill material above the original ground surface around tree trunks or over the root zone unless approved by the Superintendent.

Watering root zone: Immediately after backfilling the tree root zone shall be thoroughly watered.

Backfill to subgrade level under footpaths and carriageways (including heavy duty driveways)

Any of the following materials shall be used:

- sand (shall not be used if the bedding/overlay is coarse aggregate);
- fine crushed rock/recycled concrete in accordance with *1141Flexible pavements*;
- selected backfill material with an equivalent 4 day soaked CBR value, in accordance with AS 1289.6.1.2, to the existing subgrade and a maximum particle size of 75 mm and not containing any organic or deleterious material or reactive clay;
- under footpath—25:1 sand/cement mix (compaction testing is not required); under carriageways—14:1 sand/cement mix (compaction testing is not required).

4.3 COMPACTION OF TRENCH BACKFILL

Requirements

Backfilling shall be compacted to the requirements of Table 4.1 when tested in accordance with AS 1289.5.2.1 for modified compactive effort (MMDD) or AS 1289.5.1.1 for standard compactive effort (MSDD).

Non-cohesive materials shall be tested in accordance with AS 1289.5.6.1.

No compaction testing is required where sand/cement is used as backfill material.

Table 4.1 Compaction requirements

Zone	Relative Compaction	Density Index (for Non-Cohesive Materials)	Moisture Content (percent of optimum moisture content)
Bedding and Overlay Zones	To Utility Authority's Specification	To Utility Authority's Specification	To Utility Authority's Specification
Backfill in verge and landscape areas	90% Standard	70	Between 60% and 100%
Backfill to subgrade level under footpaths and carriageways	98% standard 95% modified	80	Between 60% and 100%

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness unless it can be demonstrated to the Superintendent's satisfaction by suitable testing that the specified compaction can be achieved with the thicker layers.

Testing frequency

Compaction tests shall be undertaken by the Contractor at the minimum frequencies shown in Annexure C.

Precautions for utility services

The Contractor shall adopt compaction methods which will not cause damage or misalignment to the underlying utility service, adjacent utility services or adjacent structures.

5 RESTORATION

5.1 GENERAL

Equivalent condition

Carriageway pavements and pathways shall be restored in a continuous manner to a condition equivalent to that existing at the commencement of the Works as agreed by the Superintendent.

All temporary and final restorations in carriageways and pathways shall be of sufficient quality to ensure the safety of the site for pedestrian and vehicular traffic.

Surface pits, etc

Utility service surface pits, access chamber frames and lids, etc, shall be set such that carriageway pavements and footpaths can be restored to original levels.

The Contractor shall liaise with other utility authorities should any other utility service surface box be required to be adjusted or replaced prior to restoration.

Paved restoration

The Contractor shall set out the areas for paved restoration.

This action constitutes a **Hold Point**.

The Superintendent shall inspect and approve the prepared areas, and verify any additional restoration work required, prior to the release of the **Hold Point**.

The requirements for trench backfill and restoration in footpaths and carriageway pavements are shown in tabular form in Annexure A.

5.2 TEMPORARY PAVEMENT

Carriageways

After backfilling to subgrade level the subbase and base material shall be installed in accordance with Final restoration of carriageway wearing surface (course) unless otherwise agreed by the Superintendent.

Carriageway pavement shall be temporarily restored if it is to be re-opened to traffic prior to final restoration.

The Contractor shall monitor and maintain temporary restorations in a safe condition until the final restoration is completed.

Temporary restoration shall consist of either:

- Bituminous cold mix, in accordance with 1142 *Bituminous cold mix*, 40-50 mm thickness, on the final subbase and base material unless otherwise agreed by the Superintendent.
- Steel plating, over the trench, of sufficient thickness to support traffic loadings and suitably secured with pins and bituminous cold mix.

Where steel plating is used, advance warning signs shall be provided in accordance with AS 1742.3.

Footpaths, including driveways

After backfilling to subgrade level the subbase material shall be installed in accordance with **Final restoration of pathways and driveways** unless otherwise agreed by the Superintendent.

Footpaths, including driveways, shall be temporarily restored if they are to be re-opened for pedestrian or vehicular use, prior to final restoration.

The Contractor shall liaise with property owners regarding access and ensure that pedestrian and vehicular access is provided to all properties at the end of each day's work unless otherwise approved by the Superintendent.

The Contractor shall monitor and maintain temporary restorations in a safe condition until the final restoration is completed.

Temporary restoration shall consist of:

- Bituminous cold mix, in accordance with 1142 *Bituminous cold mix,* 20–40 mm thickness, or other material approved by the Superintendent.
  A smooth connection shall be made with adjoining pavements such that the temporary restoration does not present a trip hazard for pedestrians.
  The surface of the temporary restoration shall be smooth and evenly graded so as to be safe for pedestrians.
- Sheeting or steel plating, over the trench, of sufficient thickness to support traffic loadings and suitably secured with pins and bituminous cold mix.
  The Contractor shall ensure that steel plating does not cause a trip hazard for pedestrians by matching the level of the steel plating to the adjacent surface with bituminous cold mix.

5.3 FINAL RESTORATION OF CARRIAGEWAY SUBBASE AND BASE (FLEXIBLE)

Remove temporary pavement

Final restoration shall be undertaken as soon as practicable and within the time specified in the Contract.

Prior to final carriageway pavement restoration, the temporary pavement material shall be removed and legally disposed of off-site by the Contractor.

If approved by the Superintendent, the temporary base material may remain in place and be incorporated into the final pavement where it complies with the requirements of this worksection for the base and subbase (including the compaction and testing requirements) and has not been disturbed or contaminated during removal of the temporary surface.

The temporary asphaltic material shall be removed and disposed of off-site by the Contractor.

Settlement of temporary pavement

If the temporary restoration shows signs of settlement, the final restoration shall not proceed until the cause of the settlement has been identified and rectified to the satisfaction of the Superintendent.

Material

Subbase and base material shall consist of crushed rock or recycled concrete complying with 1141 *Flexible pavements.*

The layers and depths shall match the existing pavement. Where the existing pavement includes cement stabilised crushed rock or a lean mix concrete subbase, the pavement shall be restored using materials and layer depths to match the existing pavement.

Uniform compaction

Each layer of the subbase and base courses shall be uniformly compacted over the full area and depth within the trench to a relative compaction of 98% when tested in accordance with AS 1289.5.2.1 (Maximum Modified Dry Density) or 102 % when tested in accordance with AS 1289.5.1.1 (Maximum Standard Dry Density).

Compaction testing shall be undertaken in accordance with this Clause, Section 6 and the Contractor's approved Quality Plan.

Precautions for underlying utility services

The Contractor shall adopt compaction methods which will not cause damage or misalignment to underlying and adjacent utility services or adjacent structures.

5.4 FINAL RESTORATION OF CARRIAGEWAY WEARING SURFACE (COURSE)

Timing

Final restoration shall be undertaken as soon as practicable and within the time specified in the Contract.

Asphaltic concrete wearing surfaces

Asphaltic concrete wearing surfaces shall be restored using asphaltic concrete supplied and placed in accordance with 1144 *Asphaltic concrete (Roadways).*

For Regional and State roads, asphaltic concrete shall be supplied and placed in accordance with the requirements of the relevant Road Authority.

The thickness and aggregate size of the asphaltic concrete shall match the existing wearing surface.

Bituminous spray seal surfaces

Bituminous spray seal surfaces shall be restored to match existing surfaces in accordance with 1143 *Sprayed bituminous surfacing.*

The thickness and aggregate size of the bituminous wearing surface shall match the existing pavement.

Where the bituminous spray seal is underlain by Asphaltic Concrete, the pavement shall be restored in Asphaltic Concrete matching the total thickness of the existing pavements.

Small openings in sprayed bituminous pavements can be restored using asphaltic concrete (AS20) minimum thickness 50 mm, supplied and placed in accordance with 1144 *Asphaltic concrete (Roadways).*

Concrete carriageways

Restorations in concrete carriageways shall be undertaken in accordance with the requirements of the worksection for 1132 *Mass concrete subbase,* 1133 *Plain and reinforced concrete base*, 1134 *Steel fibre reinforced concrete base* or 1135 *Continuously reinforced concrete base*, as appropriate.

Surface tolerance

The evenness of the resulting restored surface shall be such that when tested with a 3 m straightedge, seven to ten days after completion, departures from the straightedge are less than ±5 mm and the surface is such that an impact is not transmitted to traffic passing over the restoration.

Tack coat

The bituminous surfacing tack coat for asphalt or seal coat for sprayed bituminous seals shall present a waterproof surface at application.

Asphalt limits

The existing wearing course shall be removed in plan between a distance of 100 mm and 400 mm beyond the perimeter of any trench excavation as agreed by the Superintendent.

The removed material shall be disposed of off-site by the Contractor.

Asphalt placed as restoration shall similarly extend in plan a minimum dimension of between 100 mm and 400 mm beyond the perimeter of any trench excavation as agreed by the Superintendent.

Joint between new and existing asphalt

The joint between new and existing asphalt shall be vertical and cut by diamond saw or milling machine.

The vertical face of the old asphalt shall be treated by bituminous tack coating.

Any joints which appear between the existing and new asphalt during the defects maintenance period shall be sealed with a joint sealant approved by the Superintendent.

Pavement markings

Pavement markings shall be reinstated to match existing pavement markings and in accordance with 1191 *Pavement markings*.

5.5 FINAL RESTORATION OF PATHWAYS AND DRIVEWAYS

General

Timing: Final restoration will be undertaken as soon as practicable and within the time specified in the Contract. Pathways, and other public areas, shall be restored with materials consistent with the existing surface before commencement of the Works, or as directed by the Superintendent in consultation with the Council.

Removal Temporary Material: Prior to final footpath restoration, the temporary pavement material shall be removed and disposed of off-site by the Contractor. The temporary material may remain in place and be incorporated into the final subbase if it complies with the requirements of this Worksection for the subbase (including the requirements for compaction and testing) and has not been disturbed or contaminated during removal of the temporary surfacing.

Surface tolerance: Surface levels are to match the levels existing before the surface was disturbed and a smooth junction must be made with the adjacent existing surfaces, covers and features.

The variation between the level of the restored surface and the adjacent surface, covers and features is to be no more than 5 mm. Where the levels of existing surfaces, covers, or features do not allow the specified level tolerance to be achieved, the restoration shall be at the Superintendent's direction.

Pavement markings: Pavement Markings shall be reinstated to match existing pavement markings and in accordance with 1191 *Pavement markings.*

Street furniture: Street furniture, removed and stored, shall be reinstated at locations matching the original location unless directed otherwise by the Superintendent.

Subbase / Base

Flexible: Subbase material shall consist of fine crushed rock or recycled concrete complying with 1191 *Pavement markings.*

Thickness: The thickness of the subbase shall match the existing subbase (minimum 50 mm thickness for footpaths and light duty driveways and 150 mm thickness for medium and heavy duty driveways).

Compaction: The subbase shall be compacted to 92 per cent relative compaction when tested in accordance with AS 1289.5.2.1 (Maximum Modified Dry Density) or 95% relative compaction when tested in accordance with AS 1289.5.1.1 (Maximum Standard Dry Density).

Rigid: Where the existing footpath base is concrete, the base shall be reinstated using 20 MPa concrete match the thickness of the existing base.

Testing: Compaction testing shall be undertaken in accordance with this Clause, Quality Assurance and the Contractor's approved Quality Plan.

Precautions for adjacent utility services: The Contractor shall adopt compaction methods which will not cause damage or misalignment to underlying and adjacent utility services or adjacent structures.

Concrete footpaths and driveways including textured and patterned

Specification: The minimum width of restorations in concrete footpaths shall comply with section 5.5 of the Streets Opening Conference Information Bulletin.

Match existing footpaths and driveways: Concrete footpaths and driveways shall be restored to the same surface finish and pattern as the original surface.

Concrete footpaths: Concrete footpaths shall be constructed in minimum 20 MPa concrete to the same thickness (with a minimum of 75 mm), as the adjoining footpaths.

Light duty driveways: Light duty driveways serving single residential dwellings shall be constructed in 25 MPa concrete to the same thickness (with a minimum of 100 mm) as the original driveway.

F62 Steel Fabric with 40 mm top cover shall be provided where the existing driveway contains reinforcing.

Medium/heavy duty driveways: Medium duty driveways serving multiple residential dwellings and light commercial developments and heavy duty driveways shall be constructed in 25 MPa concrete to the same thickness as the original driveway (minimum of 150 mm with F72 Steel Fabric with 50 mm top cover to reinforcement.

Expansion joints: In concrete footpaths, expansion joints consisting of a 15 mm thick preformed jointing material of bituminous fibreboard, or equivalent approved by the Superintendent, shall be placed in line with joints in existing concrete and at full width transverse joints with existing concrete.

Control joints: Control joints shall be formed strictly in line with the control joints in existing concrete.

Treatment at poles: Around electricity supply poles, the concrete paving shall be terminated 200 mm from the pole and the resulting space filled with cold mix asphalt.

Asphalt footpaths

Asphalt footpaths shall consist of asphalt in accordance with 1144 *Asphaltic concrete (Roadways*) and shall be constructed to the same thickness as the adjoining footpath and compacted to a smooth even surface.

Segmental pavers on sand bed

Specification: All activities associated with the restoration of segmental pavers shall comply with 1145 Segmental paving.

Match existing with existing pavers: Existing pavers, taken up and stored, shall be relaid to match the pattern and surface levels of the existing paving.

Cut/damaged pavers replaced: Cut or damaged pavers shall be replaced with new pavers unless otherwise authorised by the Superintendent. Such new pavers shall be supplied by the Contractor and shall be of the same material, type, size and colour as the existing pavers.

Paving around trees: The paving pattern at tree surrounds, service boxes, poles, etc, shall match the pattern at similar existing features in the immediate area or be as directed by the Superintendent.

Decorative segmental paving on concrete base

Application: This Sub-Clause applies to the restoration of pathways or driveways with a natural stone, concrete or masonry paver surface or other surface products laid on a mortar bed and concrete base.

Concrete base: The concrete base shall be reconstructed in 25 MPa concrete with thickness and reinforcing to match the existing concrete. Where the concrete base is reinforced, the reinforcement shall be tied to the existing reinforcing, either by exposing the reinforcing either side of the restoration to allow a minimum 300 mm lap, or by installing tie bars drilled and grouted into the existing concrete.

Unless otherwise directed by the Superintendent tie bars shall be 600 mm long Y12 reinforcing bars installed at 1000 mm centres by drilling 200 mm deep 16 mm diameter holes at mid-slab depth and grout tie bars into holes using a 1cement:1sand grout mix. In the case of an unreinforced concrete base the sawn face shall be roughened to allow formation of a keyed joint.

Jointing: Where transverse or longitudinal joints have been disturbed as a result of the Works, they shall be reinstated to match the existing joints.

Damaged or sawcut pavers: Any pavers adjacent to the trench which have been damaged during the Works shall be removed. Sawcut pavers shall be removed back to the nearest existing joint.

Mortar bed: Pavers shall be laid on a mortar bed of the same material and thickness as the existing mortar bed.

Match existing pavers: Existing pavers, taken up and stored, shall be relaid. Cut or damaged pavers shall be replaced with new pavers. Such new pavers shall be supplied by the Contractor and shall be of the same material, type, size, colour and decoration as the existing pavers. The Contractor shall liaise with Council's Restoration Officer to ascertain details related to the supply of pavers. Where existing pavers cannot be sourced, an alternative, as approved by the Superintendent in consultation with Council's Restoration officer, shall be used. Pavers shall be laid to match existing surface levels, jointing pattern, gap width and infill material.

5.6 TURFED VERGES

Topsoil bed

A bed of stockpiled topsoil, or approved imported topsoil, of minimum thickness 50 mm, shall be placed on the subgrade prior to restoration of turfed verges.

Relay turfs

Existing grass turfs, taken up and stored, shall be relaid to conform with the original grassed surface.

Turfs shall be hard butted against each other in rows and the seams top dressed with topsoil.

Turf shall be rolled and watered to ensure direct and uniform contact with the topsoil.

Additional turf

Any additional turf required to fully restore grassed verges shall be supplied by the Contractor and shall be the same type as the existing grass.

5.7 VERGE PLANTS, SHRUBS AND TREES

Topsoil bed

Stockpiled topsoil, or approved imported topsoil, shall be placed on the subgrade to the same thickness as the surrounding topsoil, prior to replanting.

Planting holes shall be excavated, at locations matching the original location unless directed otherwise by the Superintendent in consultation with the relevant Council Officer responsible for road restorations, and the material spread evenly around each hole.

Replanting

Existing plants, shrubs and trees, taken up and stored which are suitable for replanting, shall be replanted in the prepared holes.

The Contractor shall replace any plants which are not suitable for replanting with plants of the same species and size, or as agreed by the Superintendent in consultation with the Council's appropriately authorised Officer.

Compacted, staked and watered

The planting hole shall be backfilled with topsoil and compacted by foot up to surface level.

The shrubs and trees shall be staked as necessary and watered and maintained in accordance with 0250 *Open space- landscaping* as necessary to ensure suitable re-establishment.

Replacement

Shrubs and trees which fail to re-establish shall be replaced by the Contractor and maintained in accordance with 0250 *Open space- landscaping.*

5.8 CLEANUP

Upon completion of all restoration Works, the areas affected by the Works and associated construction activities shall be cleaned up to a condition equivalent to that existing at the commencement of the Works.

Surfaces stained by the construction activities shall be cleaned or restored to the satisfaction of the Superintendent.

All formwork, rubbish and residue construction materials, including material left at stockpiles, shall be legally disposed of off-site by the Contractor.

Where required by the Superintendent, the Contractor shall present the cleaned up restoration works to the Superintendent for approval.

5.9 WORK-AS-EXECUTED DRAWINGS

The Contractor shall supply the Superintendent with fully marked-up Work-as-Executed Drawings for the whole of the Contract in accordance with the Utility Authorities' Specification.

6 QUALITY ASSURANCE

6.1 QUALITY PLAN

The Contractor must have approved QA accreditation as required by the Contract and an approved Quality Plan for the Works.

The Quality Plan shall incorporate all checklists, inspections, testing and documentation as required in Annexure B, and as necessary to ensure that the Works comply with the Contract Documents.

6.2 HOLD AND WITNESS POINTS

Hold Points and Witness Points shall be incorporated into the checklists.

Hold Points are to be signed off by the approved Contractor's Representative and the Superintendent.

The Superintendent shall be given 24 hours notice of when inspections are required.

Where the Superintendent instructs the Contractor that inspection is required at certain **Hold Point**s or Witness Points by Council Officers, the Contractor shall give 24 hours notice to Council.

6.3 HOLD POINT APPROVAL BY CONTRACTOR'S INSPECTOR

Where allowed by the Quality Plan, the Superintendent may allow the Contractor's nominated inspector to sign off certain **Hold Point**s.

This will be determined by the Contractor's performance in relation to the requirements of the Quality Plan and the Contract.

6.4 TESTING

Testing shall be conducted in accordance with the frequencies in Annexure C. All work represented by failed tests shall be retested and where necessary rectified.

6.5 AUDITING

The Superintendent may audit the Contractor's Quality Assurance system as required. The Contractor shall provide full co-operation in providing all information required by the Superintendent.

6.6 NO ADDITIONAL PAYMENT

The provisions for quality assurance are deemed to be included in the rates generally in accordance with this worksection and no additional payment will be paid for compliance with this Clause.

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1152.1 to 1152.16 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Provision for traffic, both vehicular and pedestrian, shall be deemed to be included in the schedule rates generally in accordance with this worksection.

Segmental paving works are measured and paid in accordance with this worksection and not

1145 *Segmental paving*.

Trenchless installation of utility services under driveways is measured and paid in accordance with 1392 *Trenchless conduit installation.*

7.2 PAY ITEMS

1152.1 Sawcut existing pavement/footpath

- 1152.1(1) Bituminous carriageway pavement
- 1152.1(2) Bituminous footpath
- 1152.1(3) Concrete footpath, including textured or patterned concrete.

The unit of measurement shall be the linear metre measured along the actual line of cut. Separate rates shall be given for sawcuts in each type of material.

The schedule rate shall include all activities associated with the sawcutting operations including hire of plant and provision of water.

1152.2 Remove existing pavement/footpath

The unit of measurement shall be the square metre of pavement removed including both bituminous and concrete material and including concrete base from segmental paving where applicable.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate shall include all activities associated with breaking out, removing, transporting off-site, disposal and any tipping fees applicable.

1152.3 Segmental pavers (including decorative segmental pavers)

- 1152.3(1) Take up and stack existing pavers—Carriageway
- 1152.3(2) Take up and stack existing pavers—Footpath
- 1152.3(3) Lay existing pavers—Carriageway
- 1152.3(4) Lay existing pavers—Footpath
- 1152.3(5) Supply and lay new pavers—Carriageway
- 1152.3(6) Supply and lay new pavers—Footpath

The unit of measurement shall be the square metre of surface of segmental pavers (or decorative segmental pavers) taken up or laid.

Separate rates shall be given for taking up existing, laying existing and supply and lay new pavers for carriageways or footpaths as appropriate.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate, for items 1152.3(1) and 1152.3(2), shall include all activities associated with taking up and stacking pavers on pallets at locations as agreed. Concrete base, where applicable, shall be removed under Pay Item 1152(2).

The schedule rate, for items 1152.3(3) and 1152.3(4), shall include all activities involved in the laying and compaction of subbase, including concrete base where applicable, and existing segmental pavers, bedding sand and joint filling sand, mortar bed where applicable, including any cutting of units, concrete edging, joints overlying concrete pavement joints, and concrete surrounds or aprons around surface penetrations.

The schedule rate, for items 1152.3(5) and 1152.3(6), shall include all activities involved in the laying and compaction of subbase, including concrete base where applicable, and supply, laying and compaction of segmental pavers, bedding sand and joint filling sand, mortar bed where applicable, including any cutting of units, concrete edging, joints overlying concrete pavement joints, and surrounds or aprons around surface penetrations.

1152.4 Remove existing edge strips

The unit of measurement shall be the linear metre measured along the length of the edge strip.

The schedule rate shall include all activities associated with breaking out, removing, transporting off-site, disposal and any tipping fees applicable.

1152.5 Grass turf

- 1152.5(1) Take up and store existing turf
- 1152.5(2) Lay existing turf
- 1152.5(3) Supply and lay new turf

The unit of measurement shall be the square metre of surface of grass turf taken up or laid. Separate rates shall be given for taking up existing, laying existing and supply and lay new turf.

The width and length shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate, for item 1152.5(1), shall include all activities associated with cutting, taking up and storing turf.

Grass unsuitable for reuse shall be removed under Pay Item 1152.5(2).

The schedule rate, for item 1152.5(2), shall include all activities associated with the topsoil bedding, rolling, laying of existing turf and topdressing.

The schedule rate, for item 1152.5(3), shall include all activities associated with the topsoil bedding, rolling, supply and laying of new turf and topdressing.

C0219.6 Verge plants, shrubs and trees

- 1152.6(1) Take up and store existing
- 1152.6(2) Plant existing
- 1152.6(3) Plant new
- 1152.6(4) Disposal of unsuitable

The unit of measurement shall be each plant, shrub or tree taken up or planted (excludes Pay Item 1152.6(4)). Separate rates shall be given for taking up existing, replanting existing and supply and plant new plants, shrubs or trees.

The schedule rate, for item 1152.6(1), shall include all activities associated with taking up, storing and watering.

The schedule rate, for Item 1152.6(2), shall include all activities associated with topsoil placement, preparatory work, planting, staking and subsequent care of each plant.

The schedule rate for Item 1152.6(3) shall include all activities associated with topsoil placement, preparatory work, supply and planting, staking and subsequent care of each new plant.

The unit of measurement for Pay Item 1152.6(4) shall be the cubic metre of unsuitable plants, shrubs and trees.

The schedule of rate for Item 1152.6(4) shall include all activities associated with transporting off-site, disposal and any tipping fees applicable.

1152.7 Stockpiling of topsoil

The unit of measurement shall be the cubic metre as bank volume.

The volume shall be calculated by multiplying the area, derived from the width and length as shown on the Drawings or as directed by the Superintendent, by the depth of topsoil.

The schedule rate shall include all activities associated with stripping topsoil, carting and placing into stockpile.

Topsoil to be disposed of off-site shall be removed under Pay Item C0219.8(2).

1152.8 Trench excavation

- 1152.8(1) To stockpile
- 1152.8(2) Disposal off-site (including unsuitable material)

The unit of measurement shall be the cubic metre as bank volume of excavation. Separate rates shall be given for excavation to stockpile and disposal off-site.

The volume shall be calculated by multiplying the width by the depth by the length as follows:

- Width—as specified for the particular utility service installation.
- Depth—average actual depth from topsoil stripped ground surface to underside of specified bedding.
- Length—actual excavation length, centre to centre of pits.

The schedule rate shall be an average rate to cover all types of material encountered during excavation. Separate rates shall not be included for earth and rock.

The schedule rate shall include all activities associated with:

- Excavation, including excavation and replacement of unsuitable material.
- Replacement for over-excavation for any reason.
- Protection of trees and treatment to cut tree roots.

The schedule rate, for item 1152.8(1), shall include all activities associated with carting and placing into stockpile.

The schedule rate, for item 1152.8(2), shall include all activities associated with transporting off-site, disposal and any tipping fees applicable.

1152.9 Trench backfill

- 1152.9(1) From stockpiled material
- 1152.9(2) From imported material
- 1152.9(3) 25:1 sand/cement mix
- 1152.9(4) 14:1 sand/cement mix

The unit of measurement shall be the cubic metre measured as backfill compacted volume in place in the trench.

The volume shall be calculated by multiplying the width by the depth by the length as follows:

- Width—average trench width
- Depth—average actual depth from top of subgrade to top of bedding overlay material around the utility service.
- Length—actual trench length, centre to centre of pits.

The schedule rate shall include all activities associated with backfilling (including supply and installation of geotextile where appropriate), compaction, testing and treatment around tree roots.

The schedule rate, for item 1152.1, shall include all activities associated with loading and carting from stockpile.

The schedule rate, for items 1152.2, 1152.3 and 1153.4 shall include all activities associated with supply and delivery of imported material, including material for a selected material zone where specified.

1152.10 Temporary pavement—Carriageway and footpath

The unit of measurement shall be the square metre of trench area restored with temporary pavement.

The area shall be calculated by multiplying the trench width by the actual length of temporarily restored pavement.

The schedule rate shall include all activities associated with the supply, delivery, placing and compaction of the base material and bituminous cold mix. It shall include all activities and material

necessary for maintenance of the temporary pavement in a safe condition until the permanent restoration is executed.

1152.11 Temporary steel plating

The unit of measurement shall be the square metre of trench area plus adequate allowance for support on both sides of the trench.

The area shall be calculated by multiplying the trench width by the actual length of trench to be covered.

The schedule rate shall include all activities associated with the hire, delivery, placement, securing and subsequent removal and return to depot of the steel plates. It shall include all activities and materials necessary for maintenance of the plating until permanent restoration is executed.

1152.12 Flexible subbase

The unit of measurement shall be the square metre of trench.

The area shall be calculated by multiplying the trench width by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement, supply, delivery, spreading and compaction.

1152.13 Flexible base

The unit of measurement shall be the square metre of trench.

The area shall be calculated by multiplying the trench width by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement where no subbase is required, supply, delivery, spreading and compaction.

1152.14 Carriageway wearing surface (course)

- 1152.14(1) Asphaltic concrete
- 1152.14(2) Sprayed bituminous surfacing
- 1152.14(3) Concrete

The unit measurement shall be the square metre of new surface area in accordance with this Worksection.

The area shall be calculated by multiplying the trench width +200 mm (or up to 800 mm as agreed) by the length.

The schedule rate shall include all activities associated with the removal of temporary pavement or existing pavement to the new perimeter, supply, delivery, spreading, compaction and provision of pavement markings as appropriate.

The schedule rate, for item 1152.14(3) shall include all activities associated with the forming, compaction of foundations, supply, delivery and compaction of mass concrete subbase, supply, delivery, placing, finishing and curing concrete base.

Where shown on the Drawings or as directed by the Superintendent this pay item shall include the supply and placement of reinforcing steel and the provision of pavement markings as appropriate.

1152.15 Footpaths and driveways

- 1152.15(1) Asphalt/sprayed bituminous seal
- 1152.15(2) Plain concrete
- 1152.15(3) Textured/patterned concrete

The unit of measurement shall be the square metre of paved surface, including driveways. Separate rates shall be given for each thickness of footpath or driveway.

The width and length shall be as shown on the Drawings or as Directed by the Superintendent.

The schedule rate, for item 1152.15(1), shall include all activities associated with the forming, compaction of foundations, supply, delivery and compaction of subbase and bituminous material.

The schedule rate, for items 1152.15(2) and 1152.15(3) shall include all activities associated with the forming, compaction of foundations, supply, delivery and compaction of subbase, supply delivery, placing, finishing and curing concrete, including texturing or patterned finish where applicable.

Where shown on the Drawings or as directed by the Superintendent this pay item shall include the supply and placement of reinforcing steel.

1152.16 Cleanup

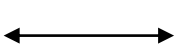
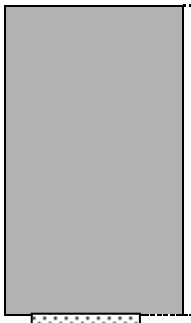
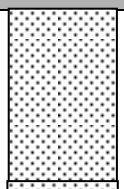
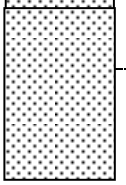
The unit of measurement shall be the square metre of carriageway and/or footway surface or other surface as applicable.

The lengths and widths shall be as shown on the Drawings or as directed by the Superintendent.

The schedule rate shall include all activities associated with the cleaning up of the Work site, and transporting off-site and disposal of material including any tipping fees applicable.

8 ANNEXURE A

8.1 TYPICAL FINAL RESTORATION IN FOOTPATH

Reinstatement Width  Finished Surface Level	**Zone**	**Zone thickness**	**Material**	**Compaction Requirement**
	Wearing Surface (Course)	75 mm min concrete Asphalt—match existing Segmental paving on sand bed—match existing Segmental decorative paving on concrete base—match existing	As specified in Final restoration of pathways and driveways	
 Sub-grade Level	Subbase/ Base Course	Match existing thickness (minimum 50 mm) Segmental decorative paving on concrete base—subbase only required if existing	As specified in Final restoration of pathways and driveways	92% MMDD or 95% MSDD
	Subgrade	Varies	As specified in Trench backfill	90% MSDD or Density Index 70
	Bedding Zone	As per Utility Authority's Specification	As per Utility Authority's Specification	As per Utility Authority's Specification

8.2 TYPICAL FINAL RESTORATION IN CARRIAGEWAY OR HEAVY DUTY DRIVEWAY

Reinstatement Width ⟷ / Finished surface level	**Backfill zone**	**Backfill zone thickness**	**Backfill material**	**Compaction requirement**
Base level	Wearing Surface (Course)	Match existing	Match existing	
Subbase level	Base Course	Match existing	As specified in Final restoration of carriageway subbase and base (flexible)	98% MMDD or 102% MSDD
Subgrade level	Subbase course	Match existing	As specified in Final restoration of carriageway subbase and base (flexible)	
	Subgrade	Varies	As specified in Trench backfill	98% MSDD or 95% MMDD Density Index 80
	Bedding Zone	As per Utility Authority's Specification	As per Utility Authority's Specification	As per Utility Authority's Specification

9 ANNEXURE B

9.1 INSPECTION AND TESTING REQUIREMENTS

Worksection Clause Reference	Inspection/testing requirement	Documentation
Utility services under concrete road pavements	Superintendent's approval	Instruction from Superintendent
Additional work	Superintendent's Approval	Instruction from Superintendent
Environmental control measures	**Hold Point**	Superintendent's approval
Provision for traffic	**Hold Point**	Superintendent's approval
Set out	**Hold Point**	Superintendent's approval
Trench excavation (Requirements of other public utility authorities)	Checklist	Contractor Checklist Signoff
Trench excavation (Excavation level)	Witness Point (3)	Superintendent's optional approval or Contractor's Checklist Signoff
Trench excavation (Disposal of unsuitable material)	Witness Point (3)	Superintendent's optional approval or Contractor's Checklist Signoff
Bedding zones	**Hold Point** Material Tests (1) Compaction Tests (1)	Superintendent's approval Test Certificates Test Certificates
Trench backfill	Material tests	Test Certificates
Compaction of trench backfill	Compaction tests Witness Point (3)	Test Certificates Superintendent's optional approval or Contractor's Checklist Signoff
Restoration (Paved restoration)	**Hold Point**	Superintendent's approval
Final restoration of carriageway subbase and base (flexible)	Witness Point (2) (3) Material Tests Compaction Tests	Superintendent's optional approval or Contractor's Checklist Signoff Test Certificates Test Certificates
Final restoration of carriageway wearing surface (course)	Material Tests	Test Certificates
Final restoration of pathways and driveways (Subbase/Base0	Witness Point (2) (3) Material Tests Compaction Tests	Superintendent's optional approval or Contractor's Checklist Signoff Test Certificates Test Certificates
Final restoration of pathways and driveways (Concrete footpaths and driveways including textured and patterned)	Material Tests	Test Certificates. Evidence of Council Approval if changing surface finish from existing
Cleanup	Witness Point (3)	Superintendent's Optional Approval or Contractor's Checklist Signoff

1 Where required by Utility Authorities' Specification.

2 **Hold Point** if Contractor intends to leave temporary base/subbase in place.

3 Contractor to give 24 hours notice to the Superintendent for optional attendance and inspection. If option not exercised, then Contractor to signoff on the Quality Checklist.

10 ANNEXURE C

MINIMUM TESTING FREQUENCY

Activity	**Key quality verification requirements**	**Minimum test frequency**	**Test method**
Trench backfill under carriageways and footpaths, materials supply	Material properties as specified in this Specification	1 per contract or source of supply for each type of material used or suppliers test certificates. Minimum 1 per 500 m^3 or as required by the relevant AUS-SPEC Pavement Specification.	As specified
Trench backfill under carriageways and footpaths, placement	Compaction	1 per 2 layers per 100 lineal metres of trench or per 20 road openings for openings of less than 10 m^2 plan area whichever results in the most frequent testing.	AS 1289.5.1.1 AS 1289.5.2.1 AS 1289.5.6.1
Subbase and base materials supply	Material properties as specified	Suppliers test certificates in accordance with the relevant AUS-SPEC Pavement Specification.	As specified
Subbase and base placement	Compaction	1 per pavement layer, per 100 lineal metres of trench or per 20 road openings for openings of less than 10 m^2 plan area whichever results in the most frequent testing.	AS 1289.5.1.1 AS 1289.5.2.1
Wearing surface materials	Material properties as specified in the relevant AUS-SPEC Pavement Specification	Supplier test certificates in accordance with the relevant AUS-SPEC Pavement Specification.	As specified
Wearing surface placement	Testing as specified in the relevant AUS-SPEC Pavement Specification	Check evenness of restored surface in accordance with **Final restoration of carriageway wearing surface (course)**	As specified

1163 RIGID CONCRETE AND ROAD SAFETY BARRIER SYSTEMS (PUBLIC DOMAIN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the setting out and construction of concrete safety barriers from precast units, by fixed forms or slipforming in accordance with the requirements for rigid road safety barrier systems in AS/NZS 3845.

Safety barriers may be constructed adjacent to or on new or existing pavements.

This worksection details the requirements for public domain, Type F and VCB, rigid road safety barrier systems.

Non-rigid road safety barrier systems are specified in 1194 *Non-rigid road safety barrier systems (Public domain).*

1.2 PATENTED SYSTEMS

Where a patented rigid road safety barrier system is specified and shown on the Drawings, all materials shall be in accordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

Where a patented crash attenuator is specified and shown on the Drawings, all materials shall be in accordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

1.3 QUALITY

Requirements for quality system or quality control are given in 0161 *Quality (Construction)*.

1.4 REFERENCE DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1101 Control of traffic

1191 Pavement markings

1192 Signposting

1194 Non-rigid road safety barrier systems (Public Domain)

Standards

AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1379	Specification and supply of concrete
AS 1906	Retroreflective materials and devices for road traffic control purposes
AS 1906.2	Retroreflective devices (non pavement application)
AS 3610	Formwork for concrete
AS 3799	Liquid membrane-forming curing compounds for concrete
AS/NZS 3845	Road safety barrier systems

2 MATERIALS

2.1 CONCRETE

Concrete
Supply and placement of concrete, steel reinforcement, formwork, tolerances, construction joints and protection shall conform to the requirements of 0310 *Minor concrete works*.

Strength
The minimum strength of concrete at 28 days shall be 30 MPa for cast-in-situ formed concrete or precast concrete and 40 MPa for slip formed concrete construction unless shown otherwise on the Drawings.

Slump
The maximum nominal size of aggregate shall be 20 mm, and the specified slump at the point of placement shall be 25 mm for slipforming and 80 mm for fixed forms.

Ready mixed concrete
If ready-mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

Sampling and testing contractor's cost
Concrete shall be sampled and tested by personnel from a NATA registered laboratory and the test results certified by a NATA endorsed signatory. All costs for sampling and testing shall be borne by the Contractor.

Testing frequency
A pair of cylinders shall be provided and tested for compressive strength for every 50 m^3 of concrete placed. Strength results shall be submitted to the Superintendent if so requested by the Superintendent.

3 CONSTRUCTION

3.1 GENERAL

Traffic control
The Contractor shall at all times conform to the requirements of 1101 *Control of traffic*.

Construction of rigid barrier shall comply with AS/NZS 3845 except where explicit departures are detailed in the Drawings.

Type of construction
Unless otherwise stated on the Drawings, the barrier may be precast, constructed in fixed forms or slip-formed to the dimensions and details as shown on the Drawings.

Connections to non-rigid barriers
Where a non-rigid road safety barrier is to be connected to a rigid road safety barrier, anchorage assemblies shall be cast into the road safety barrier to the dimensions and details as shown on the Drawings. All other components for non-rigid road safety barriers are specified in a separate worksection part.

Set out approval
The set out of the safety barrier shall be presented to the Superintendent for approval before construction commences.

This action constitutes a **Hold Point**.

The Superintendent's approval to the set out is required prior to the release of the **Hold Point**.

3.2 PREPARATION OF THE BASE

Cleaning
For safety barriers constructed on new or existing pavements, before placing the mortar pad for precast units or placing concrete or slipforming, the base shall be cleaned of all loose materials and dust.

Dowels and core holes

Safety barriers constructed on new or existing pavements shall be provided with dowels in cored holes at regular staggered spacings as shown on the Drawings. When precast units are used care must be taken to align and space the core holes accurately.

Compaction of foundations

For safety barriers constructed adjacent to new or existing pavements, the foundation material shall be shaped and compacted to form a firm base.

Other than for barriers constructed on pavement courses, the relative compaction shall be at the 95 % in accordance with AS 1289.5.4.1 for standard compactive effort. Where placed on pavement courses, the foundation shall be compacted to the requirements of the respective pavement course.

Electrical conduits

For safety barriers containing street lighting standards, the conduit carrying electrical cables must be located in the base rather than in the barrier, as detailed on the Drawings, unless otherwise approved by the Superintendent.

For slip-formed barriers the conduit trench forms a key and no dowels are required unless shown otherwise on the Drawings.

3.3 CONCRETE PLACEMENT

High/low spots

For fixed form construction, 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 shall be made before the concrete has hardened.

Concrete finish

For fixed form construction, the concrete surface shall be finished true and uniform to a class 2 finish in accordance with AS 3610.

Hand finishing

For slip form construction, where hand finishing is required, every effort shall be made to provide a uniform appearance of the barrier.

Precast units

Precast units shall be placed on a mortar pad of 10 mm minimum thickness.

3.4 ALIGNMENT AND LEVEL

Finish and appearance

The top and face of the barrier shall be true to line and the top surface shall be of uniform width, free from humps, sags and other irregularities.

Line and level tolerance

The line and level at any point on the safety barrier shall be within ±50 mm of the plan location and within ±20 mm of the design levels as shown on the Drawings.

Surface tolerance

When a 3 m long straight edge is laid on top of or along any face of the barrier the surface shall not vary more than 5 mm from the edge of the straight edge except at grade changes or curves in which case the faces shall transition uniformly.

3.5 JOINTS

Contraction joints

Where construction is in fixed forms or by slip-forming, contraction joints of minimum 50 mm depth shall be formed on all exposed surfaces at 4 m spacing.

Expansion joints

Expansion joints of 15 mm width for the full depth of the barrier shall be constructed where specified on the Drawings. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

Pavement joints

Where the barrier is cast on concrete pavement the contraction, isolation, tied or expansion joints as they appear in the pavement shall be continued through the barrier.

Adjacent to pavement
Where the barrier is cast adjacent to a concrete pavement the contraction joints shall be formed at 4 m centres.

Precast units
Precast units shall be placed such that all connections are tight, secure and true in line and level.

3.6 CURING

Curing compound
For slip-formed barriers either wax emulsion, hydrocarbon resin or water borne curing compounds to the requirements of AS 3799 Class A Type 1, Class B Type 1-D or Class Z Type 1-D respectively shall be used.

Compliance
The Contractor shall provide a certificate of compliance for the curing compound from a laboratory with appropriate NATA registration.

Application rate
The curing compound shall be applied in a fine spray to provide even coverage at a rate of 0.2 l/m2 or the rate determined on the test certificate to achieve 95 % water retention, whichever is the greater.

Equipment on site
Equipment and materials for the curing operations shall be kept on site at all times during slip-forming of the barrier.

Precast units
Moist curing systems are acceptable when demonstrated as an effective process during manufacture of precast barrier units.

3.7 DELINEATORS

Fixing
Delineators complying with AS 1906.2 shall be fixed with brackets to the concrete safety barrier at locations, and to the details, as shown on the Drawings.

Arrangement and colour
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.

3.8 SIGNAGE AND LINEMARKING AT BARRIER

Permanent signage, and longitudinal linemarking
Permanent signage, and longitudinal linemarking adjacent to the concrete safety barrier shall be provided in accordance with 1191 *Pavement markings* and 1192 *Signposting*.

Removal of temporary traffic control devices
Temporary traffic control devices installed for the control of traffic shall not be removed before the concrete safety barrier, permanent signing and longitudinal linemarking have been inspected and approved by the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the concrete safety barrier, signing and linemarking is required prior to the release of the **Hold Point**.

4 WIRE ROPE BARRIER

Wire rope barrier shall not be used.

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1163.1 and 1163.2 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Traffic control is measured and paid in accordance with 1101 *Control of traffic*.

Concrete safety barrier is measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Linemarking and signage are measured and paid in accordance with 1191 *Pavement markings* and 1192 *Signposting*.

5.2 PAY ITEMS

1163.1 Road safety barrier

- 1163.1(1) Type F
- 1163.1(2) Type VCB

The unit of measurement shall be the linear metre measured along the top of the barrier, excluding terminal ends.

A separate schedule shall be provided for differing base conditions.

The schedule rate shall include all operations and provision of materials as described in this worksection and shown on the Drawings to provide the safety barriers complete in all respects.

1163.2 Terminal ends

The unit of measurement shall be ‘each’ terminal end provided.

The schedule rate shall include all operations and provision of materials as described in this worksection and shown on the Drawings to provide the terminal ends complete in all respects.

The schedule rate shall also include, where specified and shown on the Drawings, cast in anchorage assemblies for the connection of non-rigid road safety barriers.

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1171 SUBSURFACE DRAINAGE

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of:

- preparation for subsurface drainage construction;
- siting of subsurface drainage facilities;
- the supply of all materials associated with the provision of the subsurface drainage system;
- all activities and quality requirements associated with the supply, placement and compaction of filter material;
- the provision of a detailed record of all subsurface drain installations;
- the marking on the ground of the location of all subsurface drains.

This is the general worksection common and applicable to all types of subsurface drainage and shall be read in conjunction with subsurface drainage worksections 1172 *Subsoil and fountain drains*, 1173 *Pavement drains*, 1174 *Drainage mats*, as applicable to particular contracts.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1102 Control of erosion and sedimentation

1112 Earthworks (Roadways)

1172 Subsoil and fountain drains

1173 Pavement drains

1174 Drainage mats

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by dry sieving
AS 1141.22	Wet/dry strength variation
AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.5.1	Soil compaction and density tests—Determination of the minimum and maximum dry density of a cohesionless material—Standard method
AS 2439	Perforated plastics drainage and effluent pipe and fittings
AS 2439.1	Perforated drainage pipe and associated fittings
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3705	Geotextiles—Identification, marking and general data
AS 3706	Geotextiles—Methods of test
AS 3706.11	Determination of durability—Resistance to degradation by light, heat and moisture
AS/NZS 1477	PVC pipes and fittings for pressure applications

Other publications

AUSTROADS

AP-3/90 Guide to Geotextiles.

ASTM

D2434 Test method for permeability of granular soils (Constant head)

1.4 EXTENT OF WORK

Details of the work are shown on the Drawings. The requirements of this Contract are summarised as follows:

- [complete/delete]

2 MATERIALS

2.1 SUBSURFACE DRAINAGE PIPES

Approval

Pipes shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent that the pipes conform to the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the documentary evidence is required prior to the release of the **Hold Point**.

Corrugated circular plastic pipe and fittings

Pipe: Corrugated circular plastic pipe shall comply with AS 2439.1 and shall be Class 1000 of 65 mm or 100 mm diameter as shown on the Drawings. All pipe shall be slotted except where shown on the Drawings.

Fittings: Joints, couplings, elbows, tees and caps shall also comply with AS 2439.1 and only the manufacturer's recommended fittings shall be used.

Certificate of Compliance: The Contractor shall obtain from the supplier a Test Certificate demonstrating compliance with AS 2439.1.

Corrugated flat plastic pipe and fittings

Pipe: Corrugated flat plastic pipe shall be of the 'Stripdrain' or 'Megaflo' type or equivalent as approved by the Superintendent of size as shown on the Drawings and shall be supplied already enclosed in geofabric or seamless tubular filter fabric.

The Superintendent's approval shall be subject to provision of information as set out in **Other types of subsurface drainage pipes**.

Fittings: Only the manufacturer's recommended fittings shall be used.

Thick walled PVC pipe

Pipe: Thick walled PVC pressure pipe shall comply with AS/NZS 1477 and shall have a nominal diameter of 58 mm and a minimum wall thickness of 6.5 mm. All pipe shall be slotted except where shown on the Drawings. Details of slot sizes and spacings shall be in accordance with Annexure A.

Joints: Thick walled PVC pressure pipe shall have square ends and shall be butt jointed.

Certificate of Compliance: The Contractor shall obtain from the supplier a Test Certificate demonstrating compliance with AS/NZS 1477.

2.2 OTHER TYPES OF SUBSURFACE DRAINAGE PIPES

Approval

Where a Contractor wishes to use a subsurface drainage pipe other than the pipes described in **Subsurface drainage pipes**, the Contractor shall submit, for approval by the Superintendent, full details of the type of pipe, certification from the manufacturer of its suitability and quality for use in each particular application.

Certification of the suitability of any pipe will address the crushing strength, flexural strength, jointing system and slotting details.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted details is required prior to the release of the **Hold Point**.

2.3 FILTER MATERIAL

General

All filter material shall consist of clean, hard, tough, durable particles.

Types

The types of filter material covered by this worksection shall include:

- Type A filter material for use in trench drains and Type B drainage mats.
- Type B filter material for use in trench drains and Type B drainage mats.
- Type C filter material comprising crushed rock for use in Type A drainage mats.
- Type D filter material comprising uncrushed river gravel for use in Type A and Type B drainage mats.

Type A filter material

Type A filter material shall be crushed rock or granular material complying with Table 2.1.

Type B filter material

Grading: Type B filter material shall be granular material complying with Table 2.2.

Coefficient of saturated permeability: 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 ASTM-D2434-68, of at least 8 metres per day after three hours of flow.

Grading variation: Type B filter material shall not vary from its original grading as a result of compaction processes by more than that given in Table 2.3.

Type C filter material

Type C filter material shall comply with Table 2.4

Type D filter material

Type D filter material shall be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS 2758.1 and Table 2.5.

Table 2.1 Type A filter material

Test method	Property		Requirement
AS 1141.11	Material passing AS sieve		% by mass
	6.7 4.75 2.36 1.18 425	mm mm mm mm μm	100 85 to 100 0 to 40 0 to 5 0 to 2

Table 2.2 Type B filter material

Test Method	Property		Requirement
AS 1141.11	Material passing AS sieve		% by mass
	4.75 2.36 425 300 150 75	mm mm μm μm μm μm	100 95 to 100 20 to 80 0 to 30 0 to 2 0 to 0.1

Table 2.3 Type B filter material variation

AS Sieve	Variation from grading before treatment (% of mass)
2.36 mm 1.18 mm	± 3 ± 1

AS Sieve	Variation from grading before treatment (% of mass)
425 μm 300 μm 150 μm 75 μm	± 1 ± 1 ± 0.5 ± 0.1

Table 2.4 Type C filter material

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	37.5 mm
	Maximum passing the 9.5 mm AS Sieve	5% by mass
	Maximum (D90:D10)*	3
AS 1141.22	Minimum wet strength	100 kN
	Maximum 10% fines wet/dry variation	30%
Note: The D90 value shall be determined by sieving the material using 75 mm, 53 mm, 37.5 mm, 26.5 mm, 19 mm, 13.2 mm and 9.5 mm 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 % passing. D10 denotes the theoretical size of a sieve through which 10 % of the material would pass and shall be determined from the same graph used to determine the D90 value.		

Table 2.5 Type D filter material

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

2.4 GEOTEXTILE

Approval

Geotextiles shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent that the geotextile and installation process conforms to the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the documentary evidence is required prior to the release of the **Hold Point**.

General

Material and labelling: The geotextile, other than seamless tubular filter fabric, shall consist of either a woven or a non-woven type which shall be manufactured from synthetic materials other than polyamide. Rolls of geotextile shall be marked with product identification and supplied with data sheets and information in accordance with the requirements of AS 3705. The geotextile shall be bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents when tested in accordance with the appropriate parts of AS 3706.

Ultra violet light resistant: The geotextile shall be resistant to ultra-violet light. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of twenty-one days. If exposure in excess of twenty-one days does occur, the geotextile shall be tested in accordance with AS 3706.11 and if its characteristics have deteriorated to or below 90 % of the characteristics claimed by the manufacturer or the characteristics determined on unexposed

geotextile, whichever is the better, it shall be removed and replaced with a geotextile complying with this worksection.

The geotextile material type, strength rating 'G', and minimum mass requirements shall be as shown on the Drawings. The type, properties, functions, design and construction requirements for a particular application of geotextile installation shall be compatible with recommendations provided by the AUSTROADS *Guide to Geotextiles* as well as requirements indicated on the drawings.

Water transmission rate: In addition to the abovementioned requirements, geotextiles for curtain drains shall consist of either polyester, polypropylene or polyethylene. When subjected to a pressure of 200 kPa applied at right angles to the plane of the fabric and to a constant head of water no greater than 50 mm applied to the top edge of the fabric, geotextiles for curtain drains shall have a rate of water transmission not less than 20 litres per hour per metre width of fabric through a 300 mm length of the fabric.

Seamless tubular filter fabric

Material: Seamless knitted tubular filter fabric shall be manufactured from either polypropylene or polyester and shall be used to enclose slotted pipe of 65 mm or 100 mm diameter. The fabric shall be free of imperfections in weave or yarn and have abrasion resistant and weave stability qualities such that it shall not form holes, ladder, deweave, tear or unravel more than 5 mm from a cut end.

Opening size: The representative large opening size of the fabric shall be between 200 and 500 microns.

Fitting: Fitting of the seamless tubular filter fabric shall be in accordance with the requirements of Annexure B. 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.

3 CONSTRUCTION

3.1 TEMPORARY DRAINAGE DURING CONSTRUCTION

Erosion control

All drainage works carried out by the Contractor shall comply with 1102 *Control of erosion and sedimentation*.

Runoff overflows during construction

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.

Location of equipment

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.

3.2 SITING OF WORK

Set-out approval

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.

Amendments to planned work

The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions.

Any activity resulting from such amendments by the Superintendent shall be deemed to be included as part of the work covered by the Schedule of Rates. Should the Superintendent require a change to the conditions of installation an appropriate variation shall be ordered.

Proposed changes by contractor

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.

3.3 EXCAVATION

Safety

In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

Approval by public utility authorities

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.

Blasting operation

Excavation by blasting, if permitted, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed drainage structure does not exceed 25 mm/sec.

The Contractor shall comply with other requirements concerning blasting operations in *1112 Earthworks (Roadways).*

Excavation level

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.

This action constitutes a **Hold Point**.

The Superintendent's approval to the trench level is required prior to the release of the **Hold Point**.

Unsuitable material

Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable shall be removed and disposed of in accordance with 1112 *Earthworks (Roadways)* by the Contractor and replaced with backfill material in accordance with the requirements of this worksection.

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 work.

Excavated material

The excavated material shall be used in the construction of embankments, backfilling or spoiled in accordance with 1112 *Earthworks (Roadways)*.

3.4 BACKFILLING

Backfilling shall be carried out in accordance with the requirements of the relevant subsurface drainage worksections with materials as specified in this worksection and materials to the requirements of 1112 *Earthworks (Roadways)*.

3.5 OUTLET STRUCTURES FOR SUBSURFACE DRAINAGE PIPES

Discharge and salinity prevention

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.

As a salinity prevention measure, and where practicable, discharge shall be on the downhill side of the embankment or in the cut-fill area so as to reduce the risk of recharge to the subsurface water table.

Spacing

Outlets shall be spaced at an absolute maximum interval of 150 m.

Rodent proof

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

Erosion control

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 together with a marker post to indicate location and assist maintenance.

Outlet pipe

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.

Concrete Specification
All concrete used in the construction of outlet structures shall conform to the 0310 *Minor concrete works*.

3.6 RECORDING OF SUBSURFACE DRAINAGE INFORMATION

Work as executed plans
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.

Information sheet
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.

The information to be included in the subsurface drainage information sheets shall include:

- 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

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

4 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 4.1.

Table 4.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Filter material		
- Type A	Table 2.1	**Filter material**
- Type B	Tables 2.2 and 2.3	**Filter material**
- Type C	Table 2.4	**Filter material**
- Type D	Table 2.5	**Filter material**
Geotextile		
- Exposure to sunlight	<21 days If >21 days deterioration not to exceed 10% of claimed characteristics	**Geotextile**
- Curtain Drains Water Transmission	>20 litres/hr/m	**Geotextile**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Excavation by Blasting		
Peak particle velocity	≤25 mm/sec	**Excavation**
Outlets		
Spacing	Max 150 m	**Outlet structures for subsurface drainage pipes**

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection and the associated activity specific worksections on a schedule of rates basis in accordance with Pay Items 11711.1 to 1171.5 inclusive.

Pay Items applicable to particular activities are listed in the worksections for these activities.

Common to subsurface drainage works are Filter Material and Outlet Structures and payment for these items shall be made under this worksection.

A Lump Sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Erosion and sedimentation control measures are measured and paid in accordance with 1102 *Control of erosion and sedimentation*.

Excavation and geotextile material are measured and paid in accordance with the worksection applicable to the particular activity.

Unsuitable material removal is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

Concrete work for outlet structures is measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

5.2 PAY ITEMS

11711.1 Filter material type ‘a’ backfill

The unit of measurement shall be the compacted cubic metre.

The volume shall be computed from the actual length and depth of the trench or mat up to the level of the filter material multiplied by the design width of the trench.

The rate shall include the supply, placement and compaction of filter material and the ‘capping’ of the trench where shown on the Drawings.

The schedule quantity is a provisional quantity.

1171.2 Filter material type ‘b’ backfill

The unit of measurement shall be the compacted cubic metre.

The volume shall be computed from the actual length and depth of the trench or mat up to the level of the filter material multiplied by the design width of the trench or mat.

The rate shall include the supply, placement and compaction of filter material and the ‘capping’ of the trench where shown on the Drawings.

The schedule quantity is a provisional quantity.

1171.3 Filter material type ‘c’ backfill

The unit of measurement shall be the compacted cubic metre.

The volume shall be computed from the actual length and depth of the mat multiplied by the design width of the mat.

The rate shall include the supply, placement and compaction of filter material.

The schedule rate is a provisional quantity.

1171.4 Filter material type 'd' backfill

The unit of measurement shall be the compacted cubic metre.

The volume shall be computed from the actual length and depth of the mat multiplied by the design width of the mat.

The rate shall include the supply, placement and compaction of filter material.

The schedule quantity is a provisional quantity.

1171.5 Outlet structures for subsurface drainage pipes

The unit of measurement shall be 'each' outlet structure, excluding outlets into pits, provided in accordance with this worksection.

The schedule rate under this Pay Item shall include all the operations involved in the construction of the outlet including the forming of the structure, supply of concrete and, where directed by the Superintendent, the provision of erosion control measures.

The schedule quantity is a provisional quantity.

6 ANNEXURE A

6.1 Slotting details for thick walled PVC plastic pipe

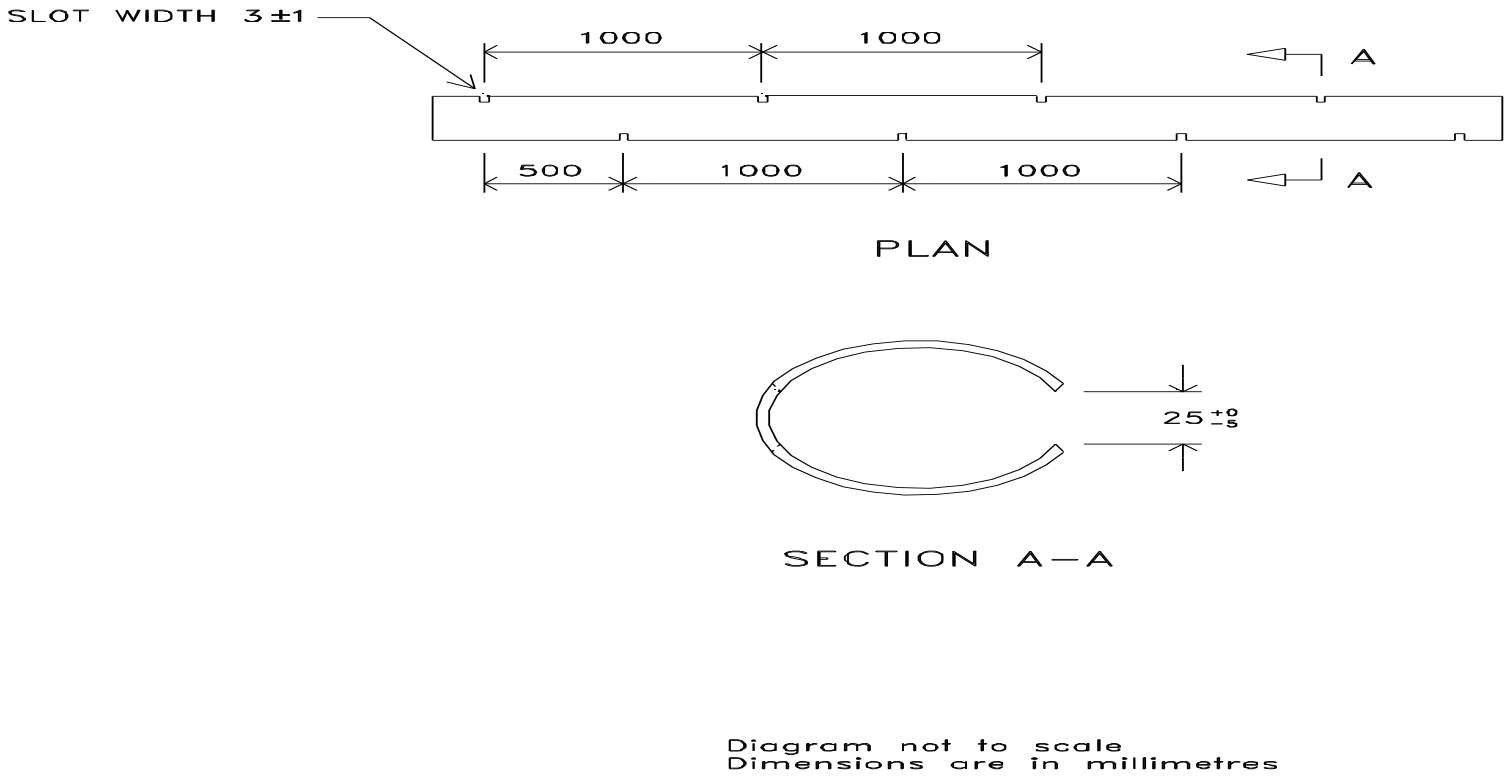

Figure A1 Slotting details for thick walled pvc plastic pipe

7 ANNEXURE B

Slotted pipes fitted with seamless tubular filter fabric

7.1 PROCEDURE FOR FITTING SEAMLESS TUBULAR FILTER FABRIC TO SLOTTED PIPE

Seamless tubular filter fabric may be fitted to slotted pipe on site 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 20 mm and 30 mm 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.

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.

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1172 SUBSOIL AND FOUNDATION DRAINS

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection covers the excavation, bedding, installation and backfilling of subsoil and foundation drains.

This worksection should be read in conjunction with 1171 *Subsurface drainage*.

1.2 TERMINOLOGY

Subsoil drains

The subsoil drains are intended for the drainage of ground water and/or the pavement in cuttings.

Foundation drains

Foundation drains are required for the drainage of seepage, springs and wet areas within and adjacent to the foundations.

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

1112 *Earthworks (Roadways)*

1171 *Subsurface drainage*

Standards

AS 1289 Methods of testing soils for engineering purposes

AS 1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

1.5 LOCATION

Subsoil and foundation drains shall be constructed where and as shown on the Drawings or as directed by the Superintendent.

1.6 ORDER OF CONSTRUCTION

Subsoil drains

Subsoil drains shall comply with the following:

- Timing of work—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.
- Excessive groundwater—Where a Selected Material Zone is specified and excessive ground water is encountered, subsoil drains may be installed in two stages as follows:
  - 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.

Foundation drains

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

2 CONSTRUCTION

2.1 SUBSOIL DRAINS

Excavation

Excavation shall comply with the following:

- Associated worksection—Excavation shall be undertaken in accordance with the requirement of 1171 *Subsurface drainage*.
- Grade—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%. In which case the trench depth shall be increased to provide a minimum grade of fall in the trench of 0.5%. The bottom of the trench shall be excavated so that no localised ponding of water occurs.
- Over-excavation—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 AS 1289.5.4.1, of at least 95% (Standard compaction), the bottom of the trench shall be at the specified floor level.
- Two stage construction—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.

Laying of pipe

Pipe laying shall comply with the following:

- Bedding—A bed of filter material 50 mm in compacted thickness and shall be laid to the specified line and grade.
  This action constitutes a **Hold Point**.
  The Superintendent's approval of the compacted bedding is required prior to the release of the **Hold Point**.
- Filter material—The type of filter material shall be as shown on the Drawings or as directed by the Superintendent.
- Location, grade and pipe—The 100 mm diameter corrugated slotted plastic piping, or the corrugated flat plastic piping, complying with 1171 *Subsurface drainage*, shall be laid on the compacted bed to the specified line and level. The pipe shall not deviate from the specified line by more than 100 mm at any point.
- Joints and capping—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 PVC cap.

Backfilling

Backfilling shall comply with the following:

- Filter material—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 300 mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance to the pipe.
- Compaction of filter material—The filter material shall be compacted for its full depth to a relative compaction of not less than 100 % (Standard compaction) as determined by AS 1289.5.4.1.
- Select Material—The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with selected free draining backfill material, conforming to the requirements of 1112 *Earthworks (Roadways)*, compacted for its full depth to a relative compaction of not less than 100% (Standard compaction) as determined by AS 1289.5.4.1.
- Geotextile—Where shown on the Drawings or as directed by the Superintendent, a geotextile conforming with the requirements of 1171 *Subsurface drainage*, shall be provided at the interface between the filter material and adjoining materials. Laps of 500 mm shall be provided at joints in the fabric.

Outlets

Outlets are to be provided as shown on the Drawings or at maximum intervals of 150 m. Subsoil drains shall discharge into gully pits and other stormwater drainage structures. Outlets shall be constructed of unslotted plastic pipe of the same diameter as the main run when outside the targeted subsurface water catchment. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

Cleanouts

Cleanouts shall be provided at the commencement of each run of subsoil drain line and at intervals of approximately 60 m or as shown on the Drawings. Details of the required cleanout construction are shown on the Drawings. The standard Cl caps as shown on the Drawings shall be supplied by the Contractor.

2.2 FOUNDATION DRAINS

Excavation

Excavation shall be undertaken in accordance with 1171 *Subsurface drainage*, and **Subsoil drains**.

Laying of pipe

Pipe laying shall comply with the following:

- Bedding—A bed of filter material 50 mm in compacted thickness and shall be laid to the required line and grade.
  This action constitutes a **Hold Point**.
  The Superintendent's approval of the compacted bedding is required prior to the release of the **Hold Point**.
- Filter material—The type of filter material shall be as shown on the Drawings or as directed by the Superintendent.
- Pipe—The 100 mm diameter corrugated slotted plastic piping, or the corrugated flat plastic piping, complying with 1171 *Subsurface drainage*, shall be laid on the compacted bed.
- Jointing of pipe—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 PVC cap.

Backfilling

Backfilling shall comply with the following:

- Filter material—The trench shall be backfilled with filter material in accordance with the provisions of **Subsoil drains**.
- Earth backfill—The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with suitable earth free draining backfill material, compacted for its full depth to a relative compaction of not less than 95 % (Standard compaction) as determined by AS 1289.5.4.1.
- Geotextile— Where shown on the Drawings or as directed by the Superintendent, a geotextile, conforming with the requirements of 1171 *Subsurface drainage*, shall be provided at the interface between the filter material and adjoining materials.

  Laps of 500 mm shall be provided at joints in the geotextile.

Outlets

An outlet structure in accordance with the detail shown on the Drawings and 1171 *Subsurface drainage* 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.

3 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1. Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Excavation		
-Trench Grade	≥0.5%	**Subsoil drains**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
- Compaction	>95% (Standard compaction)	**Subsoil drains**
Laying of pipe		
Alignment	Deviation <100 mm from specified line at any point	**Subsoil drains**
Subsoil drain backfill		
- Layer thickness	300 mm max	**Subsoil drains**
- Compaction (Relative) Filter and Backfill material	100% (Standard compaction)	**Subsoil drains**
Outlet spacing	150 m max	**Subsoil drains**
Cleanout spacing	60 m approx	**Subsoil drains**
Foundation drain backfill		
- Layer thickness	300 mm max	**Subsoil drains**
- Compaction (Relative) Filter material Backfill material	 100% (Standard compaction) >95% (Standard compaction)	 **Subsoil drains** **Foundation drains**

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed under this worksection on a schedule of rates basis in accordance with Pay Items 1172.1 to 1172.6 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Filter material and outlet structures are measured and paid in accordance with 1171 *Subsurface drainage*.

Backfill material (other than filter material) is measured and paid in accordance with this worksection and not 1112 *Earthworks (Roadways)*.

4.2 PAY ITEMS

1172.1 Excavation for subsoil and foundation drains

The unit of measurement shall be the cubic metre measured as bank volume of excavation.

The volume of excavation shall be determined by multiplying the width, depth and length of the trench.

The width of trench shall be as shown on the Drawings or as directed by the Superintendent.

The depth and length of excavation shall be based on the Superintendent's instructions and shall be determined at the time of excavation.

The sides of the trench shall be taken as vertical.

The schedule rate shall cover all types of material and separate rates shall not be included for earth or rock. The rate is deemed to include:

setting out and associated survey work;

replacement for overexcavation for any reason;

control of stormwater run-off, temporary drainage and erosion and sedimentation control.

The disposal of material from drain excavation shall be included in the schedule rate for excavation.

The schedule quantity is a provisional quantity.

1172.2 Subsoil drain pipe—100 mm dia slotted corrugated plastic pipe

The unit of measurement shall be the linear metre measured along the length of the pipe.

The schedule rate shall cover the supply and laying of the subsoil pipe.

The rate shall include connections, markers, fittings and seamless tubular filter fabric where specified.

The schedule quantity is a provisional quantity.

1172.3 Subsoil drain pipe—corrugated flat plastic pipe

The unit of measurement shall be the linear metre measured along the length of the pipe.

The schedule rate shall cover the supply and laying of the subsoil pipe.

The rate shall include connections, markers, fittings and seamless tubular filter fabric where specified.

The schedule quantity is a provisional quantity.

1172.4 Supply, placement and compaction of backfill material (other than filter material) for subsoil and foundation drains

The unit of measurement shall be the cubic metre of compacted backfill material.

The volume of backfill material shall be determined by multiplying the width, depth and length of backfill material in the trench.

The width of the trench shall be as shown on the Drawings or as directed by the Superintendent.

The depth and length of backfill material in the trench shall be based on the Superintendent's instructions and shall be determined on site.

The sides of the trench shall be taken as vertical.

The schedule of quantity is a provisional quantity.

1172.5 Supply and placement of geotextile

The unit of measurement shall be the square metre of area covered by geotextile as measured on site.

The schedule rate shall cover the supply placing and securing of the geotextile material.

No additional payment shall be made for additional geotextile used in lap joints.

The schedule quantity is a provisional quantity.

1172.6 Cleanout structures

The unit of measurement shall be 'each' cleanout structure constructed in accordance with the Drawings.

The schedule rate shall cover the supply and installation of standard cast iron lids and the recording of cleanout locations in accordance with 1171 *Subsurface drainage*.

The schedule quantity is a provisional quantity.

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1173 PAVEMENT DRAINS

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the installation of Sub-Pavement Drains, Intra-Pavement Drains and Edge Drains.

This worksection should be read in conjunction with 1171 *Subsurface drainage*.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksection

0165 Quality (Construction)

1101 Control of traffic

1112 Earthworks (Roadways)

1141 Flexible pavements

1144 Asphaltic concrete (Roadways)

1171 Subsurface drainage

Standard

AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

1.4 TERMINOLOGY

Sub-pavement drains

Sub-pavement drains are intended for the drainage of the pavement layers where the subbase is not a macadam crushed rock.

Intra-pavement drains

Intra-pavement drains are intended for the drainage of the pavement layers of a flexible pavement where the subbase material is a macadam crushed rock or open graded asphaltic concrete.

Edge drains

Edge drains are intended for the drainage of rigid pavements.

1.5 ORDER OF CONSTRUCTION

Sub-pavement drains

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.

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 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.

Intra-pavement drains

Intra-Pavement Drains shall be constructed after the completion of the layer below the crushed rock

Macadam or 40 mm open graded asphaltic concrete subbase and preceding the construction of the subsequent layers.

Edge drains

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

2 CONSTRUCTION

2.1 SUB-PAVEMENT DRAINS

Excavation

Trench dimensions:

Trenches 300 mm wide shall be trimmed to the required line and to a depth of 600 mm 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 grade: 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%, in which case the depth of the trench shall be increased to provide a grade of 0.5% in the trench. The bottom of the trench shall be excavated so that no localised ponding of water occurs.

Two-stage construction: 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.

Laying of pipe

Filter bed approval: A bed of filter material 50 mm in compacted thickness and shall be laid to the required line and grade.

This action constitutes a **Hold Point**.

The Superintendent's approval to the compacted bedding is required prior to the release of the **Hold Point**.

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

Filter bed: The 100 mm diameter corrugated slotted plastic piping, complying with 1171 *Subsurface drainage*, shall be laid on the compacted bed to the specified line and level.

The pipe shall not deviate from the specified line by more than 100 mm at any point.

Joints and capping: 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 PVC cap.

Backfilling

Filter material: 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 300 mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance of the pipe.

Compaction: The filter material shall be compacted for its full depth to a relative compaction of not less than 100% (Standard compaction) as determined by AS 1289.5.4.1.

Pipe outlets: 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 50 mm above the pipe. The balance of trench shall be backfilled with earth backfill material of maximum particle size of 50 mm and shall be compacted for the full depth to a relative compaction of 95% (Standard compaction) as determined by AS 1289.5.4.1.

Temporary plug over filter material: In the 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 50 mm thick plug of compacted select fill material having a maximum particle size of 25 mm and Plasticity Index of not more than 12 as determined by AS 1289.3.3.1. 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.

Cleanouts

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

Outlets

Location: Outlets are to be provided as shown on the Drawings or at maximum intervals of 150 m. Sub-pavement drains shall discharge into gully pits and other stormwater drainage structures. Outlets shall be constructed of unslotted plastic pipe of the same diameter as the main run when outside the pavement area. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

Rodent proof: The outlet shall be made rodent proof in accordance with 1171 *Subsurface drainage*.

Erosion control: 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.

2.2 INTRA-PAVEMENT DRAINS

Excavation

Trench dimensions: A ‘V’ shaped trench approximately 50 mm deep shall be cut to the required line in the pavement layer immediately below the crushed rock Macadam pavement layer. No excavation is required below a 40 mm open graded asphaltic concrete subbase layer.

Trench grade: The bottom of the trench is to be to the same grade as the roadway. The bottom of the trench shall be constructed so that localised ponding of water does not occur.

Discharge pipe: Where the pipe is to discharge through the fill batter a trench shall be constructed on a grade suitable for the pipe to discharge its contents without scour. After laying the pipe the trench shall be backfilled with fill material and compacted for the full depth to a relative compaction of not less than 95% (Standard compaction) as determined by AS 1289.5.4.1.

Laying of pipe

UPVC pressure pipe: Thick walled unplasticised PVC pressure pipe, complying with 1171 *Subsurface drainage*, shall be used with:

- Crushed rock subbases having not more than 10% of material passing the 9.5 mm AS sieve and having layer thicknesses neither less than 150 mm nor more than 200 mm.
- Open graded asphalt subbases having layer thicknesses neither less than 80 mm nor greater than 100 mm.

Subbases with depth exceeding 200 mm: Where crushed rock subbases require pavement drains and have a depth exceeding 200 mm, the type of pavement drain will need to be certified to have adequate crushing strength and written approval of the Superintendent to the proposed pavement drain type and specification will be required. Similar proposal and Superintendent’s approval is required for pavement drain in asphalt subbases greater than 100 mm in depth.

Inlet cap: The inlet end of the pipe shall be fitted with a cap complying with 1171 *Subsurface drainage*.

Outlet length: The outlet length of pipe from the outside edge of the free-draining subbase to an outlet structure in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with suitable couplings or mastic.

Level and alignment: The pipe shall be laid to the specified line and level. The pipe shall not deviate from the specified line by more than 100 mm at any point

Pipe anchorage: All pipes shall be securely held to the layer under the free-draining subbase to prevent movement of the pipes during placement and compaction of the free-draining subbase.

At least seven days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes to the layer under the free-draining subbase for the approval of the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted details is required prior to the release of the **Hold Point**.

Alternative securing method: Notwithstanding the Superintendent's approval to the use of a method of securing the pipes to the layer under the free draining subbase, if such securing method allows movement of the pipes, the method shall be discontinued and the Contractor shall propose an alternative securing method for approval by the Superintendent. Any additional costs resulting from the use of the alternative method of securing the pipes shall be borne by the Contractor.

Backfilling

Subbase: Subbase material shall be spread, compacted and trimmed, where appropriate, as follows:

- For crushed rock Macadam subbase, in accordance with 1141 *Flexible pavements*.
- For open graded asphalt subbase, in accordance with 1144 *Asphaltic concrete (Roadways)*.
- Prevent damage to pipes: Tipping, spreading and compaction of the subbase shall be undertaken in such a manner as not to damage the intra-pavement drain pipes. If any pipes are damaged as a result of the tipping, spreading and compaction of the subbase, the Contractor shall remove and replace the damaged pipes. The cost of the removal and replacement of such damaged pipes shall be borne by the Contractor.

Subbase layer thickness: The thickness of the layer of subbase material enclosing the pipe shall be within the limits specified in **Intra-pavement drains** for the type of pipe used in the intra-pavement drain.

Outlets

Location: Outlets are to be provided as shown on the Drawings or at maximum intervals of 150 m. Intra-pavement drains shall discharge into gully pits and other stormwater drainage structures.

Construction: Outlets shall be constructed of unslotted plastic pipe, of the same diameter as the main run when outside the pavement area. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

Rodent proof: The outlet shall be made rodent proof in accordance with 1171 *Subsurface drainage*.

Erosion control: 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.

2.3 EDGE DRAINS

Excavation

Width and level: 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.

Trench grade: 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%.

Discharge pipe: When the pipe is to discharge through the fill batter a suitable trench shall be excavated to provide the required grade.

Laying of pipe

Slotted corrugated plastic pipe: Generally, 65 mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric, complying with 1171 *Subsurface drainage*, shall be used for edge drains unless shown otherwise on the Drawings or as directed by the Superintendent.

Slotted PVC pressure pipe: Where any part of a shoulder consists of material other than concrete, slotted thick walled PVC pressure pipe, complying with 1171 *Subsurface drainage*, shall be used.

Securely hold in place: All pipes shall be securely held against the vertical face of the rigid pavement.

Approval securing method: 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.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted details is required prior to the release of the **Hold Point**.

Bedding and alignment: The pipe shall be laid on a prepared bed to the specified line and level. The pipe shall not deviate from the specified line by more than 100 mm at any point.

Jointing: Joints in the pipe shall be kept to a minimum number and shall be made using an external joint coupling approved by the Superintendent.

Inlet cap: The inlet end of the pipe shall be fitted with a cap complying with 1171 *Subsurface drainage*.

Outlet pipe: 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.

Backfilling

Filter material: The pipe shall be covered with Type B filter material, complying with 1171 *Subsurface drainage*, to the dimensions shown on the Drawings.

Soaking of filter material: 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.

Procedure and compaction: 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 1112 *Earthworks (Roadways)*. Backfilling shall be compacted to a relative compaction of not less than 100% (Standard compaction) as determined by AS 1289.5.4.1.

Cleanouts

Location: Cleanouts shall be provided at the commencement of each run of edge drain line and at intervals of approximately 60 m or as shown on the Drawings.

Construction Details: 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.

Outlets

Location: Outlets are to be provided as shown on the Drawings or at maximum intervals of 150 m. Edge drains shall discharge into gully pits and other stormwater drainage structures. Outlets shall be constructed of unslotted plastic pipe of the same diameter as the main run when outside the pavement area. An outlet structure in accordance with the Drawings shall be constructed at the discharge end.

Rodent proof: The outlet shall be made rodent proof in accordance with 1171 *Subsurface drainage*.

Erosion control: 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.

3 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Excavation Trench Grade	≥0.5%	**Sub-pavement drains** **Edge drains**
Sub-pavement drain		
Laying of pipe		
Alignment	Deviation <100 mm from specified line at any point.	**Sub-pavement drains**
Backfill		
- Layer thickness	300 mm max	**Sub-pavement drains**
- Compaction (Relative) Filter material Backfill material	 100% (Standard compaction) >95% (Standard compaction)	 **Sub-pavement drains** **Sub-pavement drains**
Cleanout spacing	60 m approx	**Sub-pavement drains**

Activity	Limits/Tolerances	Worksection Clause Reference
		Edge drains
Outlet spacing	150 m max	**Sub-pavement drains** **Intra-pavement drains** **Edge drains**
Intra-pavement drain		
- Backfill	>95% (Standard compaction)	**Intra-pavement drains**
- Alignment	Deviation <100 mm from specified line at any point.	**Intra-pavement drains**
Edge drains		
- Alignment	Deviation <100 mm from specified line at any point.	**Edge drains**
- Compaction (relative) backfill material	100% (Standard compaction)	**Edge drains**

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Pay Items shall be made for all the activities associated with completing the work detailed under this worksection on a schedule of rates basis in accordance with Pay Items 1173.1 to 1173.3 inclusive.

A Lump Sum price for any of these items will not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Filter material and outlet structures are measured and paid in accordance with 1171 *Subsurface drainage*.

Subbase material, including spreading, compacting and trimming, is measured and paid in accordance with either 1141 *Flexible pavements* or 1144 *Asphaltic concrete (Roadways)*, as appropriate.

Selected material backfill to edge drains is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

4.2 PAY ITEMS

1173.1 Excavation

The unit of measurement shall be the cubic metre measured as bank volume of excavation.

The width of trench shall be as shown on the Drawings or as directed by the Superintendent.

The depth and length of excavation shall be based on the Superintendent's instructions and shall be determined at the time of excavation.

The schedule rate shall cover all types of material and separate rates shall not be included for earth or rock.

The rate is deemed to include:

- setting out and associated survey work;
- replacement for overexcavation for any reason;
- control of stormwater run-off, temporary drainage and erosion and sedimentation control.

The disposal of material from drain excavation shall be included in the schedule rate for excavation.

The schedule quantity is a provisional quantity.

1173.2 Subsoil drain pipe

- 1173.2(1) 100 mm dia slotted corrugated plastic pipe.
- 1173.2(2) 58 mm dia thick walled unplasticised PVC pressure pipe.
- 1173.2(3) 65 mm dia slotted corrugated plastic pipe.

The unit of measurement for Pay Items 1173.2(1), 1173.2(2) and 1173.2(3) shall be the linear metre measured along the length of the pipe. Any unslotted pipe required for outlets shall be included in the length.

The schedule rate shall cover the supply, laying and securing of the subsoil pipe.

The rate shall include connections, fittings and seamless tubular filter fabric where specified.

The schedule quantity is a provisional quantity.

1173.3 Cleanout structures

The unit of measurement shall be 'each' cleanout structure constructed in accordance with the Drawings.

The schedule rate shall include the supply and installation of lids and the recording of cleanout locations in accordance with 1171 *Subsurface drainage*.

The schedule quantity is a provisional quantity.

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1174 DRAINAGE MATS

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection covers the installation of Drainage Mats (Blankets).

This worksection should be read in conjunction with 1171 *Subsurface drainage*.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

1171 *Subsurface drainage*

1173 *Pavement drains*

Standards

AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

1.4 TERMINOLOGY

Type A mats

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.

Type B mats

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.

1.5 ORDER OF CONSTRUCTION

Type A mats

Type A drainage mats shall be constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B mats

Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

1.6 LOCATION

Drainage mats shall be constructed where and as shown on the Drawings or as directed by the Superintendent.

2 CONSTRUCTION

2.1 TYPE A MATS

Location

Type A drainage mats shall be constructed under embankments as and where shown on the Drawings or as directed by the Superintendent.

Placing of geotextile

After the embankment foundation has been trimmed and any necessary trench drains installed, a geotextile complying with 1171 *Subsurface drainage* 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 500 mm shall be provided at each join in the geotextile.

Placing of filter material

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 300 mm plus an allowance for the expected consolidation of the embankment foundation under the embankment load or 500 mm 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 250 mm.

Enclosing filter material and securing of geotextile

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.

Geotextile under rock facing

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.

Damaged geotextile

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.

Protective layer

Type A drainage mats shall extend 2 m beyond the toes of embankments and such extensions shall be covered by a 300 mm thick layer of Type C 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.

Outlets

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 1171 *Subsurface drainage*.

2.2 TYPE B MATS

Location and width

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.

Placing of geotextile

After the subgrade material has been compacted and trimmed, a geotextile complying with 1171 *Subsurface drainage* shall be laid on the subgrade.

Laps of minimum width of 500 mm shall be provided at each join in the geotextile.

UPVC pressure pipe

Thick walled unplasticised PVC pressure Pipe, complying with 1171 *Subsurface drainage* shall be laid on the geotextile at a distance of 200 mm from and parallel to the longitudinal edges of the drainage blanket as shown in the Drawings.

Placing of filter material

Type A filter material shall be placed on the geotextile and compacted to achieve a relative compaction, determined by AS 1289.5.4.1, of at least 100% (Standard compaction).

Alternatively, the Superintendent may approve the use of a coarser Type D filter material having a maximum particle size of 75 mm and a maximum D90/D10 ratio of three.

Thickness of filter material

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 250 mm, the filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250 mm.

Enclosing filter material and securing geotextile

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.

Damaged geotextile

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.

Surface level tolerance

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 40 mm.

Outlet structures where specified, or where directed by the Superintendent, shall be in accordance with 1171 *Subsurface drainage*.

3 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection reference**
Filter material		
- Layer thickness	250 mm max	**Type A mats & Type B mats**
- Compaction (Relative) Type A filter material	100% (Standard compaction)	**Type B mats**
Type B mats		
- Design level at top of mat	+0, –40 mm	**Type B mats**

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1174.1 and 1174.2.

A lump sum price for any of these activities shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Filter material and outlet structures are measured and paid in accordance with 1171 *Subsurface drainage*.

Thick walled unplasticised PVC pressure pipe is measured and paid in accordance with this worksection and not 1173 *Pavement drains* or 1171 *Subsurface drainage*.

4.2 PAY ITEMS

1174 1 Supply and placement of geotextile

The unit of measurement shall be the square metre of area covered by geotextile as measured on site.

No additional payment shall be made for additional geotextile used in lap joints.

For Type A drainage mats, the additional layer of geotextile placed under rock facing shall be measured and included as an additional quantity for payment under this item.

The schedule rate shall cover the supply, placing and securing of the geotextile material.

The schedule quantity is a provisional quantity.

1174.2 Drainage mat outlet pipe

The unit of measurement shall be the linear metre of pipe laid.

The distance shall be measured along the centreline of the pipe and shall be the actual length laid including pipe leading to outlet structures.

The schedule rate shall cover the supply and laying of the pipe.

The schedule quantity is a provisional quantity.

1191 PAVEMENTS MARKINGS

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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 worksection.

1.2 APPLICATION

This worksection shall not override any applicable State or Local Government legislation and shall be read in conjunction with AS 1742.3 and the Roads and Traffic Authority (NSW) RTA QA Specification DCM R141 Pavement Marking (or equivalent document in other states).

This worksection does not cover Cold Applied Plastics (CAP) although their use throughout Australia is quite common as a long life product. For details of application and installation refer to the manufacturer's specifications.

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

Standards

AS 1580	Paints and related materials—Methods of test
AS 1580.107.3	Determination of wet film thickness by gauge
AS 1742	Manual of uniform traffic control devices
AS 1742.2	Traffic control devices for general use
AS 1742.3	Traffic control devices for works on roads
AS 1906	Retroreflective materials and devices for road traffic control purposes
AS 1906.3	Raised pavement markers (retroreflective and non–retroreflective)
AS/NZS 2009	Glass beads for pavement-marking materials
AS 4049	Paints and related materials—Road marking materials
AS 4049.2	Thermoplastic road marking materials
AS/NZS 4049	Paints and related materials—Road marking materials
AS/NZS 4049.3	Waterborne paint—For use with drop-on beads

Other publications

Roads and Traffic Authority (NSW)

RTA QA Specification DCM R141 Pavement Marking

1.5 TYPE OF PAVEMENT MARKINGS AND DEVICES

Details of the various types of pavement markings and devices are generally in accordance with the requirements of AS 1742.2.

1.6 TYPES OF MATERIALS TO BE APPLIED

The materials shall be applied as follows:

- Pavement marking paint: Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified.
- Thermoplastic pavement marking material: Permanent markings where explicitly indicated on the Drawings.
- Pavement marking tape: Temporary markings on final wearing surfaces.
- Reflective glass beads: To be applied to all painted and thermoplastic markings.
- Raised pavement markers: To be installed as permanent and temporary markings as shown on the Drawings.
- Cold applied plastics: To be installed in accordance with manufacturer's specification.

1.7 MATERIAL QUALITY

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. Only materials conforming to the requirements of the referenced worksections/Standards shall be used.

1.8 SETTING OUT

The Contractor shall set out the work to ensure that all markings are placed in accordance with the Drawings. The locations of pavement markings shall not vary by more than 20 mm from the locations shown on the Drawings.

1.9 SURFACE PREPARATION

Clean dry surface
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.

Wet weather
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 (unless otherwise directed).

Scabbling of concrete
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 to remove fine mortar material (laitance).

1.10 PROVISION FOR TRAFFIC AND PROTECTION OF WORK

The Contractor shall provide for traffic, in accordance with 1101 *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.

1.11 MAINTENANCE OF PAVEMENT MARKINGS

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.

2 PAINT MARKING

2.1 MATERIALS

Paint
Paint shall comply with the requirements of AS 4049.3 and any State Road Authority specifications (where applicable) as directed by the Superintendent. In this worksection, the term 'paint' shall mean 'pavement marking paint'.

Glass beads
Glass beads shall comply with the requirements of AS 2009. Other materials may be used if approved by the Superintendent.

2.2 MIXING OF PAINT

All paint shall be thoroughly mixed in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product.

2.3 APPLICATION OF PAINT AND BEADS

Paint thickness

The paint shall be applied uniformly and the dry film thickness shall be a minimum of 0.20 mm for class B beads, or 0.30 mm for class D beads.

Longitudinal lines

All longitudinal lines shall be sprayed by an approved machine.

The two sets of lines forming a one-way or two-way barrier line pattern shall be sprayed concurrently (unless otherwise directed by the superintendant).

The lengths of longitudinal lines shall conform to any applicable local or state requirements and not vary by more than +20 mm –0 mm from the lengths shown in AS 1742.2.

The widths of longitudinal lines shall not vary by more than +10 mm –0 mm from the widths shown in AS 1742.2.

Beads for Longitudinal Lines

Class B glass beads shall be applied to the surface of all longitudinal lines at a min application rate of 0.50kg/m^2 immediately after the 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.

Transverse lines

The lengths and widths of transverse lines shall not vary by more than 10 mm from the lengths and widths shown in AS 1742.2.

Arrows, chevrons and other markings

The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall conform to any applicable local or state requirements and shall not vary by more than 50 mm from the dimensions shown on the Drawings or in AS 1742.2 as appropriate.

Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Hand spraying

Hand spraying with the use of templates (where necessary) to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.

Beads for other markings

Class B glass beads shall be similarly applied to all other paint markings at a min application rate of 0.30kg/ m^2 immediately after application of the paint by a method approved by the Superintendent.

Class D glass beads shall be similarly applied to all other markings at a min application rate off 0.5 kg/m^2.

Pavement marking finish

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.

2.4 FIELD TESTING

Paint application

The thickness of the wet film applied to the road pavement shall be checked by the method described in AS 1580.107.3 Method B, comb gauge.

Beads application

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure A.

3 THERMOPLASTIC MARKING

3.1 MATERIALS

Thermoplastic
Thermoplastic pavement marking material shall comply with the requirements of AS 4049.2.

Definition
In this worksection, the term 'thermoplastic material' shall mean 'thermoplastic pavement marking material'.

Glass bead proportion
Glass beads shall be incorporated in thermoplastic material, in the proportion of a min 20% of the total mass, as part of the aggregate constituent and shall comply with the requirements of AS 2009, Intermix type class C beads with 20–30% by mass wet weather beads.

Glass beads
Glass beads for surface application shall comply with the requirements of AS 2009, class B 'Drop-on beads' or class D 'wet weather beads'.

Glass beads of class D wet weather beads intended for use with thermoplastic applications shall be supplied with a proprietary adhesive coating and shall be clearly labelled on the packaging.

Tack coat
Tack coat material shall be to the manufacturer's specification as approved by the Superintendent.

3.2 PREPARATION OF THERMOPLASTIC MATERIAL ON SITE

Immediately before application, the thermoplastic material shall be uniformly heated in a suitable kettle to the temperature recommended by the manufacturer.

The thermoplastic material shall not be heated above 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.

Should over-heating occur and/or the time expire for molten materials, then the thermoplastic material shall be discarded.

3.3 APPLICATION OF THERMOPLASTIC MATERIAL AND BEADS

Tack coat
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.

Longitudinal lines
All longitudinal lines shall be sprayed (or extruded in the case of profiled markings) by a machine approved by the Superintendent. The two 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 3.0 mm with a tolerance of plus or minus 0.5 mm. The lengths of longitudinal lines shall not vary by more than 20 mm from the lengths shown in AS 1742.2. The widths of longitudinal lines shall not vary by more than 10 mm from the widths shown in AS 1742.2.

Beads for longitudinal lines
Class B glass beads shall be applied by air propulsion or gravity fed to the surface of all longitudinal lines at a net application rate of 0.30kg/m^2 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.

Class D glass beads shall be applied at a min rate of 0.5kg/m^2.

Transverse lines, symbols, legends and arrows
The thermoplastic material for transverse lines, symbols, legends and arrows shall be applied uniformly and the cold film thickness shall be 3.5 mm with a tolerance of plus or minus 0.5 mm. The surface finish shall be smooth.

Where transverse lines, symbols, legends and arrows are to be screeded, the screeded thermoplastic material shall be applied using a mobile applicator, approved by the Superintendent, and templates to control the pattern.

The lengths and widths of transverse lines shall not vary by more than 10 mm from the lengths and widths shown in AS 1742.2.

Dimensions of arrows, chevrons, tolerance

The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall conform to any applicable local or state requirements and not vary by more than 50 mm from the dimensions shown on the Drawings or in AS 1742.2 as appropriate.

Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Beads for other than longitudinal lines

Class B glass beads for other than longitudinal lines shall be uniformly applied to screeded markings at a min application rate of 0.30 kg/m^2 immediately after application of the thermoplastic material by a method approved by the Superintendent.

Class D glass beads shall be applied at a min application rate of 0.50kg/m^2.

Pavement marking finish

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.

3.4 FIELD TESTING

Thickness of thermoplastic material

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.

Glass beads application rate

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in Annexure A.

4 PAVEMENT MARKING TAPE

4.1 MATERIALS

Pavement marking tape shall be a strippable type of tape approved by the Superintendent.

4.2 APPLICATION OF PAVEMENT MARKING TAPE

The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations.

4.3 REMOVAL OF PAVEMENT MARKING TAPE

When directed by the Superintendent, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations.

5 RAISED PAVEMENT MARKERS

5.1 MATERIALS

Markers

Raised pavement markers, both reflective and non-reflective, shall comply with AS 1906.3 and shall have the dimensions shown on the Drawings.

Adhesive

The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be a hot melt bitumen adhesive or an equivalent product approved by the Superintendent.

5.2 INSTALLATION OF RAISED PAVEMENT MARKERS

Adhesive

Raised pavement markers shall be fixed to the wearing surface of the pavement using a hot melt bitumen adhesive or an equivalent product.

Heating and mixing

The adhesive shall be freshly heated to the Manufacturer's instructions and thoroughly mixed. The adhesive shall not be allowed to cool and be reheated prior to use.

Application of adhesive to marker

The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm.

Adhesion of marker to pavement

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.

Adhesion to rough surfaces

On rough surfaces, such as newly laid coarse sprayed bituminous seals, and where directed by the Superintendent, an initial pad of adhesive of diameter 20 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 pavement, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface to ensure good adhesion.

6 REMOVAL OF REDUNDANT MARKINGS

The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

The removal of markings shall be performed in a 'block type manner, so as to avoid 'ghosted' images.

Blacking out of markings should only be used as a temporary measure and complete removal should occur within 48 hours.

The method of removal shall be approved by the Superintendent before commencement of the work.

7 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses of this worksection are summarised in **Table 7.1 Summary of limits and tolerances**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Location of Markings	±20 mm from specified location	**Setting out**
Longitudinal Lines		
-Length	+20 mm from lengths shown in AS 1742.3	**Application of paint and beads & Application of thermoplastic material and beads**
-Width	+10 mm (except for double barrier lines where the gap between lines must not decrease) from widths shown in AS 1742.3	**Application of paint and beads & Application of thermoplastic material and beads**
Transverse lines		

-Length -Width	±10 mm from lengths and widths shown in AS 1742.3	**Application of paint and beads & Application of thermoplastic material and beads**
Arrows, chevrons, painted medians, speed markings etc.	±50 mm from the dimensions shown in AS 1742.3	**Application of paint and beads & Application of thermoplastic material and beads**
Application of paint		
-Film thickness	Depends on the beads to be used: for class B beads—min 0.2 mm dry film; for class D beads—min 0.3 mm dry film	**Application of paint and beads**
Application of thermoplastic		
-Longitudinal lines—Cold Film Thickness	3.0 mm ±0.5 mm	**Application of thermoplastic material and beads**
-Transverse Lines, Symbols, Arrows etc. Cold film thickness	3.5 mm ±1.5 mm	**Application of thermoplastic material and beads**
Glass beads		
-Volume used in operation	Min class B—0.30 kg/m^2 Min class D—0.50 kg/m^2	**Application of paint and beads & Application of thermoplastic material and beads**

8 MEASUREMENT AND PAYMENT

8.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this Worksection on a schedule of rates basis in accordance with Pay Items 11911.1 to 1191.6.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in other items for the cost of the item which has not been priced.

No additional payment shall be made for maintenance and replacement of pavement markers in accordance with **Maintenance of pavement markings**.

Provision for traffic is measured and paid in accordance with this worksection and not 1101 *Control of traffic*.

8.2 PAY ITEMS

1191.1 Pavement marking paint—longitudinal lines

The unit of measurement shall be per line pattern kilometre (including any gaps).

The area shall be calculated from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.

The schedule rate shall cover all costs associated with the setting out of the work, the supply and application of the paint and beads and provision for traffic control.

1191.2 Pavement marking paint—Transverse lines, symbols, legends, arrows, chevrons, traffic islands and kerbs

The units of measurement shall be as follows:

- 1191.2(1) Transverse lines — Lineal metres
- 1191.2(2) Arrow — Each
- 1191.2(3) Symbols — Each
- 1191.2(4) Chevrons — Square metres
- 1191.2(5) Kerbs — Metres
- 1191.2(6) Traffic Islands — Square metres
- 1191.2(7) Legends — Each or square metres

The area of the painted surface shall be determined by direct measurement of the markings as applied.

The schedule rate shall cover all costs associated with the setting out of the work, the supply and application of all material and the provision for traffic control.

1191.3 Thermoplastic pavement marking material—Longitudinal lines

The unit of measurement shall be per line pattern kilometre (including any gaps).

The area shall be calculated from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.

The schedule rate shall cover all costs associated with the setting out of the work, tack coating where necessary, the supply and application of the thermoplastic material and beads and provision for traffic.

1191.4 Thermoplastic pavement marking material—transverse lines, symbols, legends and arrows

The unit of measurement shall be as per schedule below:

- 1191.4(1) Transverse lines — Lineal metres
- 1191.4(2) Arrow — Each
- 1191.4(3) Symbols — Each
- 1191.4(4) Chevrons — Square metres
- 1191.4(5) Kerbs — Metres
- 1191.4(6) Traffic Islands — Square metres
- 1191.4(7) Legends — Each or square metres

The surface area of the thermoplastic material applied shall be determined by direct measurement of the markings as applied (as above).

The schedule rate shall cover all costs associated with the setting out of the work, tack coating where necessary, the supply and application of all material and the provision for traffic.

1191.5 Raised pavement markers (all applications)

The unit of measurement shall be ‘each’ raised pavement marker installed.

The schedule rate shall cover all costs associated with the setting out of the work, the supply and application of all material including the provision of an initial pad of adhesive when required on rough surfaces and the provision for traffic.

1191.6 Removal of pavement markings

The unit of measurement shall be metres squared.

The schedule rate shall cover all costs associated with removal and disposal.

9 ANNEXURE A

9.1 MEASUREMENT OF APPLICATION RATE OF SPHERICAL GLASS BEADS

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.

Spherical glass beads

The glass beads shall comply with AS 2009.

Measurement

The method of field measurement shall be as follows:

- 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.
- 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.
- Compare the volume of glass beads collected with the correct figure given in Table A1.

Table A1 shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kg/m^2 for different line widths and road speeds.

The glass bead volume figures given in Table A1 are calculated for an actual application rate of 0.34 kg/m^2 . 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.

For the calibration of application rates to suit class D beads, Table A1 will need to be altered to 0.50 kg/m^2 .

Table A1 Volume of glass beads (ml) required in 10 seconds of operation

Road speed km/h	**Line widths**				
	80 mm	**100 mm**	**120 mm**	**150 mm**	**200 mm**
8	396	495	594	742	990
13	643	804	965	1207	1698
16	791	990	1188	1484	1484
Notes: 1 Tolerance of +10% shall be permissible when measuring the above volume. 2 When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown. 3 Glass beads weigh approximately 1.53 grams per millilitre.					

10 ANNEXURE B

10.1 TYPES OF GLASS BEADS

Class A beads (premix)

Class A beads are mixed into road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking. These beads are to be mixed at a rate of not less than 30% by mass.

Class B beads (drop-on)

Class B glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

These beads should be applied on a smooth substrate.

A nominal rate of 270–300 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher application rate to achieve the required level of retroreflectivity.

These beads have a moisture-proof coating to facilitate flow and reduce the risk of ‘caking’’

Class C beads (intermix)

Class C beads are mixed into thermoplastic road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking.

They should be intermixed at a rate of not less than 20% by mass.

Class C beads may also be used for surface applications to a wet film of pavement marking to provide initial retroreflectivity. They should be applied on a smooth substrate. A nominal rate of 350 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity. These beads are not moisture-proof coated, and, if used for surface applications, could ‘cake’ during handling.

Class D beads (large wet-weather beads)

Class D glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

They should be applied on a smooth substrate.

A nominal rate of 500 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity.

These beads have no moisture-proof coating and are, therefore, also suitable for intermixing into thermoplastic road-marking material to provide retroreflectivity in both dry and wet conditions, throughout the life of the marking. They should be intermixed at a rate of not less than 20% by mass.

1192 SIGNPOSTING

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of:

- the supply and erection of the Regulatory, Warning and Guide signs as described in AS 1742 (all parts), AS 1743 and AS 1744,
- the supply and erection of proprietary Street Name and Community Facility Name signs,
- the supply and erection of sign support structures to support the signs, and
- the adjustment of existing signs and sign support structures.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1101 Control of traffic

Standards

AS 1163	Structural steel hollow sections
AS 1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1379	Specification and supply of concrete
AS 1580	Paints and related materials—Methods of test
AS 1580.108.2	Dry film thickness—Paint inspection gauge
AS 1742 (Various)	Manual of uniform traffic control devices
AS 1743	Road signs—Specifications
AS 1744	Forms of letters and numerals for road signs
AS 2700	Colour standards for general purposes
AS 4100	Steel in structures
AS/NZS 1554	Structural steel welding
AS/NZS 1554.1	Welding of steel structures
AS/NZS 1734	Aluminium and aluminium alloys—flat sheet, coiled sheet and plate
AS/NZS 1580	Paints and related materials—Methods of test
AS/NZS 1580.602.2	Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°
AS/NZS 1866	Aluminium and aluminium alloys—Extruded rod, bar, solid and hollow shapes
AS/NZS 3678	Structural steel—Hot-rolled plates, floorplates and slabs
AS/NZS 3679	Structural steel
AS/NZS 3679.1	Hot-rolled bars and sections
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

1.4 PROVISION FOR TRAFFIC

Minimise inconvenience

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic, both vehicular and pedestrian.

Premature sign exposure

Where a sign is erected before it is intended for use by traffic and is visible to traffic, the face of the sign shall be completely and securely wrapped in porous cloth sheeting or other opaque covering material approved by the Superintendent, until the Superintendent directs that the sign shall be uncovered.

2 SIGNS

2.1 STREET AND COMMUNITY FACILITY NAME SIGNS

Signage system

All street and community facility name signs shall comply with Council's adopted signage system and with the details as shown on the Drawings.

Proprietary sign requirements

Proprietary signs shall be manufactured and installed in accordance with the requirements of AS 1742.5, Street Name and Community Facility Name Signs, to the following details:

- [complete/delete]

Logo

Details of Council's logo shall be supplied to the Contractor by the Superintendent.

Legends

Details of the signs and legends to be provided under the Contract shall be as shown on the Drawings.

Approval

The Contractor shall submit details of Manufacturer, all sign materials and sign attachment system to the Superintendent for approval prior to commencement of sign manufacture.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted details is required prior to the release of the **Hold Point**.

2.2 REGULATORY, WARNING AND GUIDE SIGNS

General

Approved supplier: The Contractor shall advise the names of the proposed suppliers of signs for the Superintendent's concurrence. Only suppliers who have previously established, or can now establish, their competence to carry out the work in accordance with this worksection shall be used.

Proof of quality: The Contractor shall supply documentary evidence, satisfactory to the Superintendent, that all materials and parts proposed for use comply with the requirements of this worksection. This action constitutes a **Hold Point**.

The Superintendent's approval of the documentary evidence is required prior to the release of the **Hold Point**.

Dimensions, legend, background and other details: Details of the signs to be provided under the Contract shall be as shown on the Drawings. The dimensions, legend and background for each sign shall be in accordance with this worksection and the Drawings.

Temporary signs: Temporary signs for control of traffic shall be as specified in 1101 *Control of traffic*.

Sign blanks

Aluminium quality: Sign blanks shall be 1.6 mm thick aluminium sheet alloy of Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS 1734.

Dimension tolerances: 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% of the maximum dimension of the sign blank in any direction.

One piece: 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 multipiece sign shall be allowed.

Multipiece sign: A multipiece sign shall be made up of the minimum number of pieces practical and sheets of the multipiece sign shall be butted together with a maximum gap of 1 mm at any point along the joint.

Joint backing strips: 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.

Aluminium extrusion as backing strip: The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.

Face treatment: 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.

Back treatment: 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.

Mounting: Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the Drawings.

Aluminium extrusion backing

Design section: The signs shall include special aluminium extruded sections, as shown on the Drawings, for mounting purposes. The aluminium shall be Type 6063-T5 in accordance with AS 1866.

Fixing: 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 200 mm.

Rivets

Head and shank: 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.

Painted head: 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.

Paint application: 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.

Retro-reflective material for background and legend

Approved: The retro-reflective material shall be approved by the Superintendent. The background and legend material shall be compatible both in application and durability.

Standard: Retroreflective material shall conform in colour and class to the requirements of AS 1743 for Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the Drawings, the material shall be Class 2.

Application: Retroreflective material shall be applied to the sign blank in accordance with the manufacturers recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

Non-reflective background material—Background paint

Quality: 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.

Application: 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.

Colours: Non-reflective background paint shall be as specified in AS 1743 from one of the following AS 2700 colours:

- Red: R13 Signal Red
- Yellow: Y14 Golden Yellow

- Brown: X65 Dark Brown
- Blue: B11 Rich Blue
- Standard Green: G12 Holly Green
- Freeway Green: Emerald

Background colours shall be specified from one of the following colours:

- White—Gloss
- 'Dark' Green—Matt Colour No G61 as specified in AS 2700.
- 'Tourist' Brown—Matt Colour No X65, Dark Brown, as specified in AS 2700.
- 'Dark Grey'—Matt Colour No N64, Dark Grey as specified in AS 2700.

Exact colorimetric values are set out in AS 2700.

Gloss levels: 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. For gloss coatings, the gloss level, determined by AS/NZS 1580.602.2 using a 20° head shall be neither less than 85% of gloss nor more than 95% of gloss.

Non-reflective background material—Background sheet material

Quality: Adhesive cast vinyl sheet material 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.

Colours and gloss: The colours and gloss levels shall be uniform and conform to the requirements as above.

Application: Sheet material shall be applied to the sign blank in accordance with the manufacturers recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

Non-reflective material for legend—Legend screening ink

Quality: Screening ink shall be a high quality, full gloss, non-fade, non-bleed and scratch resistant type of ink compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which the screening ink is applied.

Application: Screening ink legends shall be applied to the background material in accordance with the manufacturers recommended methods.

Non-reflective material for legend—Legend sheet material

Quality: Adhesive cast vinyl sheet material 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.

Application: Sheet material legends shall be applied to the background material in accordance with the manufacturers recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

Non-reflective material for legend—Colours and finish

The requirements of **Regulatory, warning and guide signs** shall also apply to non-reflective materials for legends but additional colours complying with AS 2700 may be specified.

2.3 REFERENCE MARKINGS

Identification code

All warning, regulatory and guide 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.

Location

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.

Information shown

Manufacturers shall include coding information in the following format:

- Sign Reference Number
- Manufacturer's Name

- Month and Year of Manufacture
- Manufacturer and Class of Retro-Reflective Material

Proprietary signs
The requirements for reference markings shall not apply to proprietary street name or community facility name signs.

2.4 PROTECTION OF SIGNS

Signs shall be adequately protected from damage during storage and transportation to site.

3 SIGN SUPPORT STRUCTURES

3.1 GENERAL

Scope
The work to be executed under this section includes the supply of materials, fabrication of components and protective treatment of the sign support structures and anchor bolt assemblies and the supply and fabrication of footing reinforcement cages.

Approved supplier
The Contractor shall advise the names of the proposed suppliers of sign support structures for the Superintendent's concurrence.

Only suppliers who have previously established, or can now establish, their competence to carry out the work in accordance with this worksection shall be used

Proof of quality
The Contractor shall supply documentary evidence, satisfactory to the Superintendent, that all materials and parts proposed for use comply with the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the documentary evidence is required prior to the release of the **Hold Point**.

Structure details
Details of the sign support structures to be provided under the Contract shall be as shown on the Drawings.

3.2 SIGN STRUCTURES AND ANCHOR BOLT ASSEMBLIES

Fabrication
Type: Sign support structures shall be either:

- Standard round galvanised steel posts of size 50, 65 or 80 mm nominal bore, as shown on the Drawings, fitted with a cap for waterproofing.
- Purpose-designed steel structures as shown on the Drawings and manufactured in accordance with the requirements of AS 1250.

Standards: Purpose-designed steel structures shall be fabricated from steel sections which shall comply with the requirement of AS 1163, AS 3678 and AS 3679.1.

Splices: Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds. All welding shall be as shown on the Drawings and in accordance with the requirements of AS 1554.1, Category SP for sign structure welds and Category GP for anchor bolt assemblies.

Anchor bolts: Anchor bolt assemblies for purpose-designed structures shall be fabricated as shown on the Drawings.

Finish: All steelwork shall be finished in a workmanlike manner and shall be free from pitting, sharp corners and projections and cleaned of mill scale, loose rust and foreign particles either by blast cleaning or other effective method.

Protective treatment
Hot-dip galvanizing: Except for standard galvanised steel posts, all steel components including brackets and anchor bolt assemblies shall be protected by hot-dip galvanizing after all fabrication processes are completed.

Finish: The steel components shall be finished by the hot-dip galvanising process in accordance with AS/NZS 4680 to provide an average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains.

Bolts and nuts: Bolts, nuts and washers and brackets shall be galvanized in accordance with AS 1214.

Splices in galvanized posts: Splices in standard galvanized steel posts shall be painted by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Clause 8 of AS/NZS 4680.

Attachment of signs

Typical systems: 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.

Contractor's responsibility: The Contractor shall submit details of the proposed attachment systems for the Superintendent's approval.

3.3 STEEL REINFORCEMENT CAGES

Standards

Steel reinforcement in cages for sign support structure footings shall comply with the requirements AS/NZS 4671.

Evidence of quality

If requested, the Contractor shall supply evidence satisfactory to the Superintendent that all materials conform with the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the supplied evidence is required prior to the release of the **Hold Point**.

Cleanliness

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.

Accuracy

Reinforcement shall be formed to the dimensions and shapes shown on the Drawings. Heating of reinforcement for purposes of bending will not be permitted unless Grade 400 deformed bar reinforcement is specified.

Full bars

All reinforcement shall be furnished in the lengths indicated on the Drawings. Splicing of bars will only be permitted with the approval of the Superintendent as to the location and method of splicing.

Splicing

Splicing 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.

Welding

Welded splices and tack welding of bars shall conform to the requirements of AS 1554.

3.4 MANUFACTURER'S IDENTIFICATION

Information shown

Each purpose-designed structure shall carry a clear marking on the post column one metre above base plate, the outreach arm, as well as the sign support vertical, showing:

- Sign reference number
- Manufacturer's name
- Month and year of manufacture
- Drawing No.

Application

The marking shall be legibly and durably applied by etching, stamping, engraving or welding.

Warranty

This marking shall be additional to date stamping required under **Sign structure warranty**.

3.5 INSPECTION

Pre-delivery Inspection
All purpose-designed structures covered by this worksection shall be subject to an inspection at the Contractor's Works prior to acceptance.

Two days notice
The Contractor shall give the Superintendent at least two working day's notice of the availability of the sign structures for pre-storage or pre-delivery inspection.

This action constitutes a **Hold Point**.

The Superintendent's certification of the sign support structures is required prior to the release of the **Hold Point**.

Inspection certificate
The Superintendent will issue the Contractor with a Certificate listing particulars of the items inspected.

The Certificate will indicate either:

- the sign structures satisfy the requirements of the worksection and shall be accepted; or
- the grounds for rejection of the goods.

3.6 STORAGE

The Contractor shall store the sign support structures and reinforcement cages until required to be incorporated into the Works or required by the Superintendent.

Completed reinforcement cages shall be stored under a waterproof shelter and supported above the surface of the ground, and shall be protected from injury and from deterioration due to exposure.

3.7 SIGN STRUCTURE WARRANTY

Warranty period
Supply of any structure under this worksection shall be subject to a warranty period of 12 months following the date of dispatch from the Contractor's Works to the Site.

Failed for defective structures
Any sign structure which has failed in service or found to be defective within 12 months of the date of dispatch shall be removed by the Contractor, who shall then make good the defect or arrange to have the defect made good, and subsequently return and re-erect the good unit at the original location at no charge to the Principal.

Unless otherwise agreed, defective structures shall be processed and returned within 30 calendar days from the date the Contractor is notified by the Principal of the defect.

Warranty exclusion
It is expressly understood that any structure which has failed as a result of a traffic accident, abuse or act of vandalism caused by a third party after delivery to the Site shall not be covered by warranty provisions.

Date of dispatch mark
In order to facilitate checking of warranty claims all separate items of the sign structure shall be legibly stamped, etched or engraved to show the date of dispatch from the Contractor's Works to the Site.

Application
This warranty shall apply notwithstanding any defects liability period provided for in the General Conditions of Contract.

4 ERECTION OF NEW SIGNS

4.1 SET OUT

Location
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.

Underground services laid in proximity to the signs shall be located prior to placement of footings and erection of signs, all care shall be taken not to damage such services.

Alignment
Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve.

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.

Set out approval
The Contractor shall submit details of the set out, for the Superintendent's inspection and approval, and the proposed disposition and alignment of each sign support structure.

This action constitutes a **Hold Point**.

The Superintendent's approval of the set out, disposition and alignment of the sign support structures is required prior to the release of the **Hold Point**.

4.2 CLEARING

Any trees and undergrowth within three metres of the sign support structure and along a driver's line of sight to the front of the sign shall be cleared and removed following set out approval by the Superintendent.

4.3 SIGN STRUCTURE FOOTINGS

Details
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.

Excavation
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 manner approved by the Superintendent.

Anchor bolt assemblies
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.

All exposed bolt threads shall be protected from damage or adhesion of concrete during footing construction.

Steel reinforcement
Steel reinforcement shall be placed as shown on the Drawings.

Concrete quality
Concrete in the footings of sign support structures shall comply with *0310 Minor concrete works* and have a minimum compressive strength at 28 days of 20 MPa for pipe support footings and 32 MPa for purpose-designed support footings.

Ready mixed concrete
If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

4.4 ERECTION

Position and support
All components shall be accurately positioned and supported during erection.

Top of post level

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.

Multi-post installation
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.

Sign damage
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.

Treatment of damaged areas

Galvanized coatings on purpose-designed support structures which are scratched or slightly damaged during erection shall be renovated by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Clauses of AS/NZS 4680.

This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure.

Any structure with totally-damaged coating areas exceeding 2500 square millimetres shall be regalvanized.

The cost of regalvanizing such damaged coating areas shall be borne by the Contractor.

5 ADJUSTMENT OF EXISTING SIGNS AND SUPPORT STRUCTURES

5.1 GENERAL

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

6 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 6.1.

Table 6.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
Sign blank		
-Dimensions	± 1.50 mm	**Regulatory, warning and guide signs**
-Bow	< 0.5% of maximum dimension	**Regulatory, warning and guide signs**
-Butt gap in multipiece sign	< 1 mm	**Regulatory, warning and guide signs**
-Rivet spacing in backing strip	< 200 mm	**Regulatory, warning and guide signs**
-Backing strip width	>50 mm	**Regulatory, warning and guide signs**
Extrusion Backing		
-Rivet Spacing	<200 mm	**Regulatory, warning and guide signs**
Background Paint		
-For matt coatings, gloss level	>12% and <15%	**Regulatory, warning and guide signs**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
- For gloss coatings, gloss level	>85% and <95%	**Regulatory, warning and guide signs**
Reference marking		
- Height of Coding	>6 mm and <10 mm	**Reference markings**
Sign Support Structures		
- Protective Treatment thickness	>100 microns	**Sign structures and anchor bolt assemblies**
- Paint coating over Splices in standard galvanised posts	>100 microns	**Sign structures and anchor bolt assemblies**
- Damaged surface of galvanised surfaces:		
. Coating with zinc rich paint	Area <2500 sq. mm	**Erection**
. Regalvanise	Area >2500 sq. mm	**Erection**
Clearing		
- Trees and Undergrowth to be cleared	<3 metres from sign support structure	**Clearing**
Concrete in footings of sign support structures		
- Strength	>20	**Sign structure footings**
. Pipe support	MPa at	**Sign structure footings**
. Purpose-designed support footings	28 days >32 MPa at 28 days	

7 DRIVEN SIGNPOST HOLDERS

Proprietary brands are permitted subject to the approval of the Council Engineer.

8 HEIGHT ABOVE GROUND LEVEL

Street blades shall be erected at a minimum of 2.6 m above natural surface to minimise vandalism.

9 REFERENCE TO AUSTRALIAN STANDARDS

Any matter referred for determination by the Council Engineer and not covered within this specification shall be determined by the Council Engineer after reference to AS 1742.

10 MEASUREMENT AND PAYMENT

10.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1192.1 to 1192.12 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

The cost of any provision for traffic and covering of signs shall be deemed to be included in the various pay items in this worksection and not 1101 *Control of traffic*.

Sign structure support concrete footings are measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete work*.

10.2 PAY ITEMS (UNITS OF MEASURE)

1192.1 Supply and delivery of signs (area less than 1 sq m)

The unit of measurement shall be each.

The schedule rate shall include the costs of mounting extrusions, fittings, labelling, packaging and delivery to site.

1192.2 Supply and delivery of signs (area between 1 and 3 sq m)

The unit of measurement shall be each.

The schedule rate shall include the costs of mounting extrusions, fittings, labelling, packaging and delivery to site.

1192.3 Supply and delivery of signs (area greater than 3 sq m)

The unit of measurement shall be the area in square metres of signs supplied.

The area shall be calculated by totalling the face surface area of each sign supplied.

The schedule rate shall include the costs of mounting extrusions, fittings, labelling, packaging and delivery to site.

1192.4 Supply and delivery of sign support structures (standard round galvanised posts)

The unit of measurement shall be each post.

The schedule rate shall include the costs of fabrication, fittings, caps, packaging, storage for up to 2 months and delivery free on truck.

1192.5 Supply and delivery of sign support structures (purpose-designed)

The unit of measurement shall be each sign support structure.

The schedule rate shall include fabrication, hot-dip galvanising, fittings, packaging, storage for up to 2 months and delivery free on truck.

Where a purpose-designed sign support structure consists of more than one post, the unit of measurement (each) shall include all posts required for that particular sign.

1192.6 Supply and delivery of anchor bolt assemblies

- 1192.6(1) Mk 1
- 1192.6(2) Mk 2
- 1192.6(3) Mk 3
- 1192.6(etc) etc

The unit of measurement shall be each for the anchor bolt assemblies for each individual footing.

The Schedule rate shall include the costs of fabrication, hot-dip galvanising, fittings, packaging, storage for up to 2 months and delivery free on truck.

C0602.7 Supply and delivery of reinforcement cages

- 1192.7(1) (Size)
- 1192.7(2) (Size)
- 1192.7(3) (Size)
- 1192.7(etc) etc

The unit of measurement shall be each for the complete reinforcement cage for each individual footing.

The schedule rate shall include the costs of fabrication, packaging, storage for up to 2 months and delivery free on truck.

1192.8 Erection of sign structures (standard round galvanised posts)

The unit of measurement shall be each post erected.

The schedule rate shall include the costs of clearing, excavation, casting of concrete footings, erection and bracing.

1192.9 Erection of sign structures (purpose-designed)

The unit of measurement shall be each sign support structure erected.

The schedule of rate shall include the costs of clearing, excavation, placement of reinforcement cages and anchor bolt assemblies, casting of concrete footings, erection and bracing.

Where a purpose-designed sign support structure consists of more than one post and footing, the unit of measurement (each) shall include all posts and footings required for that particular sign.

1192.10 Erection of signs (to standard round galvanised posts)

The unit of measurement shall be each sign erected.

The schedule rate shall include the costs of erection and attachment costs and any necessary temporary covering of signs with plastic or other approved opaque covering.

1192.11 Erection of signs (to purpose-designed structures)

The unit of measurement shall be the area in square metres of signs erected.

The area shall be determined by totalling the face surface area of the signs.

The schedule rate shall include the costs of erection and attachment costs and any necessary temporary covering of signs with plastic or other approved opaque covering.

1192.12 Adjustment of existing signs and support structures

The unit of measurement shall be the area in square metres of signs adjusted.

The area shall be determined by totalling the face surface area of the signs adjusted.

The schedule rate shall include the costs of dismantling of signs and sign structure, relocation or replacement of sign structures including excavation, concrete footings, (including placement of reinforcement cages and anchor bolt assemblies where specified) and re-erection of signs including all fittings.

Separate pay items shall be included for each adjustment required to re-erect existing signs and sign support structures and shall cover all work required that is not covered by the other pay items under signposting.

1193 GUIDE POSTS

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksection

0161 *Quality (Construction)*

1101 *Control of traffic*

Standards

AS 1604	Specification for preservative treatment
AS 1604.1	Sawn and round timber
AS/NZS 1906	Retroreflective materials and devices for road traffic control purposes
ASNZS 1906.2	Retroreflective devices (non-pavement application)
AS 2082	Timber—Hardwood—Visually stressgraded for structural purposes

1.4 MATERIALS

General

Guide posts shall be of timber or, as an alternative, the Superintendent may approve of a proprietary metallic or flexible (driveable or non-driveable) post.

The surface of all posts shall have a gloss or semi-gloss white finish. The surface shall be smooth and easily cleaned.

Proprietary posts shall be minimum 1350 mm in length and shall have one face of 100 mm width.

Timber posts

Timber posts shall be cut from Select Grade hardwood and conform with AS 2082. All surfaces shall be smooth and free from obvious saw marks.

The posts shall be of rectangular cross-section having dimensions of 100 mm × 50 mm and shall be 1,400 mm in length.

The tops of the guide posts shall be sloped so that one 100 mm edge is 10 mm lower than the opposite edge.

Proprietary posts

Where a proprietary metallic or flexible guide post is proposed, the Contractor shall supply details of the proposed guide post including the manufacturer's recommended installation procedure, technical specifications and test certificates for consideration by the Superintendent.

The test certification shall address post strength, flexibility, impact and heat resistance and durability.

This action constitutes a **Hold Point**.

The Superintendent's approval of the submitted details and acceptance of the nominated guide post type and supplier is required prior to the release of the **Hold Point**.

Delineators

Corner-cubed delineators, conforming to AS 1906.2 shall be attached to each post.

The delineators shall be neither less than 80 mm nor more than 85 mm diameter.

2 CONSTRUCTION

2.1 CONTROL OF TRAFFIC

Control of traffic shall comply with 1101 *Control of traffic*.

All necessary steps shall be taken to prevent people and stock from stepping into the post holes during the erection of the guide posts.

2.2 LOCATION

Guide posts shall be erected at the locations shown on the Drawings or as directed by the Superintendent.

Where the shoulder is in embankment, in cutting or at natural surface level, the guide posts shall be placed near the outer edge of the shoulder and at a uniform distance, minimum 1 m, from the pavement edge line.

Where the shoulder is located in a cutting, the guide posts shall be placed on the road pavement side of the table drain in such a manner as not to impede the flow of water in the drain.

2.3 UNDERGROUND SERVICES

Underground services laid in proximity to the guide posts shall be located prior to erection of posts, all care shall be taken not to damage such services.

2.4 PROTECTIVE TREATMENT OF TIMBER GUIDE POSTS

Painting

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.

Dry surfaces

Painted surfaces shall be thoroughly dry before the second coat is applied.

Paints shall be handled and applied in accordance with the manufacturer’s directions.

Paint quality

All paints shall be of the best quality, durable and suitable for exterior application on timber surfaces.

2.5 ERECTION OF GUIDE POSTS

Positioning

Guide posts shall be set vertically in the ground to a depth of approximately 500 mm. 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 900 mm above ground level, with the tops evenly graded.

Each guide post shall be erected with the 100 mm axis at right angles to the centre line of the road at minimum spacing set out in AS 1742.2 unless shown otherwise in the drawings.

Vertical alignment

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.

Backfilling

Backfilling shall be compacted in layers of depth not more than 150 mm 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.

Proprietary guideposts

Proprietary guideposts, when installed in the ground in accordance with the recommendations of the manufacturer, shall resist overturning, twisting and displacement from wind and impact forces.Delineators

Fixing

'Corner Cubed' delineators, complying with AS 1906.2, shall be attached to each guide post using one way, anti-theft screws. In the case of proprietary posts, the delineators shall be glued or otherwise fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact.

Position

The delineators shall be mounted so that the top of the reflector is 50 mm below the top of the guide post.

Arrangement

The delineators shall be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side.

3 MEASUREMENT AND PAYMENT

3.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Item 1193.1.

A lump sum price shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Traffic control is measured and paid in accordance with specification 1101 *Control of traffic*.

3.2 PAY ITEMS

1193.1 Guide posts

The unit of measurement shall be 'each' guide post.

The schedule rate shall cover all costs associated with the erection of each post, including supply of post, erection, painting (if applicable), and supply and fixing of corner-cubed delineators.

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1194 NON-RIGID ROAD SAFETY BARRIER SYSTEMS (PUBLIC DOMAIN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the setting out, supply of all materials and erection of road safety barriers and terminals, in accordance with the requirements for non-rigid road safety barrier systems in AS/NZS 3845, at the locations shown on the Drawings or as directed by the Superintendent.

This worksection details the requirements for public domain non-rigid road safety barrier systems.

Where a patented non-rigid road safety barrier system is specified and shown on the Drawings, all materials shall be in accordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

Rigid road safety barrier systems are specified in 1163 *Rigid concrete and road safety barrier systems (Public Domain)*.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1101 Control of traffic

1163 Rigid concrete and road safety barrier systems (Public Domain).

Standards

AS/NZS 1906	Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.2	Retroreflective devices (Non pavement application)
AS/NZS 3845	Road safety barrier systems
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

2 MATERIALS

2.1 COMPONENTS

Steel

All steel components for public domain non-rigid road safety barrier systems, W-beam and Thrie-beam, shall be in accordance with AS/NZS 3845 and shall be of the type as shown on the Drawings.

Timber

Timber posts are to be used only in W-beam terminal sections, as detailed on the Drawings and shall be of the timber type, grade, size and treatment level in accordance with AS/NZS 3845.

All surfaces shall be smooth and free from obvious saw marks.

Certification

Steel and timber road safety barrier components shall not be erected until the Contractor has produced documentary evidence to the Superintendent that the steel and timber road safety barrier components conform to the requirements of this worksection.

This action constitutes a **Hold Point**.

The Superintendent's approval of the documentary evidence is required prior to the release of the **Hold Point**.

3 CONSTRUCTION

3.1 TRAFFIC CONTROL

Traffic control shall comply with 1101 *Control of traffic*.

3.2 STANDARD OF CONSTRUCTION

Construction of non-rigid road safety barrier shall comply with AS/NZS 3845 except where explicit departures are detailed on the Drawings.

3.3 SEQUENCE OF CONSTRUCTION

Road safety barriers shall be erected after the construction of the 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.

3.4 LOCATION OF BARRIERS

In accordance with drawings

The Contractor shall set out the work to ensure that all road safety barriers and terminal sections are located in accordance with the Drawings or as directed by the Superintendent.

This action constitutes a **Hold Point**.

The Superintendent's approval of the set out is required prior to the release of the **Hold Point**.

Post accuracy

Posts shall stand vertical and the spacing shall be such that when the safety barrier is erected no post movement is necessary in order to align holes or for any other reason.

3.5 CABLES AND DUCTS

Underground cables and ducts laid in the road safety barrier area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts.

3.6 ALTERNATIVE METHODS OF SETTING POSTS

The posts should be set to the full depth as 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.

3.7 ERECTION OF STEEL POSTS

Positioning of posts

The safety barrier posts are to be located as shown on the Drawings.

The top of the post shall be 710 mm, 805 mm or 865 mm as appropriate for W-beam, Thrie-beam or modified blockout Thrie-beam respectively, above the ground level, unless otherwise shown on the Drawings.

On terminal ends, the level of the posts shall be such as to conform to the extended crossfall of the main pavement unless otherwise shown on the Drawings.

Smooth line/tolerances

When erected in position the posts shall be on a smooth line both horizontally and vertically with the tops of posts within ±20 mm of the heights specified in **Sequence of construction**.

Foundation and testing

Steel posts shall be erected by driving, or by other means, as directed by the Superintendent, in accordance with the requirements for foundation posts in AS/NZS 3845.

The open section of the post shall point in the same direction as adjacent traffic.

The posts are to be firm in the ground and any movement at ground level shall not exceed 3 mm in any direction when force tested in accordance with AS/NZS 3845.

Damage to posts

The posts shall not have any obvious deformation as a result of driving.

Any damage which does occur to the posts is to be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Clause 8 of AS/NZS 4680.

Any post which has been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at its own expense.

3.8 ERECTION OF TIMBER POSTS

Positioning of posts

The safety barrier posts are to be located as shown on the Drawings.

The top of the posts shall be 710 mm ±20 mm above the ground level, unless otherwise shown on the Drawings.

On terminal ends the level of the posts shall be such as to conform to the extended crossfall of the main pavement, unless shown otherwise on the Drawings.

Smooth line

When erected in position the posts shall be on a smooth line both horizontally and vertically.

Polystyrene foam

The section of the timber posts to be cast into a reinforced concrete footing shall be wrapped in 12 mm thick polystyrene foam sheeting before concrete casting.

Concrete

Concrete used in the footings for timber posts shall have a minimum compressive strength of 32 MPa at 28 days and shall conform with 0310 *Minor concrete works*.

Footing size

Concrete footings shall be 600 mm diameter, and shall have tolerances of minus zero or plus 50 mm.

Over excavation (overbreak) and excessive depth shall be filled with 32 MPa concrete at no cost to the Principal.

Reinforcing fabric

Wire fabric reinforcing shall be as detailed on the Drawings.

Painting

The surface area of the posts which will be above ground shall be painted with two coats of grey acrylic paint.

3.9 ERECTION OF ROAD SAFETY BARRIER RAILS

Blockouts

Steel blockout pieces shall be erected with the open section pointing in the same direction as adjacent traffic.

Rail laps

All rail laps shall be in the same direction as adjacent traffic such that approach rail ends are not exposed to traffic.

Stiffening pieces

Stiffening pieces, 300 mm long, shall be used on intermediate posts.

Minor damage to galvanising

Road safety barrier rails and blockout pieces shall be handled and erected in such a manner that no damage occurs to the galvanising.

Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Clause 8 of AS/NZS 4680.

Excessive damage to rails or blockout pieces

Any road safety barrier rails or blockout pieces which have been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at its own expense.

Erection procedure

Road safety barrier rail attachment bolts and splice bolts are to be tightened initially such that the barrier 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 kinks or bumps.

The overall line of the top of the safety barrier rails is to visually conform with the vertical alignment of the road pavement.

Splice bolt tightening

When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail.

3.10 END TREATMENT OF ROAD SAFETY BARRIERS

Leading, trailing terminals

Both approach and departure ends of the road safety barrier shall be constructed with leading and trailing terminal sections at locations shown and as detailed on the Drawings.

Melt

Modified eccentric loader terminals (MELT) shall be constructed, as detailed on the Drawings and, at approach end locations of road safety barriers as shown on the Drawings.

Where the departure end of a road safety barrier is within the clear zone of opposing traffic, a MELT shall be constructed in place of a trailing terminal section.

Double sided safety barrier

The approach and departure ends of double sided road safety barriers shall have terminal sections as detailed on the Drawings.

Connections to rigid barriers

Non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets shall be as detailed on the Drawings and specified in 1163 *Rigid concrete and road safety barrier systems (Public Domain)*.

3.11 DELINEATORS

Fixing

Delineators complying with AS 1906.2 shall be fixed with brackets to the road safety barrier, to the details and at the locations shown on the Drawings beginning at the first post and then in accordance with Table 3.1.

Table 3.1 Location of delineators

Radius of curve m	**Spacing of reflectors on barrier** every
30–90	3rd post
90–180	5th post
180–275	8th post
275–365	11th post
over 365 (including straight road)	16th post

Arrangement and colour

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.

4 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this worksection are summarised in Table 4.1.

Table 4.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection Clause reference**
Vertical alignment		
- Tops of steel posts.	± 20 mm	**Erection of steel posts**
- Tops of timber posts	± 20 mm	**Erection of timber posts**

Post movement	≤ 3 mm	**Erection of steel posts**
Concrete footings		
- Diameter	–0 mm or +50 mm	**Erection of timber posts**

5 WIRE ROPE BARRIER

Wire rope barrier shall not be used.

6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1194.1 to 1194.7 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Concrete footings for timber posts are measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

Traffic control is measured and paid in accordance with 0310 *Minor concrete works*.

6.2 PAY ITEMS

1194.1 Single sided road safety barrier

- 1194.1(1) Single W-beam
- 1194.1(2) Nested W-beam
- 1194.1(3) Single Thrie-beam
- 1194.1(4) Nested Thrie-beam
- 1194.1(5) Single Modified Blockout Thrie-beam
- 1194.1(6) Nested Modified Blockout Thrie-beam
- 1194.1(7) Single W-Thrie-beam Transition
- 1194.1(8) Nested W-Thrie-beam Transition

The unit of measurement shall be the linear metre.

The distance shall be measured along the centre line of the rail, centre to centre of posts, excluding terminal sections and connectors to rigid safety barriers or bridge parapets.

The schedule rate shall include the supply of all components and fixings and all activities associated with the erection of each type of road safety barrier.

1194.2 Modified eccentric loader terminal (MELT)

The unit of measurement shall be ‘each’ MELT section supplied and erected as detailed on the Drawings.

1194.3 Terminal section

- 1194.3(1) Leading Terminal
- 1194.3(2) Trailing Terminal

The unit of measurement shall be ‘each’ terminal section supplied and erected as detailed on the Drawings.

1194.4 Connectors to rigid road safety barriers (rsb) or bridge parapet

- 1194.4(1) W-beam to RSB
- 1194.4(2) W-beam to Thrie-beam to RSB

- 1194.4(3) Thrie-beam to RSB

The unit of measurement shall be 'each' connector supplied and erected as detailed on the Drawings, excluding the anchorage assemblies cast into the rigid road safety barrier or bridge parapet.

1194.5 Delineator brackets

The unit of measurement shall be 'each'.

1194 6Double sided road safety barrier

- 1194.6(1) Single W-beam
- 1194.6(2) Nested W-beam
- 1194.6(3) Single Thrie-beam
- 1194.6(4) Nested Thrie-beam
- 1194.6(5) Single Modified Blockout Thrie-beam
- 1194.6(6) Nested Modified Blockout Thrie-beam
- 1194.6(7) Single W-Thrie-beam Transition
- 1194.6(8) Nested W-Thrie-beam Transition

The unit of measurement shall be the linear metre.

The distance shall be measured along the centre line of the rails, centre to centre of posts, excluding terminal sections and connectors to rigid safety barriers or bridge parapets.

The schedule rate shall include the supply of all components and fixings and all activities associated with the erection of each type of road safety barrier.

1194.7 Double sided road safety barrier terminal section

The unit of measurement shall be 'each' terminal section supplied and erected as detailed on the Drawings.

1195 BOUNDARY FENCES FOR ROAD RESERVES

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection 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.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1111 Clearing and grubbing

1192 Signposting

Standards

AS 1289	Methods of testing soils for engineering purposes
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1725	Chain-link fabric security fencing and gates
AS 1742	Manual of uniform traffic control devices
AS 1742.2	Traffic control devices for general use
AS 2423	Coated steel wire fencing products for terrestrial, aquatic and general use

2 MATERIALS

2.1 GENERAL

All materials shall be supplied by the Contractor and shall be of dimensions, manufacture and quality in accordance with the requirements of this worksection and all galvanized wire fencing products 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.

2.2 GALVANIZED POSTS AND BRACES

All posts and bracing shall be galvanized iron pipe in accordance with AS 1725. The pipes shall be to the dimensions shown on the Drawings.

All pipe joints shall be welded. All welds shall be satisfactorily cleaned and painted with a cold galvanizing compound to the satisfaction of the Superintendent.

2.3 CHAIN WIRE

Dimensions

Galvanized chain wire mesh, 1,450 mm wide (1830 mm wide for Manproof Fencing) shall be of 3.15 mm diameter wire woven to a 50 × 50 mm square mesh.

The selvedge edges of the chain wire shall be left barbed, and it shall be supplied in lengths of not less than 30 m.

Zinc coating

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.

PVC coating

Where specified, the chain wire shall be coated in colourPVC after galvanizing.

2.4 WIRE NETTING

Wire netting shall be standard quality galvanized 1.40 mm diameter wire, 40 mm mesh, 1.05 m wide for normal use and 1.60 mm diameter wire, 50 mm mesh, 0.90 m wide where used in creek crossings.

2.5 GATES

Dimensions and fittings

Gates shall be of galvanized tubular steel construction, 3.6 metres in width by 1.5 metres or 1.2 metres (as specified) 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.

Rabbit proofing

Where required, gates shall have stout and well supported rabbit-proof mesh to a height of at least 900 mm above ground level.

2.6 REINFORCED CONCRETE POSTS

Strainer posts

Dimensions: Concrete strainer posts shall be approximately 150×150 square in section and lengths as shown on the Drawings. Each post shall be provided with 12 mm dia holes to suit the spacing of the wires shown on the Drawings for the particular type(s) of fencing to be erected.

Reinforcing steel: The posts shall be reinforced longitudinally with not less than four reinforcing bars each 12 mm diameter. All posts shall have suitable stirrup reinforcement to control diagonal cracking. Longitudinal reinforcement shall have 25 mm minimum cover. End cover on reinforcement shall be 25 mm.

Concrete strength: The concrete shall have a minimum 28 day compressive strength of 20 MPa.

Intermediate posts

Intermediate Posts shall generally conform to the requirements for Strainer Posts, except that the longitudinal reinforcing bars may be 9 mm dia.

2.7 PRESTRESSED CONCRETE POSTS

Strainer posts

Tendons: At least four longitudinal high carbon deformed high tensile strands (or equivalent) of 5 mm diameter, shall be provided. The strands shall be tensioned to a stress of 800 MPa minimum prior to placing concrete. Cross sectional dimensions of the posts shall be as shown on the Drawings.

Concrete: Concrete shall have a minimum compressive strength of 32 MPa at 24 hours.

Grooves for wire: In lieu of holes for wires, grooves may be provided to suit the spacing of the wires shown on the appropriate Drawings for the particular types of fencing to be erected.

The grooves shall be at least 5 mm deep and 5 mm wide at the surface of the post.

Intermediate posts

Intermediate posts and strainer stays shall generally conform to the requirements for Strainer Posts except that two only high tensile, high carbon deformed strands shall be required.

Cross sectional dimensions shall be as shown on the Drawings.

2.8 STEEL POSTS (RURAL FENCING)

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 galvanized.

The total weight of 30 posts each 1.65 m long shall be at least one (1) tonne.

2.9 GALVANIZED PIPE POSTS (RURAL FENCING)

Galvanized pipe posts shall be used where shown on the Drawings.

The pipes shall be of the dimensions shown on the Drawings and shall be of first grade quality in accordance with AS 1725.

2.10 WIRES

Plain wire

Plain wire shall be standard galvanized drawn annealed steel wire of diameters shown on the Drawings.

High tensile plain wire

High Tensile wire shall be galvanized and of diameters shown on the Drawings.

Barbed wire

Barbed wire including barbs shall be 2.5 mm diameter galvanized drawn annealed steel wire, with clusters of four barbs spaced at 90 mm maximum.

Alternatively barbed wire may be of 1.6 mm diameter high tensile steel wire, with clusters of barbs spaced at 90 mm maximum.

Cable wire

Type and dimensions

Cable wire shall consist of three pairs of 2 $\times$ 3.15 mm galvanized iron wire tightly twisted around posts and located as shown in the Drawings.

Tie wire

The wire shall be 2 mm diameter galvanized wire.

2.11 CONCRETE BACKFILLING

All concrete backfilling of post holes specified on the Drawings shall be of minimum 20 MPa 28 day compressive strength and shall conform to the requirements of 0310 *Minor concrete works*.

3 CONSTRUCTION

3.1 GENERAL

Construction Priority

Boundary fencing shall be erected prior to the commencement of other work on a particular section of the work, unless directed otherwise by the Superintendent.

Quality

All fencing shall be erected in a workmanlike manner, and when completed shall be sound, strong and of neat appearance.

Clearing

For a clear width of one metre on either side of the fence line, and for the full length of the line, all logs, boulders, stumps, roots, undergrowth and rubbish shall be removed and disposed of by the contractor in accordance with 1111 *Clearing and grubbing*.

Trees within this area shall be removed only as directed by the Superintendent and approved by Council.

Trees retained

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 on fence line

Wire shall not be strained around or against any trees to be left in the fence line, and strainer posts are to be provided on both sides of each tree.

Uniform grade

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.

Survey pegs

All survey pegs shall be left undisturbed and the post spacing shall be altered slightly where necessary to avoid pegs.

Stock proof

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.

Backfilling of old holes

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 150 mm.

Contractor's responsibility

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 the Contractor's part.

3.2 CHAIN LINK FENCING

Erection of posts

Concrete foundation: All posts shall be erected vertically and set in concrete fondations approximately 250 mm diameter and 600 mm deep except for end, corner, strainer and gate posts which shall be set in concrete blocks approximately 250 mm diameter and 900 mm deep unless otherwise shown on the Drawings.

Concrete shall have a minimum compressive strength of 20 MPa at 28 days and shall conform to the requirements of 0310 *Minor concrete works*.

Weather caps: Galvanized weather caps shall be fitted to all galvanized posts.

Strainer posts: 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 exceed 120 metres.

Erection of wire

Fasten and strain: All wire shall be spaced as shown in the Drawings.

Wire shall be securely fastened and strained to an even tension between strainer posts.

Chain wire mesh: 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 900 mm between posts and to each post midway between cable wires.

3.3 STOCK-PROOF FENCING

Erection of posts

Method: All posts shall be erected vertically. Reinforced concrete posts shall be erected in neatly cut holes sunk in earth, or in rock where this is encountered.

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.

Driving prestressed posts: Where prestressed posts are proposed to be used, they shall be either erected as for reinforced concrete posts or shall be driven. Where driven, the Contractor shall use a suitable post driver which shall be equipped with two sets of guiding rollers, to hold the post vertical and in position during driving.

Protection cap: A steel cap with a plywood cushion shall be used to protect the top of the post during driving.

Removal of posts due to construction issues: 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 as described for reinforced concrete posts.

Posts shall be sunk to the depths shown in Table 3.1.

Table 3.1 Post depth in Ground

Type of Post	**Depth**	
	Earth	**Rock**
Concrete Corner posts & strain posts	900	*600
Concrete intermediate posts	600	*450
Steel posts	450	450
* Permitted only in cases where posts of the correct length are provided (see below), otherwise the depth of sinking shall be the same as for earth.		

Variations to post length: Cutting of concrete posts will not be permitted, and in order to take advantage of the lesser depth of sinking permitted in rock, it will be necessary to use posts manufactured in lengths to suit the depth of sinking. Where rock is encountered, steel posts shall be sunk in drill holes of sufficient diameter to permit them to be refilled with cement mortar consisting of one part of cement to two parts of clean sand.

Backfilling at intermediate posts: Earth shall be backfilled around intermediate posts in layers of maximum depth 150 mm 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.

Mortar backfill: Where concrete posts are placed in rock, the space around the posts shall be tightly filled with cement mortar consisting of one part of cement to two parts of sand, or concrete where this is available.

Strainer posts: Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. These posts shall be backfilled with approved concrete to their full depth.

Spacing of posts: Distances between strainer posts shall not exceed 120 m in the case of fencing using steel intermediate posts, and 90 m in the case of fencing for the retention of cattle (for which only concrete posts are permitted).

Junctions with existing fencing shall be made in an approved manner.

Erection of wires

Fastening and straining: All wire shall be placed as shown on the Drawings. 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 at the top of intermediate posts, and where additional barbed wires are called for they shall be secured to the sides of the posts as shown on the Drawings.

Barbed wire: Where concrete posts are used and the barbed wires are secured either to the tops or sides of the posts by tie wire, the tie wire shall be stretched tight and shall fit snugly against the sides of the posts to prevent movement of the barbed wire.

Prestressed posts: Where prestressed posts are used, wires shall be securely tied so that they seat firmly in the grooves.

Wire joints: All joints in wires shall be as shown on the Drawings.

3.4 RABBIT-PROOF FENCING

Netting position

Wire netting shall be erected on the side of the fence remote from the roadway in the case of road reserve boundary fences.

In other cases netting shall be erected on the side of which the Superintendent shall direct.

Lap/Trench

The netting shall be erected so that there is a 200 mm lap laid on the ground surface, or trenched 215 mm into the ground as shown on the Drawings for the type of fence to be erected.

Fixing of netting

Netting shall be tied with tie wire or fixing clips approved by the Superintendent.

Straining and tying

The netting shall be loosely tied to fence wires then carefully strained without disturbing or breaking the mesh, and shall then be tied to the wires immediately on each side of the post and at intervals not exceeding 1 m.

Additional netting
At each strainer post strut, additional netting shall be attached to the fence adjacent to the strainer post, to a height of 450 mm above the strut.

3.5 CROSSING OF WATERCOURSES AND DEPRESSIONS

Marsupial proof
The crossing of all watercourses and depressions, shall be made secure by longer posts, suitably strutted as directed by the Superintendent.

Additional cable wire and chain wire/wire netting shall be provided as necessary to make the fence stock proof.

Floodwater
The fence shall allow the passage of floodwater without the accumulation of debris. If directed by the Superintendent, flood gates shall be provided in accordance with **Flood gates**.

3.6 CONNECTIONS TO EXISTING FENCES

Existing cross fences shall be connected to the new fence using a strainer post with braces in each direction of strain (including cross fence) and the wires in both fences properly fastened to the post.

3.7 FLOOD GATES

General
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 or rabbit-proof.

Small watercourses
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.

Large gullies and creeks
Location: Flood gates, in accordance with the Drawings, shall be provided in gullies and creeks at the locations indicated on the Drawings, or as directed by the Superintendent.

Construction detail: A 9 mm galvanized 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 1.0 m on the downstream side.

Netting ballast: Ballast, of sound timber securely tied to the netting, shall be provided at the downstream end of the netting.

Construction requirements: 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 three directions, as shown on the Drawings.

3.8 ERECTION OF GATES

Swing away from road
Where gates are specified or shown on the Drawings, 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.

Level surface
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.

Hanging
The gates shall be hung as indicated in the Drawings.

3.9 REMOVAL OF EXISTING FENCING

Location

Where required, existing fencing is to be removed as shown on the Drawings.

Contractor's responsibility

No fencing is to be removed if there is a risk of egress or ingress of stock.

If the existing fence is a rabbit-proof fence, then the contractor shall ensure that at night and weekends and other such times when work is not in hand that the whole of the fence is maintained in a rabbit-proof condition, even if temporary fencing is required. No extra payment will be made for this requirement.

Old material

All material removed in demolishing existing fencing shall be disposed by the Contractor as provided by **Removal and disposal of surplus material and rubbish**.

3.10 REMOVAL AND DISPOSAL OF SURPLUS MATERIAL AND RUBBISH

Contractor's responsibility

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.

Fire damage

The Contractor shall be responsible for any damage which may result from the lighting of fires associated with the work.

3.11 CATTLE GRIDS

Specification

Where shown on the Drawings, or as directed by the Superintendent, cattle grids shall be erected in accordance with the Drawings.

Bedding

The cattle grid shall be evenly bedded on a continuous layer of compacted sand or other granular material approved by the Superintendent.

The bedding material shall be compacted so that the relative compaction as determined by AS 1289.5.4.1 is not less than 95%.

Raised abutments

Cattle grids shall be installed on raised abutments with approach ramps where possible.

Alternatively, a cattle grid may be placed over an excavated pit, in which case adequate drainage shall be provided.

Crossfall

Crossfall for single lane cattle grids shall be level and for two lane cattle grids each section shall have a crossfall conforming to the crossfall of the approach road.

Extent of work

The cattle grid construction shall include all activities associated with the cattle grid including any adjustments to the fencing as shown on the Drawings.

Advance signposting, in accordance with AS 1742.2, shall be provided on each approach to the cattle grid in accordance with 1192 *Signposting*

4 PROPERTY ACCESS

Council is not responsible for the maintenance of cattle grids constructed on road reserves. All new or upgraded property access shall be in accordance with Council's "Rural Property Access Standard".

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this Worksection on a schedule of rates basis in accordance with Pay items 1195.1 to 1195.4 inclusive.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

A lump sum price for any of these items shall not be accepted.

Clearing and grubbing is measured and paid in accordance with this worksection and not 1111 *Clearing and grubbing*.

Concrete backfilling and blocks are measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Cattle grid signposting is measured and paid in accordance with this worksection and not 1192 *Signposting*

5.2 PAY ITEMS

1195.1 Supply and erection of boundary fencing

The unit of measurement shall be the linear metre of fencing, chain link, stock-proof or rabbit-proof, measured on site.

Separate pay items shall be shown for each type of fence specified.

The schedule rate under this Pay Item shall include the supply of all materials, the clearing of site, and all activities associated with the erection of the fence, including the levelling of mounds (if required), concreting, the provision of crossings for watercourses and depressions as necessary, flood gates as necessary and the connection of the new fence to existing fence where required.

The schedule rate shall also cover all types of excavation material encountered during construction work, both earth and rock and the removal and disposal of surplus material and rubbish.

1195.2 Supply & erection of boundary fence gates

The unit of measurement shall be ‘each’ gate erected.

The schedule rate shall include the supply of all material and all activities associated with the erection of each gate.

1195.3 Supply & installation of cattle grid

The unit of measurement shall be ‘each’ cattle grid installed.

The schedule rate shall include the supply of the cattle grid together with all activities associated with the construction of the cattle grid including bedding, approach ramps, wings, drainage, adjustment to fencing and the provision of signs.

1195.4 Removal of existing fence

The unit of measurement shall be the linear metre of fencing removed as measured on site.

The schedule rate shall include all activities associated with the demolition and disposal of the existing fence.

0250 OPEN SPACE - LANDSCAPING

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of:

- The vegetation of cut and fill batters, median areas, pathways, parks, verges, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, turfing or sowing of seed and may include surface protection works, hydroseeding, hydromulching and straw mulching.
- The supply of plants, planting at locations as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

1102 *Control of erosion and sedimentation*

1112 *Earthworks (Roadways)*

Standards

AS 1160 pavements	Bitumen emulsion for construction and maintenance of
AS 2507	The storage and handling of pesticides
AS 4419	Soils for landscaping and garden use
AS 4454	Composts, soil conditioners and mulches
AS 4843	Synthetic weed blocking fabric

2 VEGETATION OF SLOPES AND DRAINS

2.1 EXECUTION AND TIMING OF WORK

Contractor's responsibility

In association with the work to be executed under this worksection, the Contractor shall implement effective erosion and sedimentation control measures in accordance with 1102 *Control of erosion and sedimentation*.

Vegetation

The work to be executed includes the vegetation of cut and fill batters, pathway verges, 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.

Exposed ground

Between the months of September and May inclusive, exposed surfaces shall be vegetated before the area exceeds one hectare or lesser area as directed by the Superintendent.

No vegetation shall be carried out between June and August inclusive unless otherwise approved by the Superintendent.

2.2 MATERIALS

Topsoil

The Contractor shall use imported topsoil and/or topsoil won and stockpiled on site under 1112 *Earthworks (Roadways)*.

Where imported topsoil is required it shall comply with AS 4419 and shall:

- 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 humans, animals or plants,
- contain no stumps, roots, clay lumps or stones larger than 50 mm in size,
- have an organic content of at least 3% by mass,
- have a pH neither less than 5.5 nor more than 7.5,
- have a soluble salt content not exceeding 0.06% by mass.

Herbicide

Herbicide used shall be a glyphosate based herbicide listed in Annexure A.

Seed

Seed type and supplier: All seed used shall be of the species and varieties listed in Annexure A and shall be sown at the application rates specified 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.

Lead time for native seed: 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.

Certification: 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.

Storage: 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.

Seed batch not true to type: The Contractor shall replace any exotic seed batch found not true to type. The cost of replacement shall be borne by the Contractor.

Turf

Turf shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with 25 mm depth of topsoil. The type of grass turf to be used shall be selected from Annexure A and in accordance with the Drawings. Unless specified, Kikuyu grass shall not be used. 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 300 mm, and shall be in sound unbroken condition.

Fertiliser

Fertiliser shall be an organic type listed in Annexure A, with Nitrogen:Phosphorus: Potassium (N:P:K) ratios of 8 : 3.6 : 2.

Vegetable mulch

Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm.

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.

Water

Water used shall be potable.

Binder

The binder used in hydromulching and strawmulching shall be a Grade ASS slow setting anionic bitumen emulsion complying with AS 1160.

Wetting agent

The soil wetting agent added in hydromulching or hydroseeding shall be listed in Annexure A and applied at the application rate specified therein.

Pesticide

Pesticide used shall be a liquid or powder listed in Annexure A.

The storage and handling of pesticides shall be in accordance with AS 2507.

Soil conditioner

Unless shown otherwise in Annexure A, the soil conditioner used shall be gypsum.

2.3 VEGETATION OF SLOPES 3 TO 1 OR FLATTER

Preparation of surface

Herbicide treatment: Slopes shall be sprayed with herbicide, applied at the rate specified in Annexure A, to kill weed infestation.

Sprayed areas shall remain undisturbed for two weeks.

Preparation: The surface shall then be tyned to a depth of 200 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

Soil conditioner: All areas that are to be topsoiled shall have gypsum, or other specified soil conditioner, added at the rate specified in Annexure A.

Gypsum application: The gypsum shall be added by one of the following methods as directed by the Superintendent:

- it shall be spread evenly over the subsoil prior to topsoiling by a mechanical spreader. Any area that is spread with a soil conditioner shall be topsoiled on that day; or
- it shall be thoroughly mixed into the topsoil whilst topsoiling is being removed from the topsoil stockpiles.

Application of other conditioners: Soil conditioners, other than gypsum, shall be applied as directed by the Superintendent.

Topsoiling

Approval: Placing and spreading of topsoil shall not commence without the prior approval of the Superintendent.

Application: Topsoil shall be uniformly applied to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

The topsoiled area shall be cultivated to a depth of 50 mm to provide a roughened surface with soil lumps not exceeding 50 mm dimension.

Mixing of seed

Notice: The Contractor shall give the Superintendent two days' notice before each sowing operation.

Seed mixing: Seed to be used for each operation shall be mixed, pretreated and placed into the sowing equipment on site.

Seed shall be sown on the day of mixing with pesticide.

Incorporation of pesticide

Immediately before sowing, all grass and native seed shall be treated with pesticide (powder form).

The pesticide shall be thoroughly mixed as a dry powder with the seed at the rate specified in Annexure A to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with Annexure A.

Sowing

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 5 mm or shall be raked or harrowed to provide 5 mm cover.

Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in Annexure A.

Fertiliser shall be applied concurrently with the seeding operation.

Turfing

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 water flow. Turf seams shall then be topdressed with topsoil.

Topdressing

Four to six weeks after placement, the turf shall be lightly topdressed with topsoil to correct any undulations or unevenness in the established turf.

Watering

No run-off: The Contractor shall water areas to be sown or turfed to a uniformly moist condition without run-off.

Uniform application: After sowing or turfing the areas shall be rewatered to a uniformly moist condition without run-off, and for sowing without causing rills in the surface, on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by the Superintendent, to promote and maintain growth.

Excessive rilling: If the Superintendent is of the opinion that excessive rilling has occurred in the surface, from whatever cause, the Superintendent shall direct the Contractor to re-prepare and re-sow the affected area.

The costs of such work shall be borne by the Contractor.

2.4 VEGETATION OF SLOPES STEEPER THAN 3 TO 1

Methods

Where shown on the Drawings or directed by the Superintendent, slopes shall be vegetated by one of the following methods:

- Topsoiling and hydromulching;
- Topsoiling, hydroseeding and straw mulching;
- Hydroseeding.

Preparation of surface

Herbicide treatment: Weeds shall be killed by spraying with herbicides as specified under **Vegetation of slopes 3 to 1 or flatter**.

Preparation: 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 kg/m of length or by other methods approved by the Superintendent.

Soil conditioner: All areas that are to be topsoiled shall have gypsum, or other specified soil conditioner, added as specified under **Vegetation of slopes 3 to 1 or flatter**.

Topsoiling

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 50 mm with a minimum compacted thickness of 30 mm.

Hydromulching or hydroseeding

Application rate: The hydromulch or hydroseed shall comprise the materials shown in Table 2.1. The materials shall be applied at the application rates shown in Table 2.1.

Watering: Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

Treatment of Seed: The mixing and treatment of seed shall be carried out in accordance with **Vegetation of slopes 3 to 1 or flatter**.

Pesticide: During preparation of the hydromulch or hydroseed slurry, liquid form pesticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of pesticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table 2.1.

Equipment: Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.

Uniform mix: 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.

Weather Conditions: Hydromulch or hydroseed shall not be applied under the following weather conditions at the site:

- when temperature is higher than 35°C
- when winds exceed 15km/hr
- where, in the opinion of the Superintendent, the surface is too wet or
- during rain periods or when rain appears imminent.

Application rates shall be in accordance with Table 2.1

Table 2.1 Materials and application rates

Material	**Application rate per hectare**	
	Hydromulching	**Hydroseeding**
Vegetable mulch (kg)	1,500	Nil
Water (l)	35,000	20,000
Binder (l)	1,200	Nil
Fertiliser	See Annexure A	
Seed	See Annexure A	
Wetting agent (l)	35	20
Pesticide (l)	5	5

Straw mulching

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.

2.5 VEGETATION OF OPEN DRAINS

Preparation of surface

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.

Sowing

Before sowing, the surface shall be watered as specified under **Vegetation of slopes 3 to 1 or flatter**.

Seed and fertiliser shall then be applied uniformly at the rates specified in Annexure A by one of the following procedures as directed by the Superintendent:

- Mechanical sowing.
- Hydromulching or hydroseeding.
- By hand.

Surface protection

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:

- 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.
- Lining with organic fibre mat: The channel surface shall be lined with an organic fibre mat listed in Annexure A. 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. The upstream end of the matting shall be slotted into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. The trench shall be backfilled with soil and compacted by foot. The pins shall be 'U' shaped, 4 mm gauge wire, 50 mm wide and 150 mm long legs. Adjacent runs of matting shall be overlapped 100 mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500 mm centres and along the middle of each run at 1 m centres. End overlaps shall be 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

- Turfing: Turf shall be as specified under *Vegetation of slopes and drains (Materials)***.** 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 500 mm centres. Seams of turf shall be topdressed with topsoil.

Watering

The Contractor shall water treated areas in order to promote and maintain growth as specified under **Vegetation of slopes 3 to 1 or flatter**.

3 LANDSCAPE PLANTING

3.1 EXECUTION AND TIMING OF WORK

Extent of work

The work to be executed under Landscape Planting includes the ground preparation, the supply of plants, planting as shown on the Drawings, fertilising, mulching, staking, watering and maintenance of plants.

Notice of commencement

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 weather conditions (above 35°C or below 10°C), unless otherwise approved by the Superintendent.

3.2 MATERIALS

Topsoil

Topsoil shall comply with the requirements of **Vegetation of slopes and drains (Materials***).*

Herbicide/weed blocking fabric

Herbicide shall comply with the requirements of **Vegetation of slopes and drains (Materials)**.

Synthetic weed blocking fabric shall comply with AS 4843.

Fertiliser

Fertiliser shall be a slow-release type in pellet form, listed in Annexure A, with a nine months' release period and having Nitrogen:Phosphorus: Potassium (N:P:K) ratios of 6.3 : 1.8 : 2.8.

Mulch

All mulches used for landscape planting shall consist of organic material complying with the requirements of AS 4454.

Mulch shall be composted or pasteurized as indicated in Annexure A.

The use of other materials as ground cover shall be as indicated on the Drawings and approved by the Superintendent.

A 10kg 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.

Plant material

The Contractor shall obtain all plants from a nursery located in an area having a similar climate to the site of the Works.

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% and 25% clay by volume.

Trees shall have a single leading shoot.

For hardening off purposes, all plants shall be delivered to a site within the locality of the works 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 3.1, and planted in accordance with the Drawings.

Table 3.1 Plant Stock

		Type or stock				
		50 mm Tube	**Gro-tube**	**Semi advanced**	**Advanced stock**	**Super advanced**
Plant container:	dia (mm)	50	75	150	200	300
	depth (mm)	75	100	150	200	300
Plant height (mm)		200 min	300 min	300 min	300 min	500 min
(leaf and stem)		300 max	400 max	400 max	500 max	750 max
Planting holes:	side/dia(mm)	200	200	300	400	600
	depth (mm)	200	200	300	400	600
Number of fertilizer pellets		2	3	5	5	7

Stakes

Plants shall be staked at locations shown on the Drawings. Stakes shall be hardwood and sharpened at one end, with dimensions as follows:

- Marker stakes (tube): 15 mm x 15 mm × 800 mm
- Stakes (advanced): 25 mm x 25 mm × 2000 mm
- Stakes (super advanced): 50 mm x 50 mm × 3000 mm

3.3 PLANTING

Mass planting in mulched bed

Soil conditioner: The area to be planted shall be prepared with the addition of a soil conditioner listed in Annexure A and applied at the rate specified therein.

Herbicide/weed blocking treatment: The area to be planted shall be sprayed with herbicide as specified under **Vegetation of slopes 3 to 1 or flatter**.

Sprayed areas shall remain undisturbed for two weeks. Alternatively, where approved by the Superintendent, a synthetic weed blocking fabric shall be applied to the area to be planted.

Surface preparation: The surface shall be ripped at 500 mm centres to a depth of 300 mm and the top 200 mm of the planting bed broken up by cultivation to a maximum size of 50 mm.

Mulch, 100 mm thick, shall be spread over the planting bed. After removal of the localised mulch, planting holes shall be excavated to the dimensions and depths as shown in Table 3.1 and the material removed.

Fertilizer pellets: The specified number of fertilizer pellets as shown in Table 3.1 shall be placed beside the rootball of each plant.

Backfill and staking: The planting hole shall be backfilled with topsoil complying with **Vegetation of slopes and drains (Materials)** and compacted by foot up to surface level, care being taken to avoid mixing mulch with topsoil.

A stake shall be driven 300 mm deep and 200 mm clear of each ‘Advanced’ and ‘Super advanced’ size stock and the stock tied to it by a strip of 50 mm wide hessian webbing.

Watering and mulching: 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.

Individual planting

Planting holes: A planting area 600 mm dia. or square shall be loosened to a depth of 400 mm.

Planting holes shall be excavated to dimensions and depths as shown in Table 3.1 and the material spread evenly around each hole.

Fertilizer pellets: The specified number of fertiliser pellets, as shown in Table 3.1, shall be placed beside the rootball of each plant.

Backfill and staking: The planting hole shall be backfilled with topsoil complying with **Vegetation of slopes and drains (Materials)**and compacted by foot up to surface level.

A stake shall be driven 300 mm deep and 200 mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50 mm wide hessian webbing.

Watering: Each backfilled hole shall receive 10 litres of water.

Herbicide/weed blocking treatment

Weed infestation for a distance of 800 mm surrounding each proposed planting shall be killed by spraying with a herbicide as specified in **Vegetation of slopes 3 to 1 or flatter**.

All due care shall be taken to avoid damage caused by contact between herbicide and plant by means of spray drift etc.

Alternatively, where approved by the Superintendent, a synthetic weed blocking fabric shall be applied to the 800 mm area surrounding each proposed planting.

Mulch

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.

3.4 CARE OF LANDSCAPE PLANTING

Watering

The Contractor shall water all plants, from the time of planting, at the rate of 10 litres per plant every third day for the first twelve weeks.

Replacement plants contractor's cost

Missing plants, dead plants and plants nominated by the Superintendent as unhealthy shall be replaced by the Contractor.

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.

Weed control

Weed and grass growth in mulched areas shall be killed by treatment with herbicide, 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 or damaged plant material replaced by the Contractor at no cost to the Principal.

4 RESTORATION OF SURFACES

General

Pavements, lawns and other improved areas shall be thoroughly cleaned and left in a similar order as they were at the commencement of the works.

Lawns

Lawns shall be restored with turf cut and set aside from the original surface or with turf of the same species imported from a source approved by the Council Engineer. All new areas to be vegetated are to be couch turfed or seeded unless specified otherwise and approved by the Council Engineer.

Pavements

Pavements shall be maintained with approved gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavements.

Trenches

Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out, or the original backfill trimmed, in order that the surface of the completed trench may then conform with the adjacent surface level. Surplus material shall be adequately disposed of to areas approved by Council and arranged by the Contractor.

Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses a bitumen or concrete pavement, a pre-mixed asphaltic material shall be used for such temporary restoration. Temporary restoration shall be maintained by the Contractor until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its subbase to no less than the original condition. Final restoration may include, if required by the Council Engineer, the removal of temporary restoration.

Maintenance
All restored surfaces shall be maintained in the condition to which they are restored until expiry of the Maintenance Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the maintenance period.

5 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 4.1.

Table 4.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection reference**
Topsoil		
- Organic content	>3% by mass	**Vegetation of slopes and drains (Materials)**
- pH	>5.5 <7.5	**Vegetation of slopes and drains (Materials)**
- Soluble Salt	<0.06% by mass	**Vegetation of slopes and drains (Materials)**
Turf		
- Width of rolls	>300 mm	**Vegetation of slopes and drains (Materials)**
Vegetable Mulch		
- Material	maximum size <10 mm	**Vegetation of slopes and drains (Materials)**
- Paper pulp	<50% by mass of total mulch	**Vegetation of slopes and drains (Materials)**
Topsoiling	Minimum compacted thickness at any location of 30 mm	**Vegetation of slopes 3 to 1 or flatter, Vegetation of open drains**
Straw mulching		
- Straw mat	Finished thickness >20 mm	**Vegetation of slopes steeper than 3 to 1**
Landscape planting		
- Temperature	Planting not to be undertaken when temperatures >35°C Or <10°C.	**Execution and timing of work**
Mulch		
- Fines	Shall not exceed 5% by volume.	**Landscape planting (Materials)**
- Woodchip	Maximum size <50 mm.	**Landscape planting (Materials)**
Plant material		
- Container soil mix	Contain >20% <25% by volume of clay.	**Landscape planting (Materials)**

6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 02501.1 to 0250.5 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Notwithstanding any general statements to the contrary that may be made elsewhere in this worksection, in the context of landscape works all areas shall be measured in the plane of the surface and thicknesses specified shall apply perpendicular to the surface.

Erosion and sedimentation control measures are measured and paid in accordance with 1102 *Control of erosion and sedimentation*.

Topsoil stockpiling is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

6.2 PAY ITEMS

0250.1 Vegetation of slopes 3 to 1 or flatter

- 0250.1(1) Vegetation—Seeding
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the vegetation of such slopes by seeding other than the cost of watering, and supply of imported topsoil.
- 0250.1(2) Vegetation—Turfing
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the vegetation of such slopes by turfing other than the cost of watering, and supply of imported topsoil.
- 0250.1(3) Watering

  The unit of measurement shall be the kilolitre. The volume shall be determined by calibrated dipstick readings or other method approved by the Superintendent.
  The schedule rate shall cover all costs associated with supply and delivery of the water and the watering of the seeded and/or turfed areas.

0250.2 Vegetation of slopes steeper than 3 to 1

- 0250.2(1) Preparation of surface other than stepped batters
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the preparation of the surface for vegetation other than the cost of supply of imported topsoil.
- 0250.2(2) Preparation of surface of stepped batters
  The unit of measurement shall be the square metre on the batter slope.
  The schedule rate shall cover all costs associated with the preparation of the batter slope for vegetation other than the cost of supply of imported topsoil.
- 0250.2(3) Hydromulching
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with hydromulching as specified other than the watering of dry surfaces.
- 0250.2(4) Hydroseeding
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with hydroseeding as specified other than the watering of dry surfaces.
- 0250.2(5) Straw Mulching
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with straw mulching.
- 0250.2(6) Watering
  The unit of measurement shall be the kilolitre.
  The volume shall be determined by calibrated dipstick readings or other method approved by the Superintendent.
  The schedule rate shall cover all costs associated with supply and delivery of the water and the watering of dry surfaces.

C0250.3 Vegetation of open drains

- 0250.3(1) Preparation and Topsoiling of Drains
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with preparation of the surface for sowing.

- 0250.3(2) Mechanical Sowing
  The unit rate of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with sowing and fertilizing.
- 0250.3(3) Hydromulching
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with hydromulching as specified other than the watering of dry surfaces.
- 0250.3(4) Hydroseeding
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with hydroseeding as specified other than the watering of dry surfaces.
- 0250.3(5) Hand Sowing
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with sowing by hand.
- 0250.3(6) Spray with bitumen emulsion
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the supply and spraying of bitumen emulsion.
- 0250.3(7) Lining with organic fibre mat
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the supply and placement of organic fibre mat.
- 0250.3(8) Turfing
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the supply and placement of turf.
- 0250.3(9) Watering
  The unit of measurement shall be the kilolitre.
  The volume shall be determined by calibrated dipstick readings or other method approved by the Superintendent.
- The schedule rate shall cover all costs associated with supply and delivery of the water and the watering of dry surfaces and all treated drain areas.

0250.4 Landscape planting

- 0250.4(1) Provision of mulched bed for mass planting
  The unit of measurement shall be the square metre.
  The schedule rate shall cover all costs associated with the preparatory work of the mulched bed before planting.
- 0250.4(2) Mass planting
  The unit of measurement shall be ‘each’ plant.
  The schedule rate shall cover all costs associated with the planting in the mulched bed and subsequent care of each plant.
- 0250.4(3) Individual Landscape Planting of Stock
  The unit of measurement shall be ‘each’ plant.
  The schedule rate shall cover all costs associated with the preparatory work, planting and subsequent care of each plant.

0250.5 Supply of imported topsoil

The unit of measurement shall be the cubic metre measured loose in the truck as delivered.

The schedule rate shall cover all costs associated with the supply and delivery of the topsoil to the site as directed by the Superintendent.

Placing and spreading of the topsoil is excluded from this pay item and is included in the specific activity pay items for vegetation or planting as appropriate.

7 ANNEXURE A

7.1 LANDSCAPING MATERIALS

Landscaping Materials (Sample Only —to be completed by complier)

	MATERIAL	TYPE	MINIMUM APPLICATION RATE
1.	HERBICIDE *	'Roundup'	9 litres/200 litres water/ha
2.	SEED		
	- Grass	Rye Corn (April-August) or	60 kg/ha
		Japanese Millet (September-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	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 viscoca	200 g/ha
3.	TURF GRASS		
	- Medians - Verges/Footpaths - Other Areas	Couch Buffalo Couch	Refer to Drawings ' '
4.	FERTILISER *		
	Vegetation of Slopes/Drains Landscape Planting	Dynamic Lifter 'Nitro' 'Kokei' pellets	1000 kg/ha Refer Table 3.1
5.	WETTING AGENT *	'Aquasoil'	1 litre/1000 litres of mix water
6.	PESTICIDE *		
	Liquid Powder	'Lorsban 500 EC' 'Lorsban 250 W'	5 litres 10 kg
7.	SOIL CONDITIONER*		
	Vegetation of Slopes/Drains Landscape Planting	Gypsum _____	400 g/m2 5k g/m2

	MATERIAL	**TYPE**	**MINIMUM APPLICATION RATE**
8.	ORGANIC FIBRE MAT*	'Sta-firma' (light grade)	—
9.	MULCH	Composted/Pasteurized	100 mm thick
* Material shall be as listed or equivalent as approved by Superintendent.			

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0310 MINOR CONCRETE WORK

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the supply and placement of concrete, including sprayed concrete, and ancillary requirements like excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the Drawings but not having individual Specifications.

These works include 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.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in *0165 Buildings and facilities maintenance plan.*

1.3 REFERENCED DOCUMENTS

The following documents referred to in this Worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0165 Buildings and facilities maintenance plan

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.8.1	Method of making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.14	Method for securing and testing cores from hardened concrete for compressive strength
AS 1141	Methods for testing and sampling aggregates
AS 1141.14	Particle shape by proportional calliper
AS 1141.21	Aggregate crushing value
AS 1141.23	Los Angeles value
AS 1141.24	Aggregate soundness—Evaluation by exposure to sodium sulphate solution
AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1379	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 1554	Structural steel welding
AS 1554.3	Welding of reinforcing steel
AS 2082	Timber—Hardwood—Visually stress-graded for structural purposes
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	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
AS/NZS 1859	(Various) Reconstituted wood-based panels
AS/NZS 2271	Plywood and blockboard for exterior use
AS/NZS 4671	Steel reinforcing materials

Other publications
Dept of Environment and Conservation (NSW)
Environmental Best Management Practice Guideline For Concreting Contractors.

1.4 ENVIRONMENTAL BEST MANAGEMENT PRACTICE

All work covered by this worksection (where applicable) should be carried out in accordance with the *Environmental Best Management Practice Guideline For Concreting Contractors*.

1.5 LOADS ON MINOR CONCRETE STRUCTURES

No superimposed load shall be allowed on any part of what will become a load bearing structure within 21 days after placing concrete unless the structure is effectively and independently supported to the satisfaction of the Superintendent or when the Contractor can demonstrate that 95% of the design strength of the concrete has been achieved.

2 EXCAVATION AND FOUNDATIONS

2.1 SHORING

The Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with Statutory requirements.

2.2 EXCAVATION

The subgrade, or subbase where specified, shall be formed at the required depth below the finished surface levels shown on the drawings.

2.3 FOUNDATIONS

Suitable bed
Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned.

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).

The excavation shall be kept free of water.

Unsuitable material
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% as determined by AS 1289.5.4.1 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.

2.4 DRIVEWAYS AND FOOTPATHS

Subbase
For driveways and footpaths a subbase of approved quality and of minimum 150 mm compacted thickness, unless otherwise shown on the Drawings, shall be placed over the subgrade.

The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

Compaction
The subbase material shall be compacted to provide a minimum relative compaction as determined by AS 1289.5.4.1 of 100% for standard compactive effort or 97% for modified compactive effort as appropriate.

Subbase tolerance
The finished subbase shall not deviate more than 15 mm under a straight edge 3 metres long, subject to any necessary allowance on vertical curves.

2.5 DRAINAGE PITS AND OTHER SUPPLEMENTARY STRUCTURES

Where the excavation is in sound rock, and the Superintendent so directs, part of the concrete lining of gully pits and other structures may be omitted, provided that a neatly formed pit of the required

dimensions is constructed, and provided that the wall of the pit adjacent to and parallel with the road is constructed of formed concrete in all cases.

2.6 RETAINING WALLS, HEADWALLS AND WINGWALLS

Rock foundations

In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of 150 mm.

Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be less than that shown in the Drawings, if approved by the Superintendent.

Earth foundations

Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete bedding layer at least 50 mm thick and finished to a uniform surface.

No forms or other materials shall be placed upon the bedding layer within a period of 48 hours after the concrete has been placed.

Mass concrete bedding

Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete bedding layer while it is still in plastic state.

In the case of soil foundations, the concrete shall be not less than 50 mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50 mm above the highest points of rock.

3 FORMWORK

3.1 GENERAL

Specification

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 workers 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.

Side forms

Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the in situ earth.

Design for placement of concrete

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.

Material

Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Formwork fittings

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 or approved by the Superintendent.

Edge treatment

Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the Drawings.

Cleaning and inspection

Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

3.2 APPROVAL OF FORMWORK DESIGN

For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be, when required by legislation or a Code of Practice, designed by a structural engineer before manufacture of the formwork is commenced.

This action constitutes a **HOLD POINT.**

The Superintendent's approval of the submitted details, or direction that they are not required, is necessary prior to the release of the hold point.

3.3 PROVISION FOR DRAINAGE

Where shown on the Drawings, or where directed by the Superintendent, weepholes of 50 mm diameter shall be provided in retaining walls and wingwalls.

3.4 CONSTRUCTION

Formwork material

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.

Timber requirements

Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.

Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales.

Dressed timber may be used only with the approval of the Superintendent.

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.

Formwork panels for exposed surfaces

Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1 m and uniform lengths of not less than 2 m, 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 15 mm thick.

Form panels less than 15 mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20 mm minimum thickness.

All form panels shall be placed in a neat, symmetrical pattern.

Hidden surfaces

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.

Mild steel form surfaces

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.

3.5 ERECTION

Formwork position tolerances

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.

For tolerances in plan position and levels, refer to **Placing and compacting concrete** and **Removal of forms**.

Mortar tight

Joints as erected shall be mortar tight.

Coating of internal surface

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.

Release agent

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.

Reinforcement placement

The formwork shall be inspected by the Superintendent, and the placing of reinforcement in the spaces formed, where specified, shall not commence until the formwork is approved by the Superintendent and Council Engineer.

Concrete placement

Placing of concrete shall not commence until the reinforcement, where specified, has been accepted by the Superintendent and Council Engineer, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

Notice of inspection

When an inspection is requested by the Contractor, notice of not less than 24 hours, excluding Saturdays, Sundays and Public Holidays, shall be given to the Superintendent.

This action constitutes a HOLD POINT.

The Superintendent's approval of the formwork and reinforcement placement is required prior to the release of the hold point.

4 MATERIALS FOR CONCRETE

4.1 CEMENT

Type

Cement shall be Type GP Portland Cement, or as nominated by the Superintendent, complying with AS 3972.

Nominated brand and source

In NSW cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

When submitting details of the nominated mix in accordance with **Testing of materials**, 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.

Proof of quality

Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.

Storage time

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, the Superintendent may require a re-test at the Contractor's expense before the cement is used.

Transport and storage

All cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

4.2 WATER

Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty nor brackish.

Water which is not potable for human beings shall not be used in reinforced concrete.

4.3 FINE AGGREGATE

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%) material finer than 2 micrometres, impurities and reactive materials.

Fine aggregates shall be evenly graded within the absolute limits shown in Table 4.1, and shall not deviate from the proposed grading by more than the amounts in Table 4.1.

Table 4.1 Fine aggregate grading

Australian Standard sieve	**Proportion passing (% of mass)**	**Deviation from proposed grading (% of mass of sample)**
9.50 mm	100	
4.75 mm	90–100	±5
1.18 mm	40–85	±10
300 µm	8–30	±10
150 µm	2–10	±5
75 µm	0–4	±3

4.4 COARSE AGGREGATE

General

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%), 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 Worksection.

If required, coarse aggregate shall be washed to satisfy these requirements.

Wear test

The percentage of wear shall be determined by AS 1141.23, and the loss of weight shall not exceed 30%.

Standard tests

When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

- Crushing Value—AS 1141.21 The aggregate crushing value shall not exceed %.
- Soundness—AS 1141.24 The loss of mass when tested with sodium sulphate shall not exceed 12%.
- Particle Shape—AS 1141.14 The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35%.

Grading requirements

Coarse aggregate shall be evenly graded within the absolute limits shown in Table 4.2 and shall not deviate from the grading of the samples submitted under **Testing of materials** by more than shown.

Table 4.2 Coarse aggregate gradings

Australian Standard sieve (mm)	**Proportion passing (% of mass)**			**Deviation proposed grading (% of mass of sample)**
	40 mm Nominal	**20 mm Nominal**	**Extrusion concrete**	
	For walls exceeding 150 mm thickness	**For all other structures**		
53.0	100			

Australian Standard sieve (mm)	**Proportion passing (% of mass)**			**Deviation proposed grading (% of mass of sample)**
	40 mm Nominal	**20 mm Nominal**	**Extrusion concrete**	
	For walls exceeding 150 mm thickness	**For all other structures**		
37.5	95–100			±10
26.5		100		
19.0	30–70	95–100		±10
13.2			100	
9.50	10–35	25–35		±5
4.75	0–10	0–10		±5
2.36	0–2	0–2		

4.5 ADMIXTURES

Quality and use

Chemical admixtures and their use shall comply with AS 1478.1.

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.

Retarder for warm season

During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) approved by the Superintendent shall be used to control slump within the limits stated in **Measuring by volume, on-site mixing**.

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 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with **Testing of materials**.

Retarder for cool season

During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6% reducing sugars (Type WRRe complying with AS 1478.1) may be used in the mix.

4.6 TESTING OF MATERIALS

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.

This action constitutes a HOLD POINT.

The Superintendent's approval of the submitted report is required prior to the release of the hold point.

4.7 USE OF MATERIALS ONLY AFTER ACCEPTANCE

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 Worksection.

5 HANDLING AND TREATMENT OF CONCRETE

5.1 ENVIRONMENTAL BEST PRACTICE MANAGEMENT

When handling and treating concrete on-site, the Contractor should comply with the principals outlined in the Environmental Best Management Practice Guideline (BPM) For Concreting Contractors (refer references).

These activities shall include taking delivery of fresh concrete, placing, transfer and/or finishing the concrete into its final position.

5.2 MEASUREMENT OF MATERIALS

All materials shall be measured by weight, except that:

- Water may be measured by volume with an approved adjustable water-measuring and discharging device, and,
- 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 40 kg.
- 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.
- Measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

5.3 MEASURING BY WEIGHT, ON-SITE MIXING

Mixing by weight on site

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 5.1 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 5.1 shall not relieve the Contractor of the Contractor's obligation to provide concrete of the specified compressive strength.

Table 5.1 Materials in batch containing 1 bag (40 kg) cement

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

Variation in aggregate moisture content

The proportions set out in Table 5.1 make allowance for moisture contents of aggregates of 6% for fine aggregates and 1% for coarse aggregates.

Where the moisture content of aggregates exceeds 8% or 3% respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

5.4 MEASURING BY VOLUME, ON-SITE MIXING

Mixing by volume on site

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.

Volume batching

The nominal proportions given in Table 5.2 may be used as a guide for volume batching.

Table 5.2 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

Fine aggregate bulking

If, in the opinion of the Superintendent, the fine aggregate contains sufficient moisture to produce 'bulking' in excess of 10%, a corresponding increase in the volume of fine aggregate shall be made.

Batch measurement

The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins, the details of which shall be subject to the approval of the Superintendent.

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 40 kg bag of cement shall be assumed to have a volume of 27.5 litres.

5.5 CONSISTENCY

Fixed form mould

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.

If required by the Superintendent, the Contractor shall determine the consistency of the concrete in accordance with AS 1012.3.1.

Except for extruded concrete, the slump shall not exceed 75 mm for concrete compacted by vibrators.

Extrusion machine

In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10 mm to 15 mm.

5.6 MIXING AND DELIVERY

General

Mechanical mixing and segregation of concrete shall comply with the following:

- Mechanical mixing – Concrete may be mixed either at the site or at a central mixing plant, as approved by the Superintendent. All concrete shall be mixed with mechanically operated mixers. In an emergency, hand mixing may be permitted.
- Segregation of concrete – Any concrete which exhibits signs of segregation may be rejected by the Superintendent.

Machine mixing at site

Machine mixing at site shall comply with the following:

- Mixer requirements—The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.
- Mixer capacity—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.
- Mixing time—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.
- Total mix discharge—The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

Mixing in an emergency

Mixing in an emergency shall comply with the following:

- Hand mixing—In the case of breakdown of the mechanical mixing equipment, the Superintendent may give approval to hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint.
- Hand mixing conditions—Hand mixing shall be done on an approved water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10% more than the amount specified for machine mixed concrete.
- Hand mixing procedure—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.

Ready-mixed concrete

The concrete shall be mixed and delivered in accordance with the requirements of AS 1379, relating to:

- Mixing and delivery; and
- Use of non-agitating equipment,

with the exception that in a) the time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours, and in b) not more than 30 minutes.

Discharge of cleaning water

The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent.

Positioning of chutes

The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

5.7 PLACING AND COMPACTING CONCRETE

Air temperature requirements

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 or while the shade temperature exceeds 38°C.

All concrete shall be placed in the dry.

Prior to placing concrete the area shall be clean and moist but free from any ponding of water.

Placement within time limit

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 in forms and vibration

The concrete shall be deposited in the forms, without separation of the aggregates. 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 and to work the coarser aggregate back from the face.

The freshly placed concrete shall be compacted by continuous spading, slicing or 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.

Exposed surfaces

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the Drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Initial set

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

Slurry for extruded concrete

In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, comprised of two parts of plasterer's sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if

the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

5.8 FINISHING OF UNFORMED SURFACES

Surfaces other than wearing surfaces

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.

All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

Wearing surfaces

Finish for wearing surfaces: Where a concrete wearing surface is shown on the Drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than 2 metres.

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 free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner.

The departure from grade shall not exceed 5 mm in any 3 metre length.

Surface to receive asphalt: 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.

Textured patterned surface: Concrete wearing surfaces shown on the Drawings to be coloured, textured or patterned shall be finished as directed by the Superintendent.

Finished levels and locations

The finished surfaces of concrete structures not adjacent to road pavements shall not vary more than 25 mm in plan position and not more than 25 mm from the specified levels.

In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

Longitudinal surfaces greater than 10 metres in length shall not deviate from level or alignment by more than 5 mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical and horizontal curves.

5.9 CURING AND PROTECTION

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 in accordance with AS 3799 for a minimum period of 3 days and to a maximum of 14 days if so directed by the Superintendent.

During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete.

All costs involved in making good or replacing any work that has been damaged due to the above mentioned factors shall be borne by the Contractor.

Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in AS 3600.

5.10 REMOVAL OF FORMS

Walls, sumps etc.

All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10°C during the following periods:

- 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:
  . under 0.6 metres: 1 day.

  . 0.6 m to 3 m: 2 days.
  . 3 m to 6 m: 3 days.
  . 6 m to 9 m: 5 days.
- Supporting forms under deck slabs of culverts: 10 days.

Concrete containing special additives
In case of concrete containing special additives, stripping times shall be as determined by the Superintendent.

Protection of concrete during form removal
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.

Superimposed load
No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70% of the design strength.

Removal of hole formers
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.

5.11 TREATMENT OF FORMED SURFACES

Quality of surfaces
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.

Formed concrete surfaces shall have finishes in accordance with the classes of surface finish in AS 3610 as follows:

- Non-visible surfaces: Class 4.
- Visible surfaces: Class 2.

Repair of defects
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.

Removal of the wires
Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40 mm 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.

Coating with bonding agent
If required by the Superintendent, 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 and shall be approved by the Superintendent.

Surface tolerance
The formed surfaces of concrete structures not adjacent to road pavements shall not vary more than 25 mm in plan position and not more than 25 mm from the specified levels.

In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

5.12 JOINTS

Horizontal construction joint
Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures 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.

Vertical expansion joints

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.

Footpaths, medians, driveways

In footpaths, median toppings and driveways, unless otherwise shown on the Drawings, expansion joints, 15 mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15 m and where the pavement abuts against gutters, pits and structures.

Expansion joints shall consist of a preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

Unreinforced paving

All unreinforced paving shall be provided with narrow vertical grooves, 20 mm deep to induce 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’ no bigger than 2 m2.

The ratio of the longest side to the shortest side shall not exceed 1.6.

5.13 STRENGTH OF CONCRETE

Strength requirement

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 5.3 for the particular class of work.

The cement content restrictions shown in Table 5.3 refer to Portland cement.

Where General Purpose Blended cements are utilised the acceptable minima are indicated in brackets.

When Works are expected to experience extreme exposure or in other special circumstances, departure from the minimum cement content requirements and specific blended cements may be recommended.

Departure from the minimum requirements cited in Table 5.3 shall require a specific minimum cement content as shown on the Drawings, or the written approval of the Superintendent.

Table 5.3 Concrete strength requirements

Use	**MPa**	**Minimum portland cement per cu metre (Minimum GP blended cement)**	**Coarse aggregate nominal size**	**Cylinder strength required**	
				7 days	**28 days**
		Kg	**mm**	**MPa**	**MPa**
Foundations, mass retaining walls	20	270 (330)	40	15	20
Mass concrete footings, pitching, linings etc.	20	270 (330)	20	15	20
Drainage structures, driveways, footpaths, miscellaneous minor concrete work	20	270 (330)	20	15	20
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining	32	320 (380)	20	24	32

Use	**MPa**	**Minimum portland cement per cu metre (Minimum GP blended cement)**	**Coarse aggregate nominal size**	**Cylinder strength required**	
				7 days	**28 days**
		Kg	**mm**	**MPa**	**MPa**
walls					
Safety Barriers	40	330 (380)	20	24	40
Extruded concrete	20	270 (330)	14	15	20
Note: The total cement and Portland cement quantities indicated as minima are aimed at providing suitably durable concrete for exterior public works under normal circumstances.					

Determination of strength

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.

Moulding of cylinders

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.

Cores and test acceptance

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 nominated in Table 5.3, the concrete will be accepted.

Strength age factor

The strengths specified at 28 days shall be increased as shown in Table 5.4 for tests at ages in excess of 28 days.

Failure of cores

If cores taken fail to satisfy the strength requirements, the deduction provisions of **Limits and tolerances** will apply.

Table 5.4 Concrete age conversion factors

***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	

5.14 SAMPLING CONCRETE

Moulding of test cylinders
Concrete test specimens shall be cylinders 300 mm long and 150 mm diameter, moulded concurrently in the presence of the Superintendent or Superintendent's representative, in accordance with AS 1012.8, from samples taken in accordance with AS 1012.1.

Testing
Test specimens shall be tested only by laboratories with appropriate NATA registration. Copies of test results shall be forwarded to the Superintendent immediately upon receipt.

Contractor's responsibility
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.

The costs of all work and material required in the taking, handling, delivery and testing of specimens shall be borne by the Contractor.

6 STEEL REINFORCEMENT FOR CONCRETE

6.1 MATERIAL

General
Steel reinforcement shall comply with AS/NZS 4671. The type and size of bars shall be as shown on the Drawings.

Evidence of compliance
The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS 4671, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis.

This action constitutes a HOLD POINT.

The Superintendent's approval of the supplied details is required prior to the release of the hold point.

Material not identified with a test certificate
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.

Surface of reinforcement
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.

Bar chairs
Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for one hour at 23 ±5ºC without malfunction.

The Contractor shall demonstrate that the proposed chairs conform with these requirements.

6.2 BENDING

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 only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

6.3 SPLICING

Plan lengths
All reinforcement shall be furnished in the lengths indicated on the Drawings. If splicing is required, it shall be in accordance with the provisions of AS/NZS 4671.

Testing of splices not shown on the drawings
The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor.

Lapped splices
Laps in reinforcing bars, wire or fabric shall be as shown on the Drawings. Laps not shown on the Drawings shall be as follows for unhooked bars:

- Plain bars, Grade 250: Minimum 40 bar diameters.
- Deformed bars, Grade 400: Minimum 35 bar diameters.
- Hard-drawn wire: Minimum 50 bar diameters.

Splicing in reinforcing fabric
Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25 mm.

6.4 MARKING

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 40 mm 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.

6.5 STORAGE

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

6.6 DELIVERY AND RECEIPT OF REINFORCEMENT

Test before delivery
Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until permission to deliver has been granted by the Superintendent.

Notice to test
The Contractor shall give 10 working days notice to the Superintendent for carrying out the inspection.

This action constitutes a HOLD POINT.

The Superintendent’s inspection and approval of the reinforcement is required prior to the release of the hold point.

The Superintendent will carry out, or waive, the inspection with reasonable expediency, however the Contractor shall not be entitled to an extra payment as a result of any delays incurred.

6.7 PLACING

Reinforcement position
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 0.5 m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25 mm.

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.

Tack welding
The Superintendent may approve the use of tack welding instead of wire ties on reinforcing wire.

All welding of reinforcing steel shall be in accordance with AS 1554.3.

Tack welding of cold-worked and hard grade bars shall not be permitted.

Approval of reinforcement before concrete placement
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.

This action constitutes a HOLD POINT.

The Superintendent's approval of the reinforcement is required prior to the release of the hold point.

Splices

Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

Lapped splice

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

Bar cover

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 as stated below:

- Concrete normally in contact only with air:
  - . Slabs: 40 mm.
  - . Other than slabs: 45 mm.
- Concrete in contact with earth or fresh water:
  - . Slabs of box culverts: 50 mm.
  - . Other than culverts: 50 mm.

In no cases shall the cover be less than 1½ times the diameter of the bar.

7 BACKFILLING

7.1 GENERAL

Backfilling at paving and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

Adjacent to walls

No filling shall be placed against retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the Contractor can demonstrate that 95 per cent of the design strength of the concrete has been achieved.

Selected backfill

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 50 mm 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 150 mm and shall be compacted to provide a relative compaction of not less than 92% below 1.5 m of the finished surface and 100% within 1.5 m of the finished surface as determined by AS 1289.5.4.1 for modified compactive effort.

7.2 TREATMENT AT WEEPHOLES

Size and type of material

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 50 mm to 10 mm such that:

The maximum particle dimension shall not exceed 50 mm

No more than 5 per cent by mass shall pass the 9.5 mm A.S. sieve.

Extent of material

The broken stone or river gravel, enclosed in a filter fabric approved by the Superintendent, shall be continuous in the line of the weepholes, extend at least 300 mm horizontally into the fill and extend at least 450 mm vertically above the level of the weepholes.

Synthetic membrane

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.

8 SPRAYED CONCRETE

8.1 GENERAL

Definition
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.

Depth
The minimum depth of sprayed concrete to be applied shall be 100 mm.

Colour
Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour.

Strength
Sprayed concrete shall have a minimum cement content of 380 kg/m3 as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75 mm diameter cores taken from in-place sprayed concrete.

Test cores
Cores shall be secured, accepted, cured, capped and tested in accordance with 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.

The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.

Method statement
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.

This action constitutes a HOLD POINT.

The superintendent's approval of the submitted details is required prior to the release of the hold point.

8.2 TEST PANELS

Number and dimensions of panels
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 75 mm thickness of sprayed concrete to a hardboard panel approximately 750 mm 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.

Cores
The Contractor shall cut four 75 mm 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.

Defective core
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.

Approval of panels

Sprayed concrete shall not be applied to the Works until the Contractor produces test panels for the approval of the Superintendent.

This action constitutes a HOLD POINT.

The Superintendent's approval of the test panels is required prior to the release of the hold point.

8.3 SURFACE PREPARATION

Earth

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.

Rock

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.

Steel pipes

Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.

Water flow

The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

8.4 APPLICATION OF SPRAYED CONCRETE

Procedure

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 after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

Wind problems

Spraying shall be discontinued if wind causes separation of the nozzle stream.

Air temperature

Concrete shall not be sprayed in air temperatures less than 5°C.

Construction joints

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.

Spraying around reinforcement

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Protection of adjoining surfaces

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.

8.5 CURING

Commencement

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 in accordance with manufacturer's specifications.

Water curing
In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least 24 hours.

9 CONCRETE INVERTS AND LINING OF OPEN DRAINS

Concrete lining for open drains will be either cast-in-place concrete or sprayed concrete.

The minimum thickness of the concrete will be 100 mm.

The final concrete surface will be uniform and free of depressions or irregularities.

Concrete used for the lining of drains shall be either coloured to match the colour of the surrounding materials or natural as nominated by Council's Engineer.

Cast in place concrete will be formed, supplied, placed and cured in accordance with this Specification.

All reinforcing will be as shown on the approved engineering plans.

The Contractor will submit details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS 3600 Section 19. Operators will be experienced and skilled in sprayed concrete work.

Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 20mm deep, will be formed neatly in the surface of the freshly placed concrete at intervals of 3m. Expansion joints are to consist of jointing material, complying with RTA Specification No. 1204, and be of sufficient depth to fill the joint. Expansion joints will be placed at intervals of not more than 15m.

10 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this worksection are summarised in Table 9.1.

Table 9.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Worksection Clause Reference
Subgrade		
- Relative compaction	≥ 95% (standard compactive effort)	**Foundations**
Driveways, footpaths		
- Finished subbase	To be trimmed and compacted so that the levels do not vary more than 15 mm under a straight-edge 3 metres long. ≥ 97% (modified compactive effort)	**Driveways and footpaths**
- Relative compaction of subbase	≥100% (standard compactive effort)	**Driveways and footpaths**
Formwork		
- 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.	**Erection**
Fine aggregate		
- Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table 4.1.	**Fine aggregate**
Coarse aggregate		
- Percentage of wear	Loss of weight shall not exceed 30%	**Coarse aggregate**
- Crushing value	Crushing value shall not exceed 25%	**Coarse aggregate**

Activity	**Limits/Tolerances**	**Worksection Clause Reference**
-Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	**Coarse aggregate**
-Particle shape	The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35%	**Coarse aggregate**
-Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table 4.2.	**Coarse aggregate**
Aggregate moisture content	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	**Measuring by weight, on-site mixing**
Bulking of fine aggregate	Where bulking of the fine aggregate exceeds 10%, a corresponding increase in volume of fine aggregate shall be made.	**Measuring by volume, on-site mixing**
Consistency	In accordance with AS 1012.3 Method 1, the slump shall not exceed 75 mm for concrete compacted by vibrators.	**Consistency**
	In the case of concrete placed by extrusion machine, the slump will be between 10 mm and 15 mm.	**Consistency**
Ready-mixed concrete		
-Mixing and delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours.	**Mixing and delivery**
	Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	
Placing and compacting of concrete	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	**Placing and compacting concrete**
Finishing of unformed/ formed concrete surfaces		
-Wearing surface	To be finished true and uniform so that departure from designed grade shall not exceed 5 mm in any 3 metre length.	**Finishing of unformed surfaces**
Finished surfaces		
-Not adjacent to roads	≤25 mm plan position ≤25 mm Level	**Finishing of unformed surfaces**
-Adjacent to roads	≤10 mm Alignment ≤10 mm Level	**Finishing of unformed surfaces**

11 MEASUREMENT AND PAYMENT

11.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this Worksection and the associated activity specific worksection on a schedule of rates basis in accordance with Pay Items 0310.1 to 0310.5 inclusive.

A lump sum price for any of these items shall not be accepted.

The pay items applicable to particular activities are listed in the Worksection for these activities

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

11.2 CONCRETE

Payment shall be made at the scheduled rates provided the concrete meets the strength requirements shown in Table 5.3 or as shown on the Drawings.

Where any concrete does not reach the strength specified in Table 5.3, the scheduled rate of payment shall be reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen fails to reach the specified strength, up to a maximum deficiency of 10%.

If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made for the work nor for any remedial work to rectify the deficiency.

11.3 PAY ITEMS

0310.1 Excavation

The unit of measurement shall be the cubic metre measured as bank volume of the excavation.

This pay item applies to works included in pay items C0301.2 and C0301.3.

The disposal of surplus material shall be included in the excavation rates.

No additional payment shall be made for drying out wet excavated material or replacement of over excavation for any reason.

The schedule rate for excavation shall allow for excavation and backfilling of all types of material. Separate rates shall not be included for earth and rock.

The control of stormwater runoff shall be included in the rate for excavation.

0310.2 Footpaths, driveways, median toppings and works of similar nature

The unit of measurement shall be the square metre, measured as the horizontal surface area of the concrete footpath, driveways, median topping, or similar as constructed.

The schedule rate under this Pay Item shall include all operations involved in the forming, compaction of foundations, subbase, concreting, finishing, curing and backfilling.

Where specified on the Drawings, this Pay Item shall include the supply and placement of reinforcing steel.

0310.3 Sprayed concrete

The unit of measurement shall be the square metre of sprayed concrete in place.

The schedule rate under this Pay Item shall include all the operations involved in the surface preparation, spraying, jointing, removal of splash and rebound material, curing and testing.

0310.4 20 MPa Concrete for miscellaneous minor concrete work

The unit of measurement shall be the cubic metre of concrete supplied and placed.

0310.5 32 MPa Concrete for miscellaneous minor concrete work

The unit of measurement shall be the cubic metre of concrete supplied and placed.

1351 STORMWATER DRAINAGE (CONSTRUCTION)

12 SCOPE AND GENERAL

12.1 SCOPE

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

The work to be executed under this worksection consists of:

- preparation for stormwater drainage construction,
- temporary drainage during construction,
- siting of pipes, pipe arches and box culverts.
- all activities and quality requirements associated with excavation and backfilling,
- all concrete work associated with stormwater drainage.

This is the general worksection applicable to all types of drainage lines, open drains, kerb and gutter, and drainage structures and shall be read in conjunction with 1352 *Pipe drainage*, 1353 *Precast box culverts*, 1354 *Drainage structures* and 1121 *Open drains, including kerb and channel (gutter)*, as applicable to particular Contracts.

12.2 EXTENT OF WORK

Details of the work are shown on the Drawings.

The extent of works is summarised as follows:

- pipe culvert stormwater drainage
- precast box culvert stormwater drainage
- drainage pits, headwalls, wingwalls and aprons
- kerb and gutter
- open concrete dish drains
- scour protection of open drains at outlets to drainage structures
- demolition and removal of existing redundant pipe culverts, headwalls and pits.

12.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

12.4 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1102 Control of erosion and sedimentation

1112 Earthworks (Roadways)

1121 Open drains, including kerb and channel (Gutter)

1352 Pipe drainage

1353 Precast box culverts

1354 Drainage structures

Standards

AS1289 Methods of testing soils for engineering purposes

AS1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio

AS1289.5.7.1 Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (Rapid method)

Other publication

Resource NSW

Specification for Supply of recycled materials for pavements, earthworks and drainage, 2003

13 CONSTRUCTION

13.1 TEMPORARY DRAINAGE DURING CONSTRUCTION

Control of erosion and sedimentation

All drainage works carried out by the Contractor shall comply with 1102 *Control of erosion and sedimentation*.

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.

Dams and diversions

The Contractor shall not dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of Council.

Location of equipment

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.

13.2 SITING OF CULVERTS

Set-out

Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the Drawings, and shall present this set-out for inspection by the Superintendent.

Amendments to planned work

The Superintendent may, with the approval of the Council Engineer, amend the inlet or outlet locations or designed levels or the culvert length to suit actual site conditions.

Any activity resulting from such amendments by the Superintendent shall be deemed to be included as part of the work covered by the Schedule of Rates.

Changes by contractor

Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit the construction procedures, the Contractor shall present the proposed culvert set-out in addition to the designed set-out for consideration by the Superintendent and Council.

No changes shall be made unless the prior written approval of the Superintendent and Council is obtained.

13.3 EXCAVATION

Topsoil

Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with 1112 *Earthworks (Roadways)*.

Trench support

In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

Public Utilities

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.

Blasting

Excavation by blasting, if permitted by Council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert of drainage structure does not exceed 25mm/sec.

Blasting operations shall comply with 1112 *Earthworks (Roadways)*.

Excavation level

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.

Unsuitable material

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 1112 *Earthworks (Roadways)* and replaced with backfill material in accordance with the requirements of this worksection 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.

Spoil

The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with 1112 *Earthworks (Roadways)*.

13.4 BACKFILLING

Backfilling shall be carried out in accordance with the relevant culverts or drainage structures worksections of **Scope and general** and compacted in accordance with **Compaction**.

NOTE: Due regard should be taken of the opportunity to use recycled materials for backfill (refer to Resource NSW—Specification for Supply of Recycled Materials for Pavements, Earthworks and Drainage, 2003, taking note of the Disclaimer on the inside cover.

13.5 COMPACTION

Foundations, bedding and backfilling

Foundations, bedding (other than for pipe drainage) and backfilling shall be compacted to the requirements of Table 2.1 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

Compaction requirements adjacent to pipe drainage for concrete, steel, reinforced plastic, or flexible pipes are set out in 1352 *Pipe drainage*.

Table 2.1 Compaction of foundations, bedding and backfilling

Zone	Relative compaction
Foundations or trench base: - to a depth of 150 mm below foundation levels	95%
- material replacing unsuitable material	95%
Bedding material (other than for pipe drainage)	95%
Selected backfill and ordinary backfill material:	
- below 1.5 m of finished surface - within 1.5 m of finished surface	95% 100%
Backfill material within the selected material zone	100%

Compaction layers

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

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Compacting adjacent to culverts or drainage structures

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

Any damage caused shall be rectified, and all costs of such rectification shall be borne by the Contractor.

13.6 CONCRETE WORK

All concrete work shall comply with 0310 *Minor concrete work* in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

13.7 SPRAYED CONCRETE

If sprayed concrete has been specified, shown on the Drawings or directed by the Superintendent, it shall comply with 03101 *Minor concrete works*.

14 BACKFILLING PIPES UNDER ROADWAYS

For all trenches that are to be subject to vehicular traffic, or as directed by the Engineer, all backfill material shall be fully compacted in layers not more than 150mm thick to 100% of standard maximum dry density (AS 1289) for cohesive materials and 70% density index determined in accordance with AS 1289 for non-cohesive material to the subgrade level of the road or the finished surface level as directed.

All Backfill shall be an approved granular road base material with a plasticity index range of between 10 and 15, being free of rocks or hard nodules and being stabilised with 3% cement, Compaction of the backfill material shall be by mechanical means.

Prior to backfilling and compaction of vehicular trafficable trenches, trench stops/bulkheads consisting of polyethylene bags of minimum thickness 0.25mm, filled with clay or other approved material and sealed in an approved manner shall be constructed across the full width of the excavated trench, directly behind the kerb to contain the compacted material.

The trench stops/bulkheads shall be recessed into the sides of the trench excavation a minimum of 100mm and shall be extended from the top of the pipe surround material to the underside of the kerb.

Council will require proof rolling and/or Beam Deflection tests over the trench area to confirm the stability of the trench.

15 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 3.1.

Table 3.1 Summary of Limits and Tolerances

Activity	**Limits/Tolerances**	**Worksection clause reference**
Excavation by blasting peak particle velocity	≤ 25 mm/sec	**Excavation**
Relative Compaction (Standard)		
- Foundations or trench base:		
– to a depth of 150 mm below foundation levels – material replacing unsuitable material	95% 95%	**Compaction** **Compaction**
- Bedding material	95%	**Compaction**
- Selected backfill and ordinary backfill material: . below 1.5 m of finished surface . within 1.5 m of finished surface	 95% 100%	**Compaction** **Compaction**
- Backfill material within the selected material zone	100%	**Compaction**
Backfill - Layers - Moisture content	 ≤ 150 mm >60%, <95%	 **Compaction** **Compaction**

16 MEASUREMENT AND PAYMENT

16.1 MEASUREMENT

Payment shall be made for all activities associated with completing the work detailed in this worksection and the associated activity specific worksections on a schedule of rates basis.

The Pay Item applicable to particular activities are listed in the worksections for these activities.

Common to culverts and drainage structures is Excavation and payment for this shall be made under this worksection.

Erosion and sedimentation control measures are measured and paid in accordance with 1102 *Control of erosion and sedimentation*.

Topsoil removal is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

Concrete work is measured and paid in accordance with the worksection for the particular drainage activities and not 0310 *Minor concrete work*s

Sprayed concrete work is measured and paid in accordance with 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

16.2 PAY ITEMS

1351.1 Excavation for stormwater drainage culverts and structures

The unit of measurement shall be cubic metre measured as bank volume of excavation.

The schedule rate for this Pay Item shall be an average rate to cover all types of material encountered during excavation. Separate rates shall not be included for earth and rock.

The rate is deemed to include:

- Setting out and associated survey
- Excavation, including excavation and replacement of unsuitable material.
- Replacement for over-excavation for any reason
- Control of stormwater runoff, temporary drainage and erosion and sedimentation control.

The volumes of excavation for payment shall be computed as follows:

Reinforced concrete and fibre reinforced cement pipes

Positive Projection (if excavation required)

. **Width:**

single cell:	external pipe diameter + 1 m.
multi cell:	sum of external diameters + sum of spacings between pipes measured square to the line of the culvert + 1 m.

Depth:

in natural ground:	average actual depth from topsoil stripped ground surface to underside of specified bedding.
in embankment:	average actual depth or 500 mm above top of pipe to underside of specified bedding, whichever is lesser.

Length: actual excavation length, centre to centre of pits or centre of pit to face of headwall.

Wide trench

. **Width:**

single cell:	external pipe diameter + 1 m.
multi cell:	sum of external diameters + sum of spacings between pipes measured square to the line of the culvert + 1 m.

. **Depth:**

in natural ground:	average actual depth from topsoil stripped ground surface to underside of specified bedding.
in embankment:	maximum 500 mm above top of pipe to underside of specified bedding.

Length: actual excavation length, centre to centre of pits or centre of pit to face of headwall.

Normal trench

Width: 1.4 times external pipe diameter or external pipe diameter +300 mm on each side, whichever is the greater.

. **Depth:**

in natural ground: average actual depth from topsoil stripped ground surface to underside of specified bedding.

in embankment: maximum 500 mm above top of pipe to underside of specified bedding.

Length: actual excavation length, centre to centre of pits or centre of pit to face of headwall.

Steel pipes and pipe arches

. **Width:**

wide trench: external pipe diameter or span + 2 × external pipe diameter or span.

normal trench: external pipe diameter or span + 600 mm on each side.

. **Depth:** as for RC and FRC pipes.

. **Length:** actual excavation length.

Flexible pipes

. **Width**: For pipes of:

Ext dia at collar: external diameter of pipe plus 200 mm ≥75 ≤150

Ext. dia at collar: external diameter of pipe plus 300 mm >150 ≤300

Ext. dia at collar: external diameter of pipe plus 400 mm >300 ≤450

. **Depth:** average actual depth excavated.

Length: actual excavation length, centre to centre of pits or centre of pit to face of headwall.

Box culverts

The plan area for payment shall be the area calculated from the outside dimensions of the base slab plus 300 mm and wingwalls as shown on the Drawings.

The depth for payment shall be the average actual depth below ground surface stripped of topsoil to the bottom of the specified bedding.

Other drainage structures

The plan area for payment shall be the area calculated from the outside dimensions of the structure as shown on the Drawings.

The depth shall be determined from the actual site measurement of the surface at the time of excavation to the underside of the bedding.

Unsuitable material under culverts and drainage structures

The volume for payment of material which the Superintendent deems unsuitable shall be calculated from the actual plan area of material removed and the average actual depth below the bottom of bedding.

It shall be replaced with ordinary backfill material either from drainage excavations or from Earthworks.

1352 PIPE DRAINAGE

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the supply and installation of pipe culverts and pipe arches for stormwater drainage and should be read in conjunction with 1351 *Stormwater drainage (Construction)*.

The work to be executed under this worksection consists of supply of pipes and pipe arches, bedding, installation and backfilling.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

0310 Minor concrete works

1112 Earthworks (Roadways)

1171 Subsurface drainage

1351 Stormwater drainage (Construction)

1354 Drainage structures

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.51	Unconfined compressive strength of compacted materials
AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.4.3.1	Soil chemical tests—Determination of the pH value of a soil—Electrometric method.
AS 1289.4.4.1	Determination of the electrical resistivity of a soil—Method for sands and granular materials
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.6.1	Compaction control test—Density index method for a cohesionless material
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 1397	Steel sheet and strip—Hot dipped zinc coated or aluminium/zinc coated.
AS 1646 series	Elastomeric seals for waterworks purposes
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 2041	Buried corrugated metal structures
AS 3725	Loads on buried concrete pipes
AS 3887	Paints for steel structures—Coal tar epoxy
AS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4139	Fibre reinforced concrete pipes and fittings.

AS/NZS 1254	PVC pipes and fittings for storm or surface water applications.
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 3750	Paints for steel structures
AS/NZS 3750.9	Organic zinc-rich primer
AS/NZS 3750.15	Inorganic zinc silicate paint
AS/NZS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 9001	Quality management systems – Requirements
ASHTOM 190	Bituminous coated corrugated metal culvert pipe and pipe arches

2 COMMON REQUIREMENTS

2.1 COMPLIANCE WITH QUALITY PLAN

Pipes and/or pipe arches shall not be placed in position until documentary evidence has been produced to the Superintendent that the manufacture of the products to be used in the works has complied with the Manufacturer's Quality Plan in accordance with AS/NZS ISO 9001.

2.2 CERTIFICATION

Documentation shall comprise a conformance certificate to AS 4058 or AS 4139, as appropriate, for each batch of pipes or pipe arches to be included in the works. Conformance certificates are to be supplied at least 24 hours in advance of dispatch to site.

2.3 MARKING

Each unit shall be marked at time of manufacture with:

- Class and size.
- Manufacturer's name.
- Date of casting.

2.4 BURIED FLEXIBLE PIPES

Where a Contractor wishes to use drainage pipe other than the pipes described in this specification, the Contractor shall submit, for agreement by the Superintendent, full details in accordance with AS/NZS 2566.1 of the characteristics of the pipe materials and embedment and design loads together with certification from the manufacturer of its suitability and quality for use in each particular application. Certification of the suitability of any pipe will address the deflection, strength, buckling and any other considerations appropriate to the particular application. Upon agreement, the Superintendent must submit an application for a variation to the development consent for approval by Council.

2.5 EXCAVATION DRAINAGE

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.

2.6 TOLERANCES

Culverts shall be installed within 10 mm of the grade line and within 10 mm of the horizontal alignment specified on the Drawings.

The Contractor shall relay any culvert which is not within these tolerances.

2.7 SUBSURFACE DRAIN

At the discharge end of culverts terminating at pits and headwalls a 3 m length of 100 mm diameter subsurface drain shall be laid in the trench 100 mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100 mm above the invert level of the culvert or headwall.

The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with 1171 *Subsurface drainage*.

2.8 EXCAVATION AND BACKFILLING FOR CULVERTS

Excavation and backfilling for culverts shall be undertaken in a safe manner and in accordance with all statutory requirements.

2.9 CONSTRUCTION PLANT MOVEMENT

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.

3 PRECAST REINFORCED CONCRETE AND FIBRE REINFORCED CONCRETE PIPES

3.1 PIPES

Precast reinforced concrete pipes

Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the Drawings.

Fibre reinforced concrete pipes

Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the Drawings.

Joints

Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints complying with AS 1646 series and as recommended by the manufacturer.

3.2 EXCAVATION

Formation to finished surface level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to finished surface level and the pipes then installed in the normal trench condition.

Normal trench conditions

For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in Bedding.

The trench shall be excavated to a width 1.4 times the external diameter of the pipe, or to the external diameter of the pipe plus 300 mm on each side, whichever is the greater.

Wide trench conditions

Care is necessary to avoid laying pipe drainage in trenches excavated to excessive width.

Pipes laid in wide trench conditions will be deemed to be in embankment conditions (positive projection).

Wide trench conditions apply when, for a single pipe, the width of trench $W \geq D + 0.6$ metres where D is the pipe diameter.

For multi-cell pipes wide trench conditions apply when the width of trench $W \geq \sum D + \sum S + 0.6$ metres where S is the square spacing between the pipelines.

NOTE This definition of wide trench conditions as equivalent to embankment conditions relates to the size and geometry of the excavation utilised at construction.

Pipes shown on the Drawings to require trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength in accordance with AS 3725.

3.3 BEDDING

Pipe support type

Bedding shall be in accordance with this worksection, AS 3725 and AS 3725 Supplement 1 for the pipe support types as shown on the Drawings.

Where the pipe support type is not shown on the Drawings, the support type shall be HS3 within road reserves and H2 elsewhere.

Bedding dimensions

Figure 3.1 and Table 3.1 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions for all AS 3725 pipe support types.

Material requirements

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 3.2, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

Select fill material in the side zones, for pipe support type HS, shall also comply with Table 3.2.

Source

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

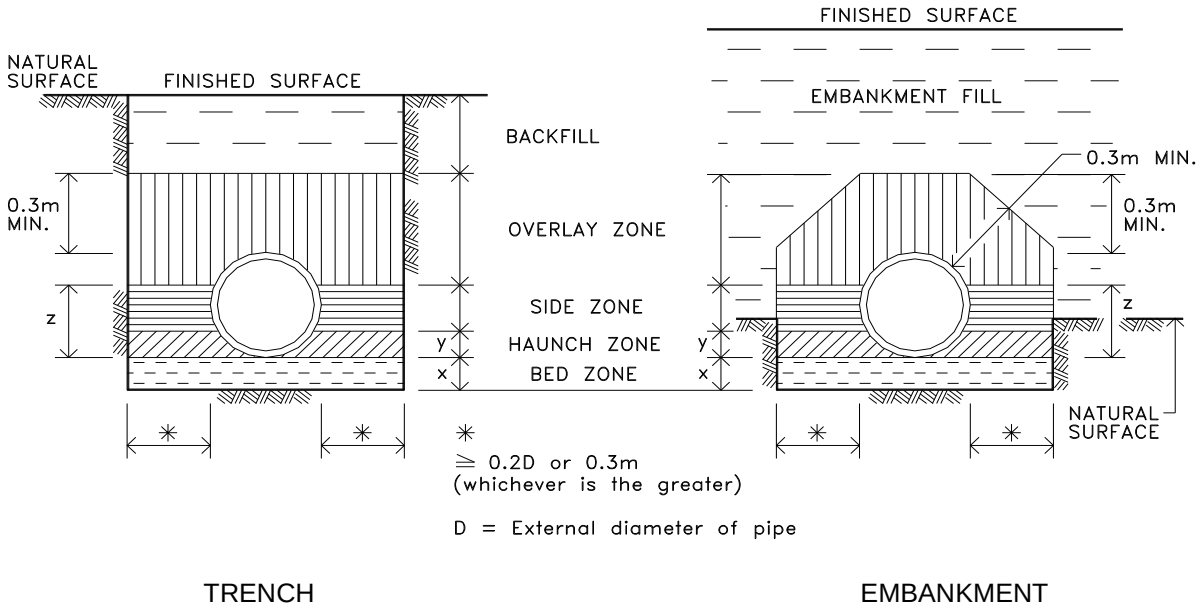


Figure 3.1 Pipe installation conditions

Table 3.1 Pipe installation dimensions

		Pipe Support Type						
		U	**H1**	**H2**	**H3**	**HS1**	**HS2**	**HS3**
Dimension (minimum)	x	75 on rock and Nil on soil	100 for D ≤ 1500 150 for D > 1500		0.25 D but >100	100 for D ≤ 1500 150 for D > 1500		
	y	—	0.1D	0.3D	0.3D	0.1D	0.3D	0.3D
	z	—	—	—	—	≥ 0.7D		
D = External diameter of pipe								

Table 3.2 Bedding material grading limits

Sieve size mm	**Weight passing %**	
	Bed and haunch zones	**Side zones**
75.0	—	100
19.0	100	—
9.5	—	50–100
2.36	50–100	30–100
0.60	20–90	15–50
0.30	10–60	—

0.15	0–25	—
0.075	0–10	0–25

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness except where explicitly approved by the Superintendent, for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage.

Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Compaction requirements

Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table 3.3 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

H3 Pipe Support includes concrete bedding. Concrete shall be grade N20 to AS 3600. Pipe shall be suitably reinforced in accordance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 Pipe Support.

Unless specifically selected pipes are nominated for use with H3 bedding.

Table 3.3 Bedding material compaction requirements

Bedding material			**Pipe support type**						
Criteria	**Location**		**U**	**H1**	**H2**	**H3**	**HS1**	**HS2**	**HS3**
Minimum Relative Compaction %	Bed and haunch zones		—	50	60	Concrete	50	60	70
AS1289.5.4.1 (Standard Compaction)	Side and overlay zones:	Cohesionless	—	—	—	—	50	60	70
		Cohesive	—	—	—	—	85	90	95

Material directly under the pipe

The top 0.1D mm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

Cementitious stabilisation

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.

Design check

A design check shall be undertaken to confirm the suitability of the proposed pipes.

3.4 LAYING

Positioning of pipes

Pipes shall be laid with the socket end placed upstream commencing at the downstream end of the pipeline.

Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings which shall be laid with the marking up.

Unless specified, no individual length of pipe shall be shorter than 1.2 m.

Stiffening of culverts

In the case of pipes 1,200 mm or more in diameter, laid in situations where embankments are to be more than 3 m high, measured above the invert of the pipe, pipes shall be stiffened temporarily by the Contractor by interior timber struts, erected before filling is placed.

Struts shall be of hardwood measuring at least 100 mm by 100 mm or 125 mm diameter.

One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200 mm.

Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe.

Both the sill and the cap shall be continuous throughout the length of the pipe and they shall be of sawn hardwood, of cross section not less than 100 mm by 100 mm.

Struts shall be made to bear tightly by the use of wedges between the top of the struts and the cap.

Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.

Seal lifting holes

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the Superintendent, or a 3:1 sand:cement mortar, before the commencement of backfilling.

Bulkheads

Bulkheads shall be constructed in accordance with the Specification for 1354 *Drainage structures* on all lines where the pipe gradient exceeds 5%.

Inspection by Superintendent

The Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling.

Rubber ringed joints in reinforced concrete pipes

Clean and dry material: Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

Procedure for Rolling Rubber Rings: 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.

Joint test: The joint shall be tested to ensure that the rubber ring has rolled evenly into place.

'Skid' rings

Where wedge shaped 'skid' rubber rings are prescribed the Manufacturer's instructions, which include the use of lubricants, shall be followed.

Flush or butt joints in concrete pipes

Jointing: 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.

Sealing: The joints shall be sealed with proprietary rubber sleeves, supplied and installed in accordance with the manufacturer's recommendations.

Joints in fibre-reinforced cement pipes: 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 Laying.

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.

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

3.5 BACKFILL OTHER THAN UNDER ROADS

Type HS pipe support

Select fill material to the side zones for pipe support type HS shall be compacted to the requirements shown in Table 3.3 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

Other pipe support types

Ordinary fill to the side zones, for all pipe support types except type HS, and overlay zones, for all pipe support types, shall consist of Selected Backfill as defined in 1112 *Earthworks (Roadways)*. It shall be placed around the pipe to the dimensions shown in Figure 3.1.

Layers

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

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the selected material zone as specified in 1112 *Earthworks (Roadways)*, shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways).* 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 1112 *Earthworks (Roadways)*.

Damage or misalignment to any culvert or drainage structure

When compacted adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any culvert or drainage structure.

Any damage caused shall be rectified, and all costs of such rectification shall be borne by the Contractor.

Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

4 STEEL PIPES AND PIPE ARCHES

4.1 NESTABLE STEEL PIPE AND DRAINAGE UNITS

Specification

Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the Drawings.

Galvanised steel sheets

The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250 and a minimum coating Class of Z600.

Protective treatment

Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by the Superintendent, to a thickness of 400 microns.

Field cuts

Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

4.2 HELICAL LOCK-SEAM CORRUGATED STEEL PIPE

Specification

Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the Drawings.

Galvanised steel sheets

The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600.

Protective treatment

Unless otherwise approved by the Superintendent, no part of the pipe shall incorporate steel strips which have been joined by welding.

Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of organic zinc-rich primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing.

4.3 BOLTED STEEL PIPES, PIPE ARCHES AND SPECIAL SHAPES

Specification

Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the Drawings.

The corrugated pipe or plate shall be hot-dip galvanised on both sides after fabrication in accordance with the requirements for coating thickness and mass for articles in AS/NZS 4680.

Protective treatment

After assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by the Superintendent.

Invert plates shall be coated on the outside before they are placed on the pipe bed.

The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer.

The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns.

Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns.

4.4 MATERIALS AND SURFACE TREATMENT

All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading as well as corrosion protection for a satisfactory design life of 100 years unless indicated otherwise on the Drawings.

Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified in Material Against Steel Structures.

4.5 MATERIAL AGAINST STEEL STRUCTURES

Resistivity and pH

The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.

Besides meeting the normal requirements of the bedding, selected backfill materials and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure 4.1 will determine the level of corrosion protection required.

Notwithstanding the height of fill, embankment material within 6 m of the structure shall conform to the above requirements.

The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.4.3.1 and AS 1289.4.4.1.

NATA Testing

The Contractor shall nominate the sources of the various materials and submit documentary evidence from a NATA registered laboratory that the representative samples conform to the requirements of this Clause and the protective treatment provided.

The samples shall be pretreated if necessary so as to represent the condition and grading when compacted and in service.

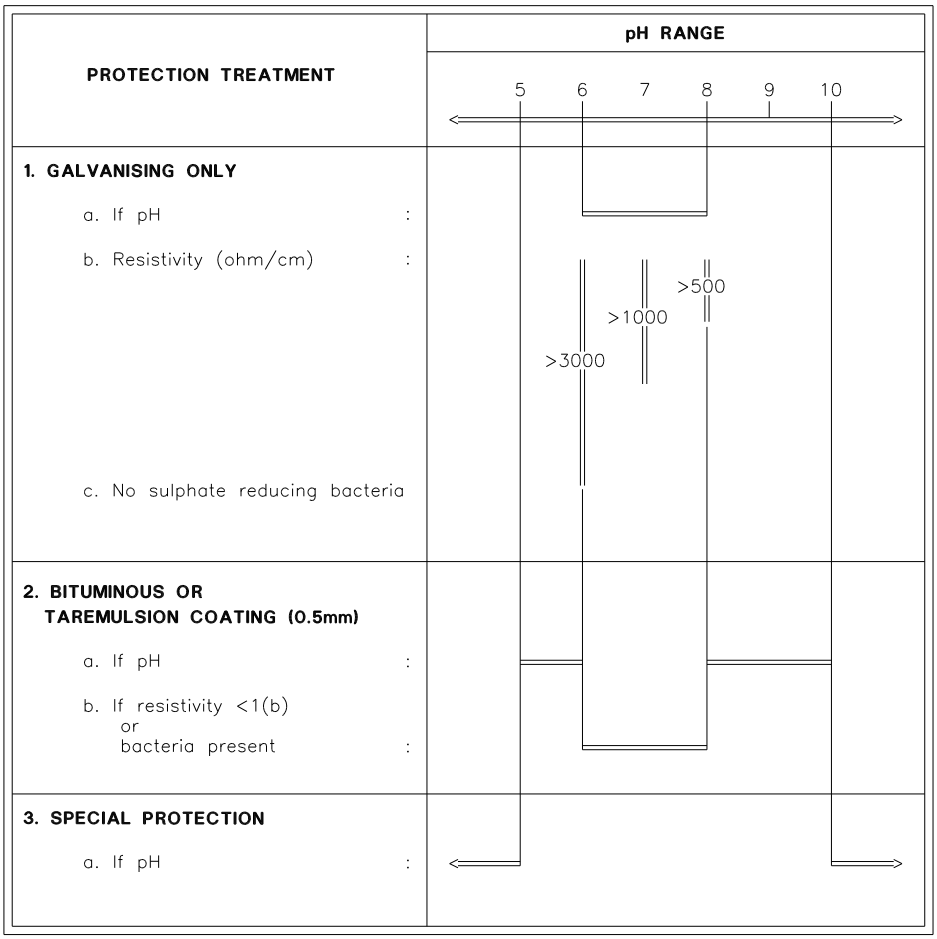


Figure 4.1 Corrosion protection requirements for steel structures

4.6 EXCAVATION AND FOUNDATION PREPARATION

Formation to finished surface level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to finished surface level and the pipes then installed in the normal trench condition.

Trench width select fill

The trench shall be excavated to a level 75 mm below the design invert and for a minimum width of 600 mm on each side of the structure.

Unsuitable material

Where unsuitable material, as determined by the Superintendent, is encountered at the foundation level, it shall be removed to a depth approved by the Superintendent.

The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in Bedding.

Rock foundation

Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250 mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure.

The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in Bedding.

4.7 BEDDING

Depth

Bedding shall meet the requirements of Bedding.

The thickness of uncompacted bedding material between the foundation and the outer surface of corrugation shall not be less than 75 mm.

The uniform blanket of loose material which provides the minimum 75 mm thick bedding, shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.

4.8 LAYING

Assembly

The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations.

These recommendations shall be submitted to the Superintendent before assembly or laying of the culverts is commenced.

Temporary bracing

If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.

Joints

Method: Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2041.

Ends to be rerolled: Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68 mm.

Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands.

Rubber ring joint seals shall be used in conjunction with the coupling bands except where specifically indicated otherwise in the Drawings.

Geotextile cover material: All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of non-woven geotextile material, of minimum 250 mm width and of minimum mass 270 grams/m^2 in accordance with the requirements for geotextile in 1171 *Subsurface drainage*, to prevent loss of sand backfill or bedding into the pipe.

4.9 BACKFILL

Selected material

Compaction of the material in the side support and overlay zones shall comply with the requirements of Bedding except that the required relative compaction in the side support and overlay zones shall be 95% (AS 1289.5.4.1 standard compaction).

Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width, on both sides.

Layers

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

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the selected material zone as specified in 1112 *Earthworks (Roadways*), shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.

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 1112 *Earthworks (Roadways).*

Distortion of structure shape

The Contractor shall check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2% for pipes and pipe arches.

4.10 INVERT PROTECTION

Material

Where shown on the Drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

Depth and width

The sprayed concrete shall be placed to a thickness of not less than 100 mm over the crest of the corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

Scale removal

All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

Production, application and curing

The production, application and curing of sprayed concrete shall be in accordance with 0310 *Minor concrete work*.

Sprayed concrete reinforcement

The sprayed concrete shall be reinforced with a fabric of hard drawn steel wire 4 mm diameter with 200 mm square mesh.

The fabric shall be securely supported at a central location within the sprayed concrete by non-metallic supports.

Laps in fabric

Laps in fabric shall be 300 mm and a cover of 50 mm of sprayed concrete shall be provided to the fabric at all edges.

Cement slurry application

Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

Water flow

No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

5 FLEXIBLE PIPES

5.1 MATERIALS

General

Flexible pipes shall be those covered by Australian Standard AS/NZS 2566.1 'Buried Flexible Pipelines Part 1: Structural Design.' This Standard is applicable to buried flexible pipes manufactured from homogeneous or composite material; of plain or structured wall construction; and plastic (UPVC, OPVC, ABS, GRP, Polyethylene) or metallic (Aluminium, Steel, Ductile Iron) materials of manufacture.

The size/type/class of the flexible pipeline shall be as shown on the Drawings.

Section 4 applies to corrugated metal pipes.

Embedment material

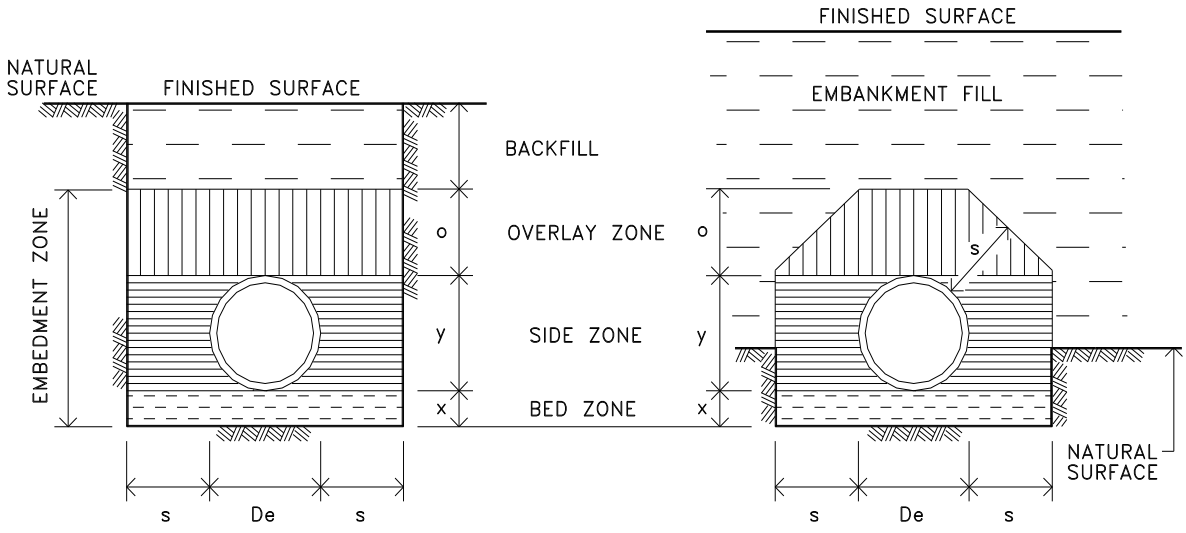
Embedment material in the bedding, side support and overlay zones shall be in accordance with this worksection, AS 2566.1 and AS 2566.2.

Unless otherwise specified, embedment material in the bedding, side support and overlay zones, as shown in Figure 5.1, shall be a cohesionless granular material having a grading, determined by AS 1141.11, no finer than Table 5.1 and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

Other aggregates, gravels and sands suitable for embedment material are those complying with Tables G2 and G3 of AS 2566.2.

Backfill material

Trench backfill material shall satisfy the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.



TRENCH EMBANKMENT

(Figure taken from AS 2566.2)

Figure 5.1 Pipe installation conditions

Table 5.1 Embedment material grading

Sieve size (mm)	**Weight passing (%)**
19.0	100
2.36	50–100
0.6	20–90
0.3	10–60
0.15	0–25
0.075	0–10
(Table taken from AS 2566.2, Table 5.5)	

5.2 EXCAVATION AND BEDDING

Formation to finished surface level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to finished surface level and the pipes then installed in the normal trench condition.

Bedding dimensions

Figure 5.1 and Table 5.2 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the Drawings.

Compaction

Bedding zone material shall be placed and compacted in accordance with the requirements in Bedding except that the required relative compaction in the bedding zone shall be 95% (AS 1289.5.4.1 Standard compaction).

Table 5.2 Trench and embedment dimensions

Extreme external	**Minimum dimensions (mm)**			
Dia (De)mm	**x**	**s**	**o**	**y**
≥75 ≤150	75	100	100	Pipe dia.
>150 ≤300	100	150	150	Pipe dia.
>300 ≤450	100	200	150	Pipe dia.

Extreme external	**Minimum dimensions (mm)**			
>450 ≤900	150	300	150	Pipe dia.
>900 ≤1500	150	350	200	Pipe dia.
>1500 ≤4000	150	0.25 De	300	Pipe dia.
Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension 's' for the larger of adjacent pipes.				

Table 5.3 Minimum relative compaction

Embedment material	**Test method**	**Compaction**	
		Traffic loading	**No traffic loading**
Cohesionless	Density index (AS 1289)	70%	60%
(Taken from AS 2566.2 Table 5.5)			

5.3 EMBEDMENT AND LAYING

Embedment

Embedment of the flexible pipes shall be in accordance with the requirements of the Drawings, Section 5 of AS/NZS 2566.2 and to the dimensions shown in Figure 5.1.

Laying and Jointing

Pipes shall be laid and joined in accordance with the manufacturer's Specifications, and to any Australian Standards relevant to installation of the type of pipe.

Pipes with markings indicating the crown or invert of the pipe, or the required direction of flow in the pipe shall be laid strictly in accordance with the markings.

All pipes shall be lowered into the trench without being dropped

Bulkheads

Bulkheads or trenchstops shall be constructed where required in accordance with Table 5.7 of AS 2566.2. Bulkheads shall be constructed in accordance with 1354 *Drainage structures*.

Approval of bedding zone material and pipeline placement

The Superintendent's approval of the bedding zone material compaction and positioning and jointing of the pipeline is required.

5.4 BACKFILL

Embedment compaction

Compaction of the material in the side support and overlay zones shall comply with the requirements of Bedding except that the required relative compaction in the side support and overlay zones shall be in accordance with Table 5.3.

Layers

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

Moisture content

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 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the selected material zone as specified in 1112 *Earthworks (Roadways)*, shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.

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 1112 *Earthworks (Roadways)*.

6 LIMITS AND TOLERANCES

The limits and tolerances for materials and product performance related to the various Clauses in this worksection are summarised in Table 6.1.

Table 6.1 Summary of limits and tolerances

Activity	**Limits/Tolerances**	**Worksection clause Reference**
Culverts		
- Grade line	± 10 mm	**Tolerances**
- Horizontal alignment	± 10 mm	**Tolerances**
Concrete pipes		
Bedding		
- Bed and haunch zone compaction	Table 3.3	**Bedding**
- Backfill		-
- Side and overlay zone compaction	Table 3.3	**Backfill**
Steel pipes		
Backfill		
- Side and overlay zone compaction	Table 3.3, HS3	**Backfill**
- (Pipe/Structure distortion		-
. Horizontal and vertical variation	< 2% of specified dimensions	**Backfill**
Invert protection sprayed concrete		
- Over crest of corrugations over bottom third of pipe circumference	> 100 mm	**Invert Protection**
Flexible pipes		
Bedding Zone Compaction	≥95%	**Excavation and Bedding**
Backfill—PVC Pipes		
- Side and overlay zone compaction	Table 5.3	**Flexible pipes (Backfill)**

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a Schedule of Rates basis in accordance with Pay Item 1352.1.

A lump sum price for this item shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Subsoil drains at pits and headwalls are measured and paid in accordance with this worksection and not 1171 *Subsurface drainage*.

Selected material around pipes, trench backfill in embankment material to the underside of the selected material zone and selected material backfill within the selected material zone where approved, is measured and paid in accordance with this worksection and not 1112 *Earthworks (Roadways*).

Sprayed concrete invert protection is measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

Bulkheads are measured and paid in accordance with 1354 *Drainage structures*.

7.2 PAY ITEM

1352.1 Pipe culverts

The unit of measurement shall be the linear metre measured along the centreline of each particular type, class and size of stormwater drainage pipe culvert and shall be the plan length between centres of gully pits or faces of headwalls.

The schedule rate shall include:

- Supply
- Survey and setting out
- Bedding
- Jointing (including connections)
- Subsoil drains at pits and headwalls
- Temporary bracing and strutting
- Bituminous painting
- Sprayed concrete lining and other protective measures
- Selected material backfilling
- Embankment material trench backfilling

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1353 PRECAST BOX CULVERTS

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the installation of precast concrete box culverts and should be read in conjunction with 1351 *Stormwater drainage (Construction)*.

The work to be executed under this worksection consists of:

- preparation of foundations;
- provision of bedding;
- construction of base slabs;
- installation of precast culvert units;
- headwalls and wingwalls;
- backfilling against structures;
- provision and removal of coffer dams;
- excavation of inlet and outlet channels.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

0310 *Minor concrete works*

1112 *Earthworks (Roadways)*

1121 *Open drains, including kerb and channel (gutter)*

1141 *Flexible pavements*

1171 *Subsurface drainage*

1172 *Subsoil and foundation drains*

1351 *Stormwater drainage (Construction)*

1352 *Pipe drainage*

1354 *Drainage structures*

Standards

AS 1597 Precast reinforced concrete box culverts

AS 1597.1 Small culverts (not exceeding 1200 mm width and 900 mm depth) (Obsolescent)

AS 1597.2 Large culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm height)

AS/NZS ISO 9001 Quality management systems - Requirements

Other publications

AUSTROADS

AP – 3/90: Guide to Geotextiles

2 MATERIALS

2.1 CULVERT UNITS, LINK AND BASE SLABS

Supply

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 1200 mm width and 900 mm depth, and
- AS 1597.2 for large culverts from 1500 mm span and up to and including 4200 mm span and 4200 mm height;
- with the following alterations or additional requirements:
- Proof load testing shall be arranged by the Contractor in batches as specified in either AS 1597.1 or AS1597.2 as determined by the Council Engineer.
- Lifting holes, galvanised lifting points or steel lifting eyes shall be provided in the culvert units, link and base slabs.
- The end units shall have factory installed starter bars for headwall and wingwall construction.

Delivery and unloading shall be the Contractor's responsibility.

The Supplier shall implement and maintain a Quality System in accordance with ISO 9002 to ensure materials, manufacture and proof load testing conform to the requirements of AS 1597.1 or AS 1597.2 as appropriate.

Box culvert units

A conformance certificate, to AS 1597.1 or AS 1597.2, for the box culvert units shall be submitted at least 3 working days prior to despatch.

This action constitutes a HOLD POINT.

The Superintendent's approval of the conformance certificate is required prior to the release of the hold point.

Each unit shall be marked at time of manufacture with:

- Type and size.
- Casting date.
- Manufacturer's name.
- Inspection pass and date.

2.2 CONCRETE

The concrete and reinforcement for cast-in-situ base slabs shall comply with 0310 *Minor concrete works*.

2.3 SELECTED BACKFILL

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

2.4 ORDINARY BACKFILL

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which is in accordance with the requirements for the upper 1.5 m of embankment construction as detailed in 1112 *Earthworks (Roadways)*.

3 CONSTRUCTION

3.1 COFFER DAMS

Construction costs

At some sites it may be expedient for the Contractor to construct a coffer dam.

All costs associated with the construction of coffer dams shall be borne by the Contractor.

Construction

Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation.

Coffer dams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure.

A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete.

The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the Superintendent, but the Contractor shall be responsible for the successful construction of the work.

Specified clearances

Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide clearances specified. This work will be at the Contractor's expense.

Timber or bracing Removal

No timber or bracing shall be left in the concrete or in the backfill of the finished structure.

Coffer dams, including temporary piles, shall be removed at least to the level of the invert after completion of the structure.

3.2 EXCAVATION

Excavation shall be carried out in accordance with 1351 *Stormwater drainage (Construction)*.

The trench width shall be the width of the base slab plus 150 mm minimum each side.

3.3 FOUNDATIONS

Rock Foundations

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.

Additional excavation

Where rock is encountered over part of the foundation only, or lies within 300 mm below the underside of the mass concrete or selected fill, all rock shall be removed to a depth of 300 mm 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 as specified in Ordinary Backfill.

Uniform surface

Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50 mm above the highest points of rock.

Line and level

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.

Unsuitable material

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 1351 *Stormwater drainage (Construction)*.

3.4 BEDDING

Cast-in-situ base slabs

Bedding shall be either mass concrete or lightly bound DGB20 in accordance with 1141 *Flexible pavements*, whichever is shown on the Drawings, as follows:

- Mass concrete bedding: Mass concrete bedding shall be of the same compressive strength as for the base slab and shall not be less than 50 mm 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 ±10 mm in level and ±5 mm in line. The bedding shall be finished to a smooth surface by screeding.
- DGB20 bedding: Lightly bound DGB20 bedding shall be compacted in accordance with 1351 Stormwater drainage (Construction) to the dimensions shown on the Drawings.
  It shall be laid to the line and level of the underside of the base slab to a tolerance of ±10 mm in

level and ±5 mm in line.
The bedding shall be finished to a smooth surface by screeding.
This action constitutes a **HOLD POINT**.
The Superintendent's approval to the bedding is required prior to the release of the hold point.

Precast base slabs
Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bed zone of selected backfill of minimum compacted depth 150 mm in accordance with AS 1597.2.

This action constitutes a HOLD POINT.

The Superintendent's approval to the bedding is required prior to the release of the hold point.

3.5 CAST-IN-SITU BASE SLABS

Construction
Cast-in-situ base slabs shall be constructed to the dimensions shown on the Drawings and in accordance with worksection and not with 0310 *Minor concrete works*.

The invert levels shall be within –10 mm to +10 mm, grade 5 mm in 2.5 m (1 in 500) and plan position ±50 mm of the design level and position.

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

3.6 INSTALLATION OF PRECAST UNITS

Minimum strength
Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa.

Mortar bed in recess
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 the ends of units shall be packed or sealed with cement mortar or grout of a consistency that ensures filling of the void.

Mortar bed on supports
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 5 mm after placement of precast unit.

Lifting hooks
Steel lifting hooks shall be cut flush with the surface of the concrete, cleaned to bright metal and coated with two coats of coal tar epoxy or equivalent approved by the Superintendent. Alternatively, they shall be cut off 12 mm below the surface of the unit and the recess sealed with epoxy mortar.

Gap between cells
In the case of multi-cell culverts, the gap as shown on the Drawings, typically 15 mm, shall be provided between adjacent cells.

This gap shall be filled with cement mortar or grout.

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

Joint covering
All external surfaces of joints between precast crown units, both laterally and longitudinally, shall be covered full length, and minimum 250 mm width, with strips of non-woven geotextile of minimum mass 270 grams/m^2 in accordance with AUSTROADS *Guide to Geotextiles.*

3.7 BACKFILL

Removal of formwork
All bracing and formwork shall be removed prior to backfilling.

Selected backfill
Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300 mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150 mm 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 1112 *Earthworks (Roadways)*.

Wingwalls

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

Subsoil drain

A subsoil drain shall be installed at the outer walls of the precast crown sections and at wingwalls as shown on the Drawings and in accordance with 1172 *Subsoil and foundation drains*.

The subsoil drain shall be enclosed in a seamless tubular filter fabric in accordance with 1171 *Subsurface drainage*.

Sequence

Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600 mm level difference to avoid differential loading.

Backfilling and compaction shall commence at the wall and proceed away from it.

Horizontal terraces

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 1 m width before the backfill is placed.

3.8 EXCAVATION OF INLET AND OUTLET CHANNELS

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 1121 *Open drains, including kerb and channel (gutter)*.

3.9 CONSTRUCTION LOADING ON CULVERTS

Traffic over culvert

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 32 MPa.

Loading restrictions

Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

4 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in

Table 4.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Worksection Clause Reference
Mass Concrete Correction		
- Over highest points of rock	≥50 mm	**Foundations**
Mass Concrete Bedding		
- Level	± 10 mm	**Bedding**
- Line	± 5 mm	**Bedding**
Culvert Location		
- Invert Level	±10 mm	**Cast-in-Situ Base Slabs**
- Grade	5 mm in 2.5 m (1 in 500)	**Cast-in-Situ Base Slabs**
- Plan Position	±50 mm	**Cast-in-Situ Base Slabs**

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis in accordance with Pay Items 1353.1 and 1353.2.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Excavation for box culverts is measured and paid in accordance with 1351 *Stormwater drainage (Construction)*.

Excavation for inlet and outlet channels is measured and paid in accordance with 1121 *Open drains, including kerb and channel (gutter)*.

Base slab bedding using lightly bound DGB20 is measured and paid in accordance with this worksection and not 1141 *Flexible pavements*.

Cast-in-situ base slabs are measured and paid in accordance with this worksection and not Specification and not with 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

Ordinary embankment backfill is measured and paid in accordance with 1112 *Earthworks (Roadways)*.

Cast-in-situ headwalls and wingwalls are measured and paid in accordance with 1354 *Drainage structures*.

Subsoil drains are measured and paid in accordance with 1172 *Subsoil and foundation drains*.

5.2 DEDUCTIONS

Payment for in-situ concrete work shall be made at the scheduled rates provided the concrete meets the strength requirements specified in 0310 *Minor concrete works*.

Where any concrete does not reach the strength specified, the scheduled rate of payment shall be reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen fails to reach the specified strength, up to a maximum deficiency of 10%.

If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made.

5.3 PAY ITEMS

1353.1 In-situ base slab

The unit of measurement shall be the cubic metre of reinforced concrete in place (excluding the mass concrete bedding layer).

The width, length and depth of the slab shall be as specified on the Drawings or as directed by the Superintendent.

The schedule rate shall include foundation preparation, bedding and all activities associated with the construction of the base slab.

The schedule rate does not include excavation.

1353.2 Precast concrete box culverts

The unit of measurement shall be linear metre of the actual length installed for each size of box culvert as shown on the Drawings.

The Schedule Rate shall include supply, installation and jointing of the precast units, selected backfilling and testing of the units.

1354 DRAINAGE STRUCTURES

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the construction of drainage structures and shall be read in conjunction with 1351 *Stormwater drainage (Construction)* and 1352 *Pipe drainage*, 1353 *Precast box culverts* and 1121 *Open drains, including kerb and channel (gutter)*, as applicable.

The work to be executed under this worksection 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.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

0310 *Minor concrete works*

1102 *Control of erosion and sedimentation*

1112 *Earthworks (Roadways)*

1121 *Open drains, including kerb and channel (gutter)*

1351 *Stormwater drainage (Construction)*

1352 *Pipe drainage*

1353 *Precast box culverts*

Standards

AS 3996 Metal access covers, road grates and frames

2 MATERIALS

2.1 STRUCTURES

Drainage structures shall be constructed in concrete and in accordance with 0310 *Minor concrete works*.

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.

2.2 PRECAST UNITS

Handling and installation

Where precast units, including kerb inlet lintels, are provided in the design they shall be handled and installed in accordance with the manufacturer's instructions.

Replacing cast-in-situ with precast units

If the Contractor proposes to use precast units in place of cast-in-situ units, detailed drawings and complete details of installation procedures shall be submitted for the approval of the Superintendent.

Delivery

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.

This action constitutes a HOLD POINT.

The Superintendent's approval to the quality test documentation is required prior to the release of the hold point.

3 CONSTRUCTION

3.1 ALIGNMENT OF HEADWALLS, PITS AND WINGWALLS

Unless otherwise shown on the Drawings, headwalls and pits shall be constructed parallel to the road centreline and wingwalls at 135° to the headwall.

Where the culvert is laid skew to the road, 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.

Energy dissipators shall be constructed in accordance with the Drawings and with centreline on the axis of the culvert.

3.2 HEADWALLS AND WINGWALLS

Batter retention

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.

Rock foundations

Where rock is encountered at the bottom of excavations for wingwalls and headwalls, and after approval is given by the Superintendent, 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 150 mm into sound rock.

3.3 PITS

Construction

All new pits, including access covers, 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.

Full depth rock excavation

Where the full depth of the excavation is in sound rock, and the Superintendent approves, part of the concrete lining of gully pits and sumps may be omitted, provided that a neatly formed pit of the required dimensions is constructed.

In all such cases the wall of the pit adjacent to and parallel to the road shall be constructed of concrete.

Step irons

Step irons shall be installed in accordance with the Drawings. 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 shall be either fixed firmly in the formwork prior to pouring the concrete for the pit walls or by using blockout formers to make recesses in the concrete to receive the arms of the step irons or alternatively, installed at a later date by drilling the pit wall.

Holes may only be drilled using a rotary masonry bit or similar. Percussion tools shall not be used to form the hole for the step iron.

Where the step irons are installed in recesses or drill holes after the concrete wall is poured, the step irons shall be fixed in position by using an epoxy resin in accordance with the step iron and epoxy resin manufacturer's instructions and specifications.

The Contractor shall ensure that no movement of the step irons occurs until the epoxy resin has reached the specified strength.

Inlet and outlet pipes

Inlet and outlet pipes shall be integrally cast into the pit at the time of pouring the concrete for the pit walls.

Subsoil drain
A subsoil drain shall be installed into the pit or headwall in accordance with 1352 *Pipe drainage*.

3.4 BULKHEADS

Concrete bulkheads shall be constructed on all pipe stormwater drainage lines where the pipe gradient of the line exceeds 5%.

Bulkheads shall be constructed at the spacings and to the details shown on the Drawings.

3.5 JOINTING

Where drainage structures abut concrete paving, kerb and gutter or other concrete structures, a 10 mm wide joint shall be provided between the structure and paving or kerb and gutter or other concrete structure.

The joint shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

3.6 FOUNDATION FOR CONCRETE BASES

Mass concrete bedding for concrete bases
Mass concrete bedding for reinforced concrete bases 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 50 mm thick, shall be placed over the excavated surface and shall be finished to a smooth even surface.

Foundation preparation constitutes a HOLD POINT.

The Superintendent's approval of the foundation is required prior to the release of the hold point.

Unreinforced Concrete Base
Unreinforced concrete bases may be cast on earth or rock foundations without the mass concrete bedding.

Foundation preparation constitutes a HOLD POINT.

The Superintendent's approval of the foundation is required prior to the release of the hold point.

3.7 BACKFILL

Commencement
Backfilling shall not commence until the compressive strength of concrete has reached at least 15 MPa unless otherwise approved by the Superintendent.

Selected backfill
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.

Composition
Selected backfill shall consist of a granular material in accordance with 1112 *Earthworks (Roadways)*.

Horizontal terraces
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 600 mm in width, as the backfill is placed.

Backfill on both sides of the structure shall be carried up to level alternately in layers so as to avoid wedge action or excessive horizontal forces.

Backfilling and compaction shall commence at the wall. Compaction shall be in accordance with 1351 *Stormwater drainage (Construction)*.

4 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 4.1.

Table 4.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Clause Worksection Reference

Headwalls and wingwalls – cut off walls		
– Depth into sound rock	>150 mm	**Headwalls and Wingwalls**
Foundation for concrete bases		
– Mass concrete bedding depth	>50 mm	**Foundation for Concrete basis**

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a schedule of rates basis, in accordance with the Pay Items 1354.1 to 1354.3 inclusive.

A lump sum price for any of these items shall not be accepted.

If any item, for which a quantity of work listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in other items for the cost of the activity which has not been priced.

Excavation is measured and paid in accordance with 1351 *Stormwater drainage (Construction)*.

Backfill is measured and paid in accordance with this worksection and not 1112 *Earthworks (Roadways)*.

Drainage structures are measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

5.2 PAY ITEMS

1354.1 Concrete headwalls and wingwalls

The unit of measurement shall be cubic metre of concrete as calculated from the dimensions on the Drawings.

The Schedule Rate shall include formwork, supply and fixing of steel reinforcement, supply, placing and curing of concrete, stripping, finishing and backfilling.

1354.2 Pits, dissipators, channel basins and other supplementary structures

The unit of measurement shall be ‘each’ for the completed structures as scheduled.

The rate shall include all activities and materials required to complete the structures as shown on the Drawings, including the supply and installation of all cast in metalwork, frames, grates, lintels and lids, finishing and backfilling.

1354.3 Bulkheads

The unit of measurement shall be ‘each’ bulkhead completed.

The rate shall include all activities and materials required to complete the bulkhead structures as shown on the Drawings, including formwork, supply and fixing of steel reinforcement, supply, placing and curing of concrete, stripping and selected backfilling.