

1133 PLAIN AND REINFORCED CONCRETE BASE
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1 GENERAL**1.1 RESPONSIBILITIES****Objectives**

General: Provide plain or reinforced concrete base, as documented.

Performance

~~Requirements: [complete/delete]~~

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following:

- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of Traffic.
- 1121 Open drains, including kerb and channel (gutter).
- 1132 Lean mix concrete subbase.
- 1172 Subsoil and foundation drains.

~~[complete/delete]~~

1.3 REFERENCED DOCUMENTS**Standards**

General: The following documents are incorporated into this worksection by reference:

Australian standards

AS 1012	Methods of testing concrete
AS 1012.1-1993	Sampling of fresh concrete
AS 1012.3.1-1998	Determination of properties related to the consistency of concrete - Slump test
AS 1012.3.3-1998	Determination of properties related to the consistency of concrete - Vebe test
AS 1012.4.2-1999	Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1-2000	Method for making and curing concrete - Compression and indirect tensile test specimens
AS 1012.9-1999	Determination of the compressive strength of concrete specimens
AS 1012.12.2-1998	Determination of mass per unit volume of hardened concrete - Water displacement method
AS 1012.13-1992	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1012.14-1991	Method for securing and testing cores from hardened concrete for compressive strength
AS 1141	Methods for sampling and testing aggregates
AS 1141.11.1-2009	Particle size distribution – sieving method
AS 1141.12-1996	Materials finer than 75 micrometre in aggregates (by washing)
AS 1141.14-2007	Particle shape, by proportional calliper
AS 1141.18-1996	Crushed particles in coarse aggregate derived from gravel
AS 1141.22-2008	Wet/dry strength variation
AS 1141.24-1997	Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1160-1996	Bituminous emulsions for the construction and maintenance of pavements

AS 1289	Methods of testing soils for engineering purposes
AS 1289.4.2.1-1997	Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379-2007	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000	Admixtures for concrete
AS/NZS 1554	Structural steel welding
AS/NZS 1554.3:2008	Welding of reinforcing steel
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1-1998	Concrete aggregates
AS 3582	Supplementary cementitious materials for use with portland and blended cement
AS 3582.1-1998	Fly ash
AS 3583	Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13-1991	Determination of chloride ion content
AS 3600-2009	Concrete structures
AS 3799-1998	Liquid membrane—forming curing compounds for concrete
AS 3972-2010	General purpose and blended cements
AS/NZS 4671: 2001	Steel reinforcing materials
AS/NZS 4680:2006	Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
SAA HB 155-2002	Guide to the use of recycled concrete and masonry materials
<i>Austrroads</i>	
AGPT04C-2009	Guide to pavement technology part 4C: Materials for concrete road pavements
AGPT04E-2009	Guide to pavement technology part 4E: Recycled materials
AGPT04J-2008	Guide to pavement technology part 4J: Aggregate and source rock
AGPT08-2009	Guide to pavement technology part 8: Pavement construction
Other publications	
<i>NSW RMS Test Methods</i>	
T 240 – 2012	Road surface texture depth (sand patch)
T 1160 - 2001	Low temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1161 - 2001	High temperature recovery of polychloroprene elastomeric joint seals for bridge structures
T 1163 - 2001	Resistance of vulcanised rubber to the absorption of oil
T 1192 – 2001	Adhesion of sealant
T 1193 - 2001	Accelerated Aging of cured sealant
<i>ASTM Standards</i>	
C793 - 2010	Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
C794 - 2010	Standard test method for adhesion-in-peel of elastomeric joint sealants
D792 - 2008	Standard test methods for density and specific gravity (relative density) of plastics by displacement
D2240 - 2010	Standard test method for rubber property-durometer hardness
D2628 - 2011	Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements
D2835 - 2007	Standard specification for lubricant for installation of preformed compression seal in concrete pavements
<i>US Military Specifications</i>	
SAE AMS-S - 8802 2011	Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion
<i>ARRB Group</i>	<i>Specification for Recycled Crushed Glass as an Engineering Material</i>
<i>NSW RMS</i>	<i>QA Roadworks Specification R83 for Jointed Concrete Base</i>

1.4 STANDARDS

General

Standard: To AS 1379, AS 3600, AGPT08 and AGPT04C.

1.5 INTERPRETATIONS

Abbreviations

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

- JRCP: Jointed reinforced concrete.
- PCP: Jointed plain concrete.

Definitions

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

- Lot: A continuous placement of up to 50 m³ of subbase concrete.
- Nominated mix: Proposed concrete mix after the approval.

1.6 HOLD POINTS AND WITNESS POINTS

Approval

Submissions: To the Superintendent's approval.

Notice

General: Give notice so that the documented inspection and submissions may be made to the **HOLD POINT table** and the **WITNESS POINT table**.

HOLD POINTS table

Clause title / Item	Requirement	Notice of inspection	Release by
DESIGN AND CONTROL OF CONCRETE MIX			
Nominated mix	Submit details and certificates for nominated concrete mix and material constituents	21 working days before ordering concrete	<i>Principal Certifying Authority</i>
SITE ESTABLISHMENT			
Subbase survey	Work-as-executed survey of the subbase.	2 working days before starting any works	<i>Principal Certifying Authority</i>
TRIAL CONCRETE BASE			
Construction	Obtain approval for the trial section	5 working days before main works	<i>Principal Certifying Authority</i>
Deficient trial section	Review of deficiencies in the trial section	2 working days after construction	<i>Principal Certifying Authority</i>
Non-conforming trial section	If trial section does not conform then remove and replace	5 working days before main works	<i>Principal Certifying Authority</i>
SLAB ANCHORS			
Excavation	Submit compacted excavated surface	1 working day before concreting	<i>Principal Certifying Authority</i>
INSTALLATION OF STEEL REINFORCEMENT			
Placing and cover requirements	Approval of placement and fastening of reinforcing steel	4 working hours before concrete placement	<i>Principal Certifying Authority</i>
PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE			
Concrete production and transport	Submit proposed methods and equipment	4 weeks before starting	<i>Principal Certifying Authority</i>

Clause title / Item	Requirement	Notice of inspection	Release by
PLACING AND FINISHING			
Equipment and methods	Submit full details of proposed placing and finishing methods together with a paving plan	4 weeks before starting	<i>Principal Certifying Authority</i>
Surface texture	Submit details of proposed texturing device and method of texturing	Before texturing	<i>Principal Certifying Authority</i>
JOINTS			
Permanent sealing	Submit proposed method for permanent joint sealing	4 weeks before installation	<i>Principal Certifying Authority</i>
TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH			
Sampling	Inspection of sampling procedure	Progressive	<i>Principal Certifying Authority</i>
Acceptance criteria	Submit test results	Progressive	<i>Principal Certifying Authority</i>
Acceptance criteria for cored concrete	Submit test results	Progressive	<i>Principal Certifying Authority</i>
REMOVAL AND REPLACEMENT OF BASE			
General	Submit proposed method of removal to preserve adjoining base and underlying subbase	7 working days before replacement works	<i>Principal Certifying Authority</i>

WITNESS POINTS table – Off site activities

Clause/ subclause	Requirement	Notice of inspection
STEEL REINFORCEMENT		
General	Provide NATA certificates and manufacturer's information.	Before delivering to site
Bar chairs	Demonstrate load bearing capacity	Before delivering to site
SEALANTS		
General	Provide NATA certificate and manufacturer's information	4 weeks before joint work

WITNESS POINTS table – On site activities

Clause/ subclause	Requirement	Notice of inspection
CEMENT		
Storage and transport	Re-test cement stored for longer than 3 months	Progressive
AGGREGATES		
Storage	Storage and handling to preserve quality of aggregate	Progressive
SLAB ANCHORS		

Clause/ subclause	Requirement	Notice of inspection
General	Locations as shown on drawings	Progressive
PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE		
Concrete delivery	Keep record of delivery information	Progressive
PLACING AND FINISHING		
Equipment and methods	Notice of planned start on site	7 working days before starting on site
Consistency	Provide slump check test results	Progressive
Ambient conditions	Provide details of protection methods for cold or hot weather and rain	Progressive
Evaporation and moisture loss	Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits	Progressive
Paving in general	Construction joint if hand or mechanical paving is disrupted	Progressive
Assessment of base thickness	Survey of base surface, edge alignment and thickness	3 working days after placement
Traffic considerations	Provide traffic management measures	Progressive
JOINTS		
Location	Locations as shown on drawings or as directed	Before works
CURING		
Application method	Check curing compound application rate	Progressive
TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH		
Testing of specimens cut from the work	Carry out coring in presence of the Superintendent	
Remedial work after coring	Restore holes with non-shrink cementitious concrete	After coring
RELATIVE COMPACTION OF CONCRETE		
Testing for relative compaction	Remove and replace non-conforming base	Progressive

2 PRE-CONSTRUCTION PLANNING

2.1 ACTIVITY PLAN

General

Program: Plan the following activities:

- Provide planning resources to allocate plant and personnel for the contract period.
- Program the work to meet the constraints of **HOLD POINTS, WITNESS POINTS**.
- Plan work to make sure that where jointed concrete shoulders are specified, the plain and reinforced concrete base is constructed first.

2.2 DESIGN AND CONTROL OF CONCRETE MIX

Nominated mix

General: Before starting the production of the concrete for base works, carry out a trial mix to certify the conformance of the proposed concrete mix.

Testing authority: NATA registered laboratory.

Submission requirements:

- Details of all material constituents and test reports to the **MATERIALS** clause and the following:
 - . Cement: Brand and source.
 - . Fly ash: Powerhouse source.
 - . Admixtures: Proprietary source, type, name and dosage recommended by manufacturer.
 - . Aggregates: Source, geological type, moisture condition, proportions and grading for each type and the grading for the combined aggregate.
 - . Curing compounds: Application rate.
- Concrete mix design.
- Test results and certificates of conformance for the concrete mix:
 - . Standard: To AS 1379.
 - . Acceptance criteria: To **CONCRETE QUALITY REQUIREMENTS**.

Submission type: **HOLD POINT**.

Pre-approved mix

Identical mix: To avoid testing the nominated mix, submit results from earlier testing of a mix identical with the nominated mix for approval.

Pre-approval: A mix may be pre-approved under the following conditions:

- If the mix was used in a separate contract within 12 months of the proposed works date.
- If fully approved details have been previously used.
- If the constituent materials and quality remain unchanged from those previously approved.
- If the in-service performance of the concrete incorporating the nominated mix is acceptable.

Variations to nominated mix and materials

Approval: Submit details of any changes to the nominated mix, its method of production or source of supply of constituents.

Non-conformance: Consider any change made without approval to a material in the approved mix as a non-conforming material. Concrete containing this material may become non-conforming.

2.3 SITE ESTABLISHMENT

General

General: Provide the following:

- Personnel, plant, equipment, components and materials.
- On site and off site facilities.
- Liaison with authorities.
- Safety procedures.

3 MATERIALS

3.1 CEMENT

General

Standard: To AS 3972.

Storage and transport

Storage time: Re-test cement that has been stored for more than three months from the time of manufacture.

Inspection type: **WITNESS POINT**.

Transport: Transport cement in watertight packaging and protect from moisture. Do not use caked or lumpy cement.

3.2 FLYASH

General

Standard: To AS 3582.1.

3.3 WATER

General

Standard: AS 1379.

Requirement: Clean, free from oil, acid, alkali, organic or vegetable matter.

Limits: Conform to the following:

- Maximum 300 parts per million of chloride ion, as determined to AS 3583.13.
- Maximum 400 parts per million of sulfate ion, as determined to AS 1289.4.2.1.

3.4 ADMIXTURES

General

Standard: To AS 1478.1.

Requirement: Provide admixtures free from calcium chloride, calcium formate, or triethanolamine or any other accelerator.

Dosage: Vary the dosage of chemical admixture to account for air temperature and setting time in conformance with the manufacturer's recommendations.

Compatibility of admixtures: Provide certification from the manufacturer for combinations of two or more admixtures.

Types of admixtures

Warm season retarder: During the warm season, (October to March inclusive), use a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRRe) to control slump within the limits stated in **CONCRETE QUALITY REQUIREMENTS, Consistency**.

Cool season retarder: During the cool season, (April to September inclusive), use only a lignin or lignin based set-retarding admixture containing not more than 6 % reducing sugars (Type WRRRe conforming to AS 1478.1).

3.5 AGGREGATES

General

Standards: AS 2758.1 and AGPT04J.

Recycled concrete aggregate

Coarse aggregates from demolition concrete: To the recommendations of SAA HB155 and Austroads AGPT04E.

Blending: If blending coarse recycled concrete aggregate with natural aggregates, make sure substitution rates are below 30%.

Concrete mix proposed for slipforming: Conform to the **Combined aggregate grading table**.

Combined aggregate grading table

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

Australian Standard sieve	% passing by mass of sample
75 µm	0–2

Recycled crushed glass

Requirement: Meet the recommendations of the ARRB Group in Specifications for Recycled Crushed Glass as an Engineering Material and all other technical criteria for fine aggregate.

Blending: Maximum of 30% by mass of the total fine aggregate.

Fine aggregate

Properties:

- Size: Max 4.75 mm.
- Water absorption: 5% maximum.
- Quartz sand content for pavements without asphalt surfacing: Provide at least 40% by mass of the total aggregates in the concrete mix of quartz sand, containing minimum 70% quartz, by mass.

Quality requirement: Clean, hard, tough, durable, uniform, uncoated grains.

Sodium sulfate soundness: To AS 1141.24 and not to exceed the limits shown in the

Sodium sulfate soundness limits table.**Sodium sulfate soundness limits table**

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 µm	8
600 µm to 300 µm	12

Blending of two or more fine aggregates: To the **Sodium sulfate soundness limits table** for each constituent material.

Grading: To AS 1141.11.1 and within the limits shown in the **Fine aggregate grading table.**

Fine aggregate grading table

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 requirements: Clean, crushed, hard durable rock, metallurgical furnace slag or gravel. If required, wash coarse aggregates.

Properties: Conform to the **Coarse aggregate properties table.**

Coarse aggregate properties table

Property	Specification limits	Method
Water absorption	2.5 % max	AS 1141.6.1
Material finer than 75 micrometers	1 % max	AS 1141.12
Wet strength	≥ 80 kN	AS 1141.22

Property	Specification limits	Method
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
Fractured faces (two or more)	≥ 80%	AS 1141.18

Grading: To AS 1141.11.1 and within the limits shown in the **Coarse aggregate grading table**.

Coarse aggregate grading table

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	-

Storage

Storage areas: Locate the storage area to prevent segregation and mixing of the aggregates with foreign materials.

Inspection type: **WITNESS POINT**.

3.6 STEEL REINFORCEMENT

General

Standards: To AS/NZS 4671 and AGPT04C clause 5.

Certification: Provide NATA test certificates for the steel reinforcement to AS 4671.

Activity type: **WITNESS POINT**.

Grade, type and size: As shown on the drawings.

Surface condition: Free from loose mill scale, rust, grease, mud, mortar or any other material which would reduce the bond between the reinforcement and the concrete.

Galvanised bars: Hot-dipped to AS/NZS 4680.

Cold-worked reinforcing bars: Do not use.

Tie wire: Annealed iron wire with minimum 1.25 mm diameter.

Bar chairs

General: Provide plastic bar chairs or plastic tipped wire chairs, capable of withstanding a load of 200 kg mass on the chair for one hour at $23 \pm 5^\circ\text{C}$.

Inspection type: **WITNESS POINT**.

3.7 SEALANTS

General

Certification: Provide certificate from a NATA registered laboratory.

Manufacturer information: Provide evidence confirming compatible fit and suitability for designed joint dimensions and proposed method.

Inspection type: **WITNESS POINT**.

Silicon joint sealants: To **Silicone joint sealant requirements table**.

Silicone joint sealant requirements table

Test method	Test	Requirements
ASTM-D792	Specific Gravity	1.1 to 1.55
SAE AMS-S-8802	Extrusion Rate	90 to 250 g per min
SAE AMS-S-8802	Tack Free Time	30 to 70 min
ASTM D2240	Durometer	10 to 25
RMS T1192 RMS T1193	Durability: Extension Durability: Compression	To 70% To 50%
ASTM C794	Adhesion to Concrete	35 N minimum average peel strength
ASTM C 793	Accelerated Weathering at 5,000 hours	No cracks, blisters or bond loss
N.A.	Colour	Grey, compatible with pavement concrete

Neoprene joint sealants: To ASTM D2628. NSW RMS Test Methods T1160, T1161 and T1163 or relevant State Road Authority requirements.

3.8 CURING COMPOUNDS

General

Standards: AS 3799, AS 1160 and AGPT04C clause 6.

Efficiency index: Minimum 90 % when tested to AS 3799 Appendix B.

Alternative curing compounds

Type	Suitability with bituminous / asphaltic surfacing		Base type
	Wearing surface	No wearing surface	
C5 hydrocarbon resin compound conforming to AS 3799 Class B and with no aromatic hydrocarbon additions. *	Yes	Yes	
Water borne hydrocarbon resin or styrene butadiene resin (SBR) conforming with AS 3799 Class Z. *		Yes	JRCP
Bitumen emulsion grade CRS/170 conforming to AS 1160. *	Yes	Yes	JRCP
White pigmented wax emulsion Class A Type 2. *		Yes	PCP, JRCP
Debonding treatment bitumen seal with 5-7mm aggregate	Yes	Yes	PCP, JRCP

Notes:

Conform to AGPT04C Table 6.1.

* For paving in NSW from November to March, use a Type 2 compound which contains a titanium dioxide reflective pigment. At all other times, use a Type 1-D compound.

3.9 CONCRETE QUALITY REQUIREMENTS

General

Standard: To AS 3600 and AS 1379.

Concrete properties

Requirements: Conform to the **Concrete properties table**.

Concrete properties table

Properties	Quality requirement
Minimum cement content	270 kg/m ³ of concrete
Minimum flyash content	50 kg/m ³ of concrete
Minimum compressive strength at 28 days (AS 1012.9)	35 MPa
Drying shrinkage of nominated mix (AS 1012.13) - at the nominated slump ± 10 mm	< 450 $\mu\epsilon$ after 21 days of air drying average of readings within 5% of the median of the three readings
Consistency (Slump to AS 1012.3.1)	30 mm - 40 mm for mechanically placed concrete 55 mm - 65 mm for hand placed concrete
Air content (To AS 1012.4.2)	4% - 7% when discharged from the transport vehicle ready for placement
Minimum relative compaction (To AS 1012.12.2)	98%

Testing of concrete properties

Sampling and testing for compressive strength: To **TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH**.

Testing for drying shrinkage: To AS 1012.13 and the following:

- Perform shrinkage tests on every 150 m³ of concrete poured or one day's production.
- Average: Take the drying shrinkage at the nominated slump ± 10 mm as the average of all readings within 30 $\mu\epsilon$ of the median value.

Testing for consistency:

- Slump: To AS 1012.3.1.
- Vebe time reading for slipform concrete mix: Maximum of 3 seconds at the nominated slump less 10 mm when tested to AS 1012.3.3.

Testing for air content: To AS 1012.4.2. If the measured air content is not within the limits of the **Concrete properties table**, make one repeat test immediately from another portion of the sample. If the value from the repeat test falls within the specified limits, the sample is acceptable.

Testing for compaction: To **RELATIVE COMPACTION OF CONCRETE**.

4 EXECUTION**4.1 PROVISION FOR TRAFFIC****General**

Requirement: Conform to *1101 Control of traffic*.

4.2 SITE ESTABLISHMENT**Subbase survey**

Measure the base invert levels: If the underlying layer is required to be spray sealed, take levels on the top of the seal and after removal of foreign or loose material such as aggregate.

Method: Report levels to the nearest mm and survey on 5.0 m grid on a plan area.

Requirement: Submit a work-as-executed survey of the subbase to the full extent of the works. Highlight any locations where the actual level is higher than the design levels.

Submission type: **HOLD POINT**.

Non-conforming levels: In the case of non-conforming levels, locally redesign the pavement levels as directed by the Superintendent.

4.3 TRIAL CONCRETE BASE

Construction

Trial section requirement: Before starting the paving works, construct a trial section of concrete base including texturing, curing, sawing joints and placement of the tie bars and dowels.

Trial section: Construct as follows:

- Incorporate the trial section into the concrete base works.
- Construct separate trial sections for each concrete base type.
- Length:
 - . 50 to 100 m for mechanical placing.
 - . 15 to 50 m for manual placement.
- Width: Same as proposed for the work.

Materials and methods: Construct the concrete base using the materials, concrete mix, equipment and methods for the entire works.

Trial results: Provide test results to demonstrate conformance for compressive strength, compaction and thickness.

Inspection: Notify the Superintendent for inspection of the completed trial concrete base.

Approval: Obtain approval of the trial section before starting the remaining works.

Inspection type: **HOLD POINT**.

Deficient trial section

Assessment: If there are deficiencies in the trial concrete base, review the method, equipment, materials and personnel and submit a report.

Submission type: **HOLD POINT**.

Non-conforming trial section

General: If the trial concrete base is not approved, conform to the following:

- Submit changes proposed for construction of the new trial section including the equipment, materials, mix, plant or rate of paving.
- Remove the non-conforming base and make good any damage caused by such removal.
- Construct the new trial concrete base in conformance with **REMOVAL AND REPLACEMENT OF CONCRETE BASE**.

Inspection type: **HOLD POINT**.

4.4 SLAB ANCHORS

General

Location: Construct anchors normal to the control line, to the dimensions and at the locations shown on the drawings and extended over the full width of the base.

Spacing: Place the associated transverse expansion joints at minimum distance of 2 m to from other transverse joints.

Inspection type: **WITNESS POINT**.

Excavation

General: Remove all loose material, trim the vertical faces and compact the bottom of the trenches.

Inspection type: **HOLD POINT**.

Spoil: Dispose excavated material at approved locations.

Adjacent to flexible pavement: If a slab anchor is required at the junction of an existing flexible pavement, make a straight sawcut to the full depth of the asphaltic concrete or bituminous seal in the flexible pavement along the joint line.

Remediation: Make good any disturbance or damage to the flexible pavement.

Sub-soil drains: Provide a subsoil drain at the bottom of the trench to *1172 Subsoil and foundation drains*.

Construction

Method: Produce, transport and place concrete for slab anchors to conform to the requirements for hand-placed base concrete.

Sequence: Pour slab anchors separately from the base slabs up to the top surface of the subbase.

Transverse isolation joint: Provide a transverse isolation joint on the downhill side of the slab anchor.

Steel reinforcement: As shown on the drawings.

Bridge approach slabs

Details: If not in the bridge contract, construct bridge approach slabs at bridge abutments to the dimensions and details shown on the drawings and to conform to the requirements for base concrete.

4.5 INSTALLATION OF STEEL REINFORCEMENT

General

Standard: AS 3600, clause 17.2.

Diameter, shape, dimensions and lapped splices: As shown on the drawings.

Lapped splices: The ends of the bars forming a lapped splice must be either welded or securely tied together in at least 2 places.

Storage: Store under a waterproof cover to prevent damage due to exposure and support clear of the ground.

Placing and cover requirements

Inspection: Submit for approval the placement and fastening of reinforcing steel before concrete placement. Allow adequate time in giving notice of inspection for all corrective works to be completed before placing concrete.

Inspection type: **HOLD POINT**.

Position: Conform to the following:

- Secure the reinforcement in position by blocking from the forms, by supporting on bar chairs and by tying together.
- Provide these supports in a regular grid not exceeding 1.0 m. Do not use wooden supports or pieces of aggregate.

Chair spacing: Make sure layout and spacing of chairs provide proper support with permanent deflection or displacement of the reinforcement no more than 2mm during placing and consolidation of the concrete.

Minimum bottom cover: 50 mm or as shown on the drawings.

Longitudinal steel: Conform to the following:

- Placement: Place longitudinal steel on top of transverse steel.
- Minimum top cover: 70 mm or as shown on the drawings.

Tack welding: To AS/NZS 1554.3 only in approved locations.

Tie bars: Conform to with the following:

- Place tie bars in their documented location. Do not place tie bars through the finished upper surface of the pavement.
- Place tie bars either manually before placement of concrete or by an automatic tie bar inserter on the mechanical paver.
- Provide details of the proposed method of tie bar insertion.

Dowelled joints: Conform to the following:

- Place dowelled joints, parallel to the pavement surface and normal to the line of the joint, or as shown on the drawings.
- Install dowels ahead of paving by an approved dowel support assembly.

- Coat one end of each dowel on the same side of each joint for a distance of $(L/2 + 25 \text{ mm})$ with two coats of bitumen emulsion (or one coat of bitumen) and sanded to make sure free movement of the concrete base slab with temperature variations.
- Provide a preformed cap at the coated end to provide a minimum of 30 mm clearance for movement.
- Dowel ends: Check dowels before placement and make sure the dowels are straight and free of irregularities including burrs and protrusions.

4.6 PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE

General

Standard: To AS 1379.

Concrete production and transport

General: Submit the proposed work methods for the following:

- Handling, storing and batching of materials for concrete.
- Monitoring and measuring the constituent materials for concrete.
- Mixing and transport of concrete.

Submission type: **HOLD POINT**.

Concrete delivery

Delivery dockets: For each batch of mix, keep record of the following delivery information:

- Supplier name and location.
- Volume of material supplied.
- Product constituents.
- Dispatch time and date.

Inspection type: **WITNESS POINT**.

Delivery time limits: After addition of the cement to the aggregate, concrete to be incorporated into the works within:

- 90 minutes if transported by truck mixer or agitator.
- 60 minutes if transported by non-agitating trucks.

4.7 PLACING AND FINISHING

General

Subbase surface condition: Clean and free of loose or foreign matter and prepared to *1132 Lean mix concrete subbase*.

Equipment and methods

Proposal: Submit 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.

Submission type: **HOLD POINT**.

Notice: Give notice before construction of the concrete base on any section of work including the trial concrete base.

Inspection type: **WITNESS POINT**.

Consistency

Requirement: Supply concrete of a homogeneous, dense and non-segregated mass with low bleeding. If bleed water flows over the slab edge, cease paving until the mix is redesigned and approved.

Concrete edges: Construct edges with no sag or tear.

Testing: Perform slump tests on each truckload of concrete.

Timing of testing: Check the consistency of the concrete within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, also check the consistency immediately before discharge.

Slump tolerances:

- Mechanically placed concrete: ± 10 mm.
- Hand placed concrete: ± 15 mm.

Equipment: Provide all equipment, materials and labour for consistency testing.

Test results: Provide all consistency test results.

Inspection type: **WITNESS POINT.**

Ambient conditions

Air temperature: If the air temperature in the shade is below 10°C or above 30°C, protect the concrete from cold or hot weather. Provide detailed proposals for protection of concrete in cold or hot weather.

Concrete temperature limits: 5°C to 35°C.

Rain: In case of rain, protect the concrete from rain damage and provide detailed proposals for protection procedures.

Inspection type: **WITNESS POINT.**

Records: Measure and record concrete temperature and wind velocity at the point of concrete placement throughout the course of the work.

Equipment: Provide and maintain all equipment necessary for such measuring and recording.

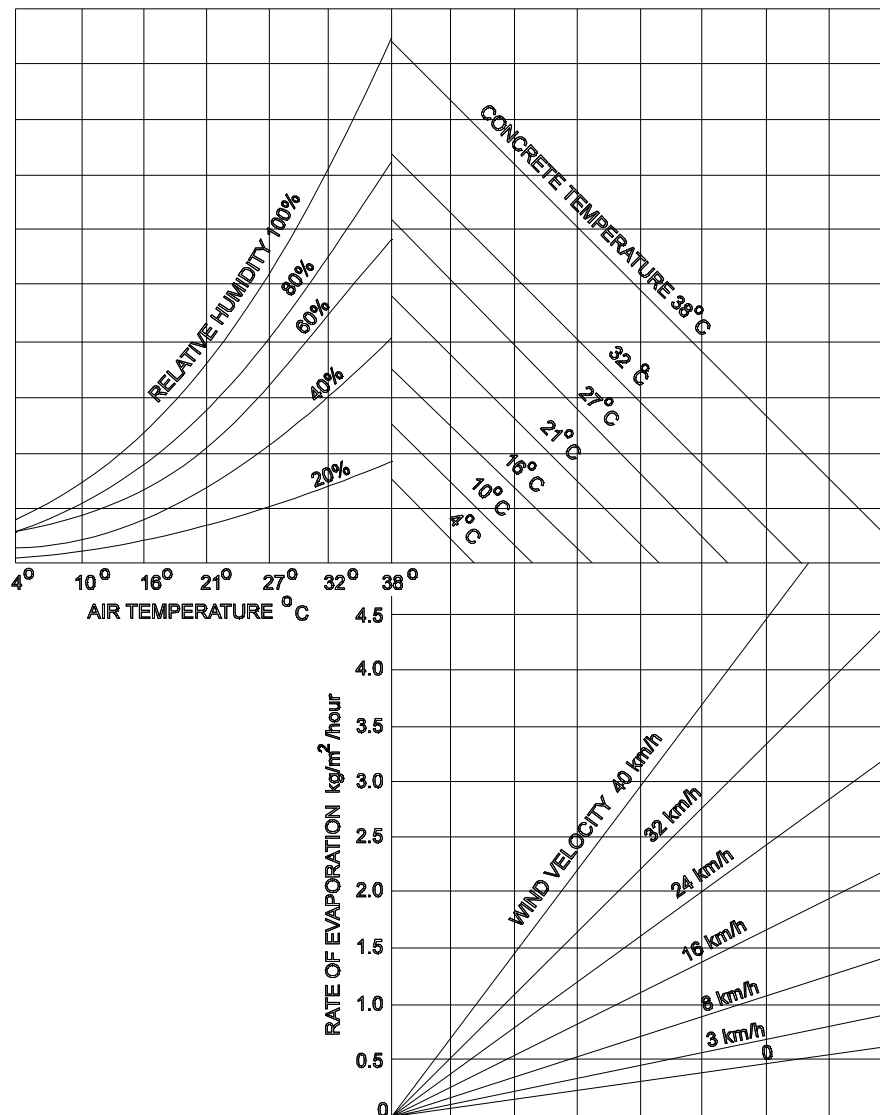
Evaporation and moisture loss

Evaporation limit: Take precautionary measures when the value of rate of evaporation as determined from the **Rate of evaporation graph**, exceeds 0.50 kg/m²/hr. Obtain approval of the methods used to prevent moisture loss or cease work.

Inspection type: **WITNESS POINT.**

Evaporation retarder: If it is proposed to use an evaporation retarder to prevent excessive moisture loss, apply by fine spray after all finishing operations are complete, except minor manual bull-floating. Re-application of evaporation retarder after level floating may be directed as required.

Rate of evaporation graph



Using the Rate of evaporation graph

Information: The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity on the rate of evaporation of water from freshly placed and unprotected concrete.

Example: To determine the evaporation rate from the graph using air temperature at 27°C, relative humidity at 40%, concrete temperature at 27°C and a wind velocity of 26 km/h:

- Enter the graph at the air temperature of 27°C.
- Move vertically to intersect the curve for relative humidity encountered 40%.
- Move horizontally to the respective line for concrete temperature of 27°C.
- Move vertically down to the respective wind velocity curve and interpolate for 26 km/hour.
- Then move horizontally to the left to intersect the scale for the rate of evaporation.
- The rate of evaporation would be 1.6 kg/m²/hour.

Paving in general

Concrete finish: Dense and homogeneous with a surface exhibiting low porosity.

Continuity: Once spreading starts, maintain a continuous concrete paving operation.

Disruptions: If disruptions occur, form a construction joint before the restart of paving operations.

Inspection type: **WITNESS POINT.**

Non-monolithic concrete: If subsequent testing at the location of an interruption indicates the presence of non-monolithic concrete, remove and replace such concrete to

REMOVAL AND REPLACEMENT OF BASE.

Mechanical paving

Paver machine: Conform to the following:

- A self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width.
- 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.
- Include an automatic control system with a sensing device to control line and level to the specified tolerances.
- Able to spread the mix uniformly and regulate the flow of mix to the vibrators without segregation of the components.
- Contain internal vibrators capable of compacting the full depth of the concrete.
- Contain an adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capable of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

Concrete finish: Spread, compact, screed and finish the freshly placed concrete with the mechanical paver to minimise finishing by hand.

Spreading device: Use a separate device ahead of the mechanical paver as follows:

- To transport and spread concrete uniformly over the full pavement width.
- Without disturbing the reinforcement or its supports.
- Without segregating or otherwise adversely affecting the concrete.

Supporting surface: Provide smooth and firm supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train.

Hand placing

Restriction: Use hand placement only in areas where mechanical placement is not practical. Obtain approval before starting the works.

Formwork: Conform to the following:

- Designed and constructed for removal without damaging the concrete.
- True to line and grade.
- Braced to support wet concrete.
- Mortar tight.
- Prevents adhesion of concrete to the forms.

Placing in forms: Deliver concrete in agitator trucks and deposit uniformly in the forms without segregation.

Compaction: Compact the concrete by poker vibrators and by two passes only of a hand-guided vibratory screed traversing the full width of the slab on each pass.

Build-up: Prevent any build-up of concrete between the forms and vibratory screed.

Alignment and surface tolerances

Horizontal tolerances at outer edges: ± 30 mm.

Thickness: -0 mm/ +10 mm.

Surface levels: Conform to the following:

- Deviation from the design levels: +10 mm / -0 mm
- Deviation from a 3 m straightedge, laid in any direction: 5 mm.

Ponding: Not acceptable.

Assessment of base thickness

Base survey: Perform survey runs to the nearest 5mm, taken on a 5m grid on the plan area and compare with the subbase survey to **SITE ESTABLISHMENT, Subbase survey.**

Alternative methods:

- Concrete cores.
- Measurement at the pavement edge.
- Audit checks: Obtain approval to use a suitable probe whilst the concrete is being placed measured to the nearest 5 mm.

Inspection type: **WITNESS POINT**.

Non-conformance

Non conforming thickness: If thickness is 10 mm or more below the specified thickness, remove and replace the base to **REMOVAL AND REPLACEMENT OF BASE**.

Thickness 10 mm or less below: If the thickness is 10 mm or less below the specified thickness and represents isolated sections within a lot, comprising less than 5 % of the area of the lot, conform to **DEDUCTIONS**.

Odd-shaped and mismatched slabs

Definitions:

- Slab: A portion of concrete base bounded by joints or free edges.
- Slab dimensions: The average dimensions measured normal and parallel to the longitudinal joints.
- 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.
 - . Slabs containing blockouts for drainage structures will be considered as odd-shaped.
- Mismatched slabs: Where any joint meets a slab and is not continued across that slab.

Reinforcement for odd-shaped and mismatched slabs: Minimum SL 82 reinforcing fabric at top layer or as shown on the drawings. Place fabric clear of all transverse and longitudinal joints by 50 mm to 100 mm.

Terminal slabs

Placement location: Construct terminal slabs adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Construct terminal slabs to the dimensions and details shown on the drawings.

Surface texture

Longitudinal texture: Texture surface with a hessian drag or approved equivalent. Adjust length of drag to achieve required texture.

Transverse texture: Conform to the following:

- As soon as possible after longitudinal texturing, transversely texture the surface of the freshly placed concrete.
- Use texturing equipment with rectangular-shaped tynes of flat spring steel, approximately 0.6 mm thick.
- Width of the tynes: 3 mm.
- Spacing of tynes: Randomly spaced between 10 mm and 21 mm, with an average spacing of 13-14 mm.

Brush or comb width: Minimum 750 mm. Provide for downward adjustment to compensate for wear.

Submission: Submit details of the proposed texturing device and demonstrate the method proposed to achieve the required texture.

Submission type: **HOLD POINT**.

Average texture depth: When tested to RMS Test Method T240, conform to the following:

- Longitudinal: 0.55 ± 0.05 mm.
- Transverse: 0.65 ± 0.05 mm.

Machine texture: For paving widths exceeding 4.5 m, perform texturing using a machine spanning the concrete slab and guided, with regard to both level and direction, by the rails, in the case of fixed-form construction, or by the paver guide wires.

Alternative: Where an asphalt surfacing is documented over the concrete base, or as directed, texture the surface with a fine broom or hessian-drag.

Remedial grooving: Transversely saw cut groove areas with less than the allowable average texture depth.

Saw-cut grooves: Conform to the following:

- Width: 3 mm.
- Depth: 3 mm.
- Spacing of grooves: Randomly spaced between 10 mm and 18 mm, with an average spacing of 12-15 mm.
- Procedure: Remove grooving residue from pavement and do not allow into drainage system or across lanes which are in public use.

Traffic considerations

Traffic restrictions: Do not allow traffic or construction equipment, other than that associated with testing, sawcutting, groove cleaning or joint sealing, 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: Traffic management required to effect the traffic restrictions to conform at a minimum with *1101 Control of traffic*.

Additional measures: If such measures are warranted due to specific requirements provide additional traffic management measures either pedestrian or vehicular in excess of that specified.

Inspection type: **WITNESS POINT**.

4.8 JOINTS

Location

General: Provide joints at locations indicated on the drawings or as directed by the Superintendent. Inspection type: **WITNESS POINT**.

Inspection of joints

Timing: Inspect each joint within 24 hours of its construction.

Sawcutting

Sequence: Saw joints by a two-cut operation as follows:

- Initial cut: 3 mm wide x 0.4(D) deep, where (D) is the full depth of the base slab.
- Widening cut: 7 mm wide x 35 mm below the surface of the base slab.

Timing: Between 6 hours and 24 hours after initial paving to avoid excessive ravelling of aggregate adjacent to the cut.

Equipment: Use equipment and type of blade suited to the hardness of the concrete being sawn. Have standby equipment available on site to maintain continuity of sawing.

Tolerances: Maximum 10 mm deviation from a 3 m straight edge.

Ravelling: Conform to the following:

- The surface of the transverse contraction joint is < 5 mm of vertical or horizontal edge ravelling.
- The length of edge ravelling is < 300 mm in any 1 m length of joint on each edge.
- Saw debris is washed from the joint and pavement immediately after sawing.

Non-conformance: Perform corrective actions if there are non-conforming sawcuts.

Cleaning of sawcut: Immediately after any sawing, clean the sawcut of all debris.

Method of cleaning: A pressurised liquid or liquid/air jet. Do not gravity feed cleaning liquid from tanks.

Neoprene compression sealants

Installation: Conform to the following:

- Coat the neoprene sealant with a clear or concrete-coloured lubricant compound approved by the Superintendent and conforming to ASTM D2835.
- Insert the sealant into the joint using equipment which does not damage the sealant during its insertion.
- The maximum increase in length of the sealant after installation: 5% of original length.
- Reject any sealant exceeding 5 % extension.
- Locate the sealant in the transverse contraction joint in the design orientation without twist or buckle.
- Continuity between formed longitudinal joints: Where discontinuity occurs, angle butt join the sealant by an approved method.

Silicone sealants

Preparation: Conform to the following:

- Clean out any foreign or disturbed material from the joint and from the top of the backer rod by dry air jet.
- Depress the backer rod to the depth such that the bottom of the silicone sealant is at the planned location and of the correct shape.
- If the backer rod is damaged in any way replace it for the full length of the joint.

Sealant installation: To the manufacturer's recommendations.

Treatment before asphalt overlay: If asphaltic surfacing over the concrete base is documented provide only the initial 3 mm wide saw cut and fill with silicone joint sealant.

Temporary sealing

Installation timing: Immediately after cleaning sawcut(s).

Temporary sealing material alternatives:

- Continuous closed-cell polyethylene backer rod of diameter shown on the drawings or as required by the Superintendent. Install the top of the sealant neither higher than nor more than 10 mm below the concrete surface and pass over any longitudinal joint seal already in place.
- Continuous UV-stabilised PVC spline 5 ± 1 mm in diameter installed at the top of the saw cut, passing under any sealant inserted in longitudinal sawn joints.

Maximum increase in length of a temporary sealant after installation: 10% of the original length.

Permanent sealing

Timing: Within ten days of initial sawing and immediately on removal of the temporary sealant, place the permanent sealant in the joint. The permanent sealant may be either a neoprene compression seal or an in situ cast silicone sealant.

Method of sealing: Submit the method for permanent sealing 4 weeks before sealing works.

Submission type: **HOLD POINT.**

Top of the sealant: Between 5 mm above and 7 mm below the surface of the base.

Overlay any longitudinal sealants.

Transverse construction joints

Requirement: Conform to the following:

- Provide only at discontinuities in the placement of concrete determined by the paving operations.
- Do not place closer than 1.5 m to a transverse contraction joint. The Superintendent may authorise a change in the spacing and/or skew of transverse contraction joints to make sure that sufficient clearance is obtained.
- Construct normal to the control line and to the dimensions and details shown on the drawings.
- Tie bars: To conform to **STEEL REINFORCEMENT.**
- Make smooth across the joint before texturing.

- Do not to deviate from a 3 m straightedge placed along the joint by more than 10 mm.
- Align joints so that the skew angles of odd-shaped slabs is not increased.

Adjoining edge: Before placing adjoining concrete roughen the surface of the concrete to expose coarse aggregate. Wash clean the roughened surface and the projecting reinforcement and remove all excess water and loose material.

Transverse expansion joints

Extent: Continuous across the full width of the base.

Method and sealant: As shown on the drawings.

Transverse contraction joints

Extent: Continuous across the full width of the base.

Location: Normal to the control line and as shown on the drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.

Method: Sawn or as shown on the drawings.

Plastic joint: If the concrete base is to be overlaid with an asphalt wearing course, the Superintendent may approve the joint to be formed with a suitable plastic joint inducing system.

Transverse isolation joints

Location: At bridge approach slabs and at slab anchors where shown on the drawings and where directed.

Construction: Continuous across the full width of the base normal to the control line and as shown the drawings.

Spacing: 2.0 m minimum to other transverse joints.

Changes: A change in the spacing and/or skew of adjacent transverse contraction joints to make sure that sufficient clearance is obtained may be approved or directed.

Joint filler: Preformed jointing material of bituminous fibreboard or equivalent joint sealant in conformance with the **Silicone joint sealant requirements table**.

Installation: In conformance with the drawings and the manufacturer's recommendations except that reference to backer rods does not apply.

Tolerance: 10 mm maximum deviation from a 3 m straightedge placed along the joint.

Longitudinal isolation joints

Location: Provide longitudinal isolation joints where shown on the drawings and where directed by the Superintendent.

Tolerances:

- 10 mm maximum deviation from the designed position at any point.
- 10 mm maximum deviation from a 3 m straightedge.

Filler and sealant: Install preformed jointing material of bituminous fibreboard or as shown on the drawings. Install to conform to the drawings and the manufacturer's recommendations except that reference to backer rods does not apply.

Longitudinal tied joints

Location: As shown on the drawings or as directed, parallel to the control line.

Method: Form or induce either by sawing or by machine insertion of a crack inducer ribbon.

Tie bars: Conform to the following:

- 12 mm diameter deformed steel bars Grade 500N, 1 m long and inserted to conform to **INSTALLATION OF STEEL REINFORCEMENT, Placing and cover requirements**.
- Locate and space as shown on the drawings.
- Omit tie bars within 500 mm of a transverse joint.
- Use hydrophilic epoxy resin when installing tie bars in existing concrete. Use the setting system to develop an anchorage strength at least 85% of the yield strength of the bar.

Tolerances:

- 10 mm maximum deviation from the designed position at any point.
- 10 mm maximum deviation from a 3 m straightedge with due allowance for any planned curvature.

Corrugated joint face: If the longitudinal tied joint is formed or slipformed, corrugate the joint face to conform to the details shown on the drawings.

Isolation joint: If the multi-lane width is greater than 18 m, construct a longitudinal isolation joint at each location shown on the drawings and to conform to **Longitudinal isolation joints**.

Asphalt surface: Provide longitudinal tied joints where asphalt surfacing is intended.

Sawn-induced joints

Location: Provide sawn longitudinal tied joints as shown on the drawings.

Sawcutting: Conform to **Transverse contraction joints**.

Joint cleaning: Remove all debris within 24 hours of sawing.

Sealant preparation: Insert a neoprene backing rod as shown on the drawings.

Sealant insertion: Conform to the following:

- Coat the sealant with lubricant-adhesive compound, coloured to approximately match the pavement.
- Insert the sealant into the groove using equipment which will not damage the sealant.
- Maximum increase in length of the sealant after installation: 10% of the original length.

Joints in sealant: Keep joints in the sealant to a minimum and cement together using an adhesive to the manufacturer's recommendations.

Top of the sealant: Between 5 mm above and 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: As shown on the drawings.

Insertion: By machine, so that the top of the ribbon does not protrude above the surface of the base, nor lie below the surface of the base by more than 3 mm.

Requirements: Provide the following:

- Inducer ribbon thickness: 0.5 mm minimum.
- Place it within 5° of the vertical plane.
- Reject 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.

Ribbon ends: Splice ribbon ends for continuity of the induced joint.

Asphalt surfacing over sawn longitudinal tied joints: Depress the sealant to a depth below the concrete surface not less than 10 mm and, following thorough cleaning, seal the joint flush with the concrete surface with bituminous rubber compound, compatible with the narrow groove.

Kerb and/or channel (gutter)

Application: Kerbs and/or gutters constructed within the shoulder of a concrete base.

Location: Construct the longitudinal joint parallel to the control line (parallel to the centre line for ramps) and to the dimensions shown on the drawings.

Construction: Form directly onto the concrete subbase. Cast either integrally with the concrete base or separately.

Face of joint: Do not scabble the face and do not seal the joint.

Tie bars: If constructed separately, tie kerbs and/or gutters to the concrete base by 12 mm diameter deformed steel tie bars Grade 250N or 500N, 1000 mm long at 1 m centres.

Insert the tie bars in conformance with the drawings and **INSTALLATION OF STEEL REINFORCEMENT, Placing and cover requirements**.

Tolerances: Construct the line of the longitudinal joint to the tolerances to conform to

Longitudinal tied joints.

Kerb and/or channel (gutter): Construct to conform to *1121 Open drains, including kerb and channel (gutter)* regardless of method of construction. Provide concrete with strength greater than 35 MPa.

Longitudinal joint with kerb and/or channel (gutter)

Tie bars: If the kerb and/or gutter is not constructed integrally with the concrete base, insert tie bars in conformance with the drawings and **Placing and cover requirements**.

Face of joint: Do not scabble the face and do not seal the joint.

4.9 CURING

Application method

Fine spray: Apply the curing compound using a fine spray and as follows:

- For transversely tined surfaces: In two applications:
 - . First application: Immediately following texturing.
 - . Second application: Fifteen to thirty minutes later.
- At the rate stated on the certificate of conformance or at 0.2 litres/m², whichever rate is the greater.
- Apply bitumen emulsion at a minimum rate of 0.5 litres/m².
- Apply the curing compound with a mechanical sprayer, spraying transversely or longitudinally, with a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.
- Use a sprayer which incorporates a device for continuous agitation and mixing of the compound in its container during spraying. Do not allow any dripping of the curing compound on the concrete surface, after shut-off of the spray nozzles.
- For hessian-dragged surface: Immediately following texturing at the rate stated on the Certificate of Conformance or 0.2 litres/m², which rate is the greater. Apply bitumen emulsion at a minimum rate of 0.5 litres/m².

Application time: Apply the curing compound immediately after the surface is free of bleed water, or as directed.

Application rate: Calculate the application rate. Check the amount of curing compound falling on three felt mats.

Inspection type: **WITNESS POINT**.

Hand spraying: For the sides of formed slabs and for small areas where a mechanical means of distribution cannot be used, spray the compound by hand lance at a rate 25% higher than that used on the main base.

Curing membrane: Conform to the following:

- Maintain the curing membrane intact for seven days after placing the concrete.
- Make good any damage to the curing membrane by handspraying the affected areas.

Equipment on site: Keep equipment and materials for curing operations on site at all times during concrete placement and curing.

Plant unavailable: If the mechanical sprayer becomes inoperable, cease concrete paving by mechanical means and do not restart until the mechanical sprayer becomes fully operable again.

4.10 CONCRETE CRACKING

Planned cracks

Definition: Full depth transverse cracks over the full width of a paving run.

Remedial work: Not required.

Unplanned cracks

Treatment: If unplanned cracking occurs, immediately implement treatment as follows:

- Fill cracks whose width exceeds 0.3 mm with a suitable low viscosity penetrating epoxy resin.

- Cross stitch individual longitudinal cracks which are greater than 300 mm long and which lie within 1.0 m of an edge or longitudinal joint, 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, remove that area of concrete base and replace base to conform to **REMOVAL AND REPLACEMENT OF BASE**.

Exception: Do not treat unplanned cracks not covered in items above.

4.11 TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH

Sampling

Method of sampling: AS 1012.1.

Sampling locations: Take samples from the delivery vehicles, or from concrete deposited ready for placement.

Minimum frequency of sampling: To AS 1379 and the following:

- At least one sample for the concrete being placed at one time.
- At least one sample for each lot.

Inspection type: **HOLD POINT**.

Making and curing of testing specimens

Standard: AS 1012.8.1.

Moulding: Mould at least two test specimens from each sample. Supply the number of moulds required for the documented frequency of testing.

Curing: Carry out initial curing on site between 18 to 36 hours.

Identification: Inspect, cap and mark specimens for identification before sending to testing laboratory.

Transport: Do not transport specimens within 3 hours of being cast.

Testing

Testing of specimens: Test each specimen for compressive strength to AS 1012.9.

Test authority: NATA registered laboratory.

Compressive strength of each sample: Average compressive strength of the two specimens taken from the sample and tested at the same age.

Age of specimens: 28 days.

Adjustment due to age: If specimens are tested at more than 28 days after moulding, obtain the equivalent 28 day compressive strength by dividing the test compressive strength by the factor shown in the **Concrete age conversion factors table**. For intermediate ages determine the factor by interpolation.

Concrete age conversion factors table

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

Acceptance criteria

Assessment process of test results: Project assessment to AS 1379.

Reports and records of test results: To AS 1012. Submit test results and keep copies on site.

Submission type: **HOLD POINT**.

Average compressive strength of samples representing the lot: To **CONCRETE QUALITY REQUIREMENTS, Compressive strength**.

Non-conforming concrete: Perform coring test to **Testing by specimens cut from the work**

Testing by specimens cut from the work

General: If the concrete base strength is non-conforming, request permission to core the in situ concrete base for testing of the actual compressive strength representing the particular lot.

Testing authority: NATA registered laboratory nominated by the Contractor.

Specimens' characteristics:

- Shape: Cylindrical cores.
- Preferred dimension of cores: 100 mm diameter.
- Minimum dimension of cores: 75 mm diameter or two and one half times the nominal size of the coarse aggregate, whichever is the greater.
- Tolerance in uncapped state: 5 mm.
- Minimum length: Same as the core diameter.

Frequency of coring: One core for each lot or one core for the area of concrete base placed between any two consecutive construction joints, whichever is the lesser.

Nominate the lot represented by each core at the time of sampling and record before testing.

Coring procedure: Carry out core cutting in the presence of and at the locations nominated by the Superintendent.

Inspection type: **WITNESS POINT**.

Curing of cores: Despatch cores to arrive at the testing laboratory within 24 hours of the core being cut from the concrete base. Start wet curing within 24 hours of the receipt of the cores.

Test method: To AS 1012.14 and the following:

- Adjust the test strength determined for form by a factor to conform with **Core strength factor table**.
- Only use wet conditioning.

Core strength factor table

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
Interpolate factors for intermediate form ratios.	

Acceptance criteria for cored concrete

Equivalent 28 days compressive strength of the specimens cut from work: To **CONCRETE QUALITY REQUIREMENTS, Compressive strength**.

Test results: Submit the test results for approval.

Submission type: **HOLD POINT**.

Non-conforming concrete: To **REMOVAL AND REPLACEMENT OF CONCRETE BASE.**

Remedial work after coring

Restoration method: Clean all core holes taken in the base and fill 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 of the restored hole: Similar to the surrounding surface in texture and colour.

Inspection type: **WITNESS POINT.**

Guarantee: Guarantee the integrity of the core for a period of 6 months after the completion of works and passage by traffic. Make good any core sites damaged by traffic within the warranty period.

4.12 RELATIVE COMPACTION OF CONCRETE

Testing for relative compaction

Test specimens: Cut cores from the work to provide test specimens for determining the relative compaction of the concrete placed in the work.

Depth: Cut cores from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions:

- The requirement that the concrete is at least 28 days old before the core is removed will 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 minimum nominal diameter of the cores: 75 mm.

Location of cores: Select the location of coring to exclude joints, steel reinforcement or tie bars from the core. Select locations which will make sure that the whole of the concrete base conforms to the minimum requirements of the Worksection.

Marking: Mark cores for identification.

Storage: Place cores immediately either in a tank of lime saturated water or in an individual plastic bag, sealed to prevent water loss. Keep cores stored in plastic bags in the shade.

Temperature control: Do not subject cores to temperatures in excess of either ambient temperature or 23°C whichever is the higher, and to temperature < 10°C, until delivered to the testing laboratory.

Frequency of coring: Conform to the following:

- Minimum frequency: Take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded to conform to **Making and curing of testing specimens.**
- Hand placed concrete: Take two cores to represent a section of work.
- A section of work is confined between construction joints.
- Hand-worked or placed base that is cast with machine-placed concrete and not separated from the machine-placed concrete is deemed to be part of the machine-placed concrete, and to be cored and tested as part of the machine-placed concrete base.

Curing: The core specimens to be wet conditioned to AS 1012.14 for not less than 24 hours immediately before testing for compaction.

Testing: Determine the mass per unit volume of specimens at age 7 of days.

Relative compaction: The relative compaction of a core specimen is 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 7 day compressive strength from the same lot of concrete base. Mass per unit volume of both standard cylinders and cores to AS 1012.12.2.

Non-conformance: If the relative compaction is less than 98 %, remove and replace the lot represented by the core to conform to **REMOVAL AND REPLACEMENT OF BASE**.

Inspection type: **WITNESS POINT**.

4.13 REMOVAL AND REPLACEMENT OF BASE

General

Replacement method: Conform to the following:

- Rejected base, which extends more than 25 m longitudinally: Replace by mechanical means unless the slabs are odd-shaped or mismatched.
- Replace full slab widths between longitudinal joints and/or external edges.
- Approval: At least seven days before the base removal, submit details of the proposed removal methods.

Submission type: **HOLD POINT**.

Disposal: Dispose the removed base slabs at locations acceptable to the Superintendent.

Transverse sawcut

Location:

- At each end of the section of base to be removed, for the full depth of the base layer.
- Normal to the control line and not closer than 1.5 m to an existing contraction joint in the base.

Over sawing: Do not oversaw into the adjoining base or underlying subbase.

Longitudinal sawcuts

Location:

- Along existing longitudinal joints to define the edges of the base section for removal.
- Not extending more than 250 mm past the transverse sawcut at each end of the section to be removed.

Over sawing: Do not oversaw into the adjoining base or underlying subbase.

Replacement of base

Subbase preparation: Before construction of the replacement base, prepare and debond the subbase in conformance with *1132 Lean mix concrete subbase*.

Replacement requirements: Conform to this worksection, including the following:

- Deeply scabble the joint faces on the adjoining slab at the transverse sawcuts, except the top 25 mm which is to be left smooth.
- Provide tie bars to form a transverse construction joint in conformance with **JOINTS, Transverse construction joints**.
- Provide transverse contraction joints continuous across the full width of the base containing the replaced section.
- Seal the length of the joint across the full width of the base with the same sealant as in adjacent work and in conformance with **JOINTS, Transverse contraction joints**.
- Deeply scabble the lower two-thirds of the depth of the longitudinal joint faces and remove loose concrete.
- Attach a crack inducer ribbon to the surface of any formed longitudinal joint in the replacement base and provide tie bars to form a longitudinal tied joint in conformance with **JOINTS, Longitudinal tied joints**.
- Set tie bars placed into hardened concrete in a hydrophilic epoxy resin. The setting system used to develop an anchorage strength at least 85 % of the yield strength of the bar.

Traffic restrictions: Do not allow traffic or construction equipment other than that associated with testing, sawcutting, groove cleaning or joint sealing 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.

4.14 LIMITS AND TOLERANCES

Application

Summary: The limits and tolerances applicable to this worksection are summarised in

Summary of limits and tolerances table.

Summary of limits and tolerances table

Activity	Limits/Tolerances	Worksection clause/ subclause
Water		
Chloride ion	Maximum 300 ppm	WATER, General
Sulfate ion	Maximum 400 ppm	WATER, General
Aggregates		
Fine aggregate - Grading	To Fine aggregate grading table	AGGREGATES, Fine aggregates
Coarse Aggregate - Properties	To Coarse aggregate properties table	AGGREGATES, Coarse aggregates
Concrete quality		
Cement content	Minimum 270 kg/m ³	CONCRETE QUALITY REQUIREMENTS, Cement and flyash
Flyash	Minimum 50 kg/m ³	
Compressive Strength	The minimum 28 day compressive strength: 35 MPa.	CONCRETE QUALITY REQUIREMENTS ,Drying Shrinkage
Shrinkage	Not to exceed 450 µε after 3 weeks of air drying.	
Slump	30 mm - 40 mm for mechanically placed concrete 55 mm - 65 mm for hand placed concrete Vebe time reading – maximum of 3 seconds	CONCRETE QUALITY REQUIREMENTS , Consistency
Air content	4% to 7% when discharged from the transport vehicle ready for placement.	CONCRETE QUALITY REQUIREMENTS , Air content
Concrete mixing and transport	After addition of cement to the aggregate, concrete to be incorporated into the work within: - 90 minutes where transported by truck mixer or agitator. - 60 minutes where transported by non-agitating trucks.	PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE, Concrete delivery
Concrete placing	Protect the concrete when it rains or when the air temperature in the shade is below 10°C or above 30°C. The temperature of the concrete to be within 5°C to 35°C.	PLACING AND FINISHING, Ambient conditions
	Take precautionary measures if the value of Rate of Evaporation exceeds 0.50 kg/m ² /hr, cease work.	PLACING AND FINISHING, Evaporation and moisture loss
Alignment and surface		
Horizontal alignment of outer edges	± 30 mm.	PLACING AND FINISHING, Alignment and surface tolerances
Surface level tolerance	+10 mm / -0 mm from design surface levels. ±5 mm over a 3 m straightedge.	
Average surface texture depth	0.3 mm - 0.65mm.	PLACING AND FINISHING, Surface texture

Activity	Limits/Tolerances	Worksection clause/ subclause
Joints		
General	± 10 mm over a 3 m straightedge.	JOINTS
Transverse contraction joints	May skew 1 in 12 to accommodate construction joints and slab anchors.	JOINTS, Transverse contraction joints
	± 10 mm over a 3 m straightedge.	
Sawcutting	The surface of the joint not to have more than 5 mm of vertical or horizontal edge ravelling. The length of edge ravelling to be not more than 300 mm in any 1 m length of joint on each edge.	JOINTS, Sawcutting
Temporary sealing	Temporary Sealing—the top of the sealant to be neither higher than nor more than 10 mm below the concrete surface.	JOINTS, Temporary sealing
Permanent sealing	Permanent Sealing—The top of the sealant to be neither less than 5 mm nor more than 7 mm below the surface of the base.	JOINTS, Permanent sealing
Longitudinal tied joints	All parts of any tie bar to be within 50 mm of its designed position.	JOINTS, Longitudinal tied joints
	The line of longitudinal tied joints not to deviate from the designed position at any point by more than 10 mm and not deviate from a 3 m straightedge by more than 10 mm having made due allowance for any planned curvature.	
Sawn-Induced joints	The maximum increase in length of the sealant after installation to be 10% of the original length. The top of the sealant to be neither less than 5 mm nor more than 7 mm below the surface of the base.	JOINTS, Sawn-Induced Joints
Ribbon-Induced joints	The inducer ribbon to be a minimum of 0.5 mm thick and within 5° of the vertical plane.	JOINTS, Ribbon-Induced Joints
Slab anchors	Not placed closer than 2.0 m to transverse joints (other than associated transverse expansion joints).	SLAB ANCHORS, General

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

General

Payments made to the Schedule of Rates: To *0152 Schedule of rates – supply projects*, this worksection, the drawings and Pay items **1133.1** to **1133.10** inclusive.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology

General: The following methodology will be applied for measurement and payment:

- If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa, remove the lot represented by the test cylinders. No payment will be made.
- If the relative compaction of the concrete is determined at less than 98 %, remove the lot represented by the core. No payment will be made.
- If the concrete base thickness is more than 10 mm below the documented thickness, remove the concrete. No payment will be made.
- Preparation of subbase and application of bond breaker: Conform to *1132 Lean mix concrete subbase*.

- Construction of kerb and/or gutter (channel): Conform to 1121 Open drains, including kerb and channel (gutter).
- Subsoil drains at slab anchors: Conform to this worksection and not 1172 Subsoil and foundation drains.
- Site specific traffic management measures: Conform to 1101 Control of traffic.

5.2 DEDUCTIONS

General

Deductions: Conform to the following:

- Concrete with a 28 day compressive strength between 33 MPa and 35 Mpa: Subject to a deduction of 4% of the applicable schedule rate for **Pay Item 1133.1** for the lot represented, for each 0.5 Mpa, or part that, 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 10 mm or less below the specified thickness, after application of allowable tolerances for the base, may be accepted. Subject to a deduction to the schedule rate for **Pay Item 1133.1**, for the lot represented:
 - . 24% for areas with thickness 5 mm below the documented thickness.
 - . 60% for areas with thickness between 5 mm and 10 mm below the documented thickness.

5.3 PAY ITEMS

Pay items	Unit of measurement	Schedule rate scope
1133.1 Supply and place concrete in base	m ³ - The width and length as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. - The depth is the depth documented or as directed by the Superintendent across each section. - Take no account of the allowable tolerances.	All costs associated with all documentation and approvals and the supply and placing of concrete base including all costs of providing transverse construction joints and longitudinal tied joints in association with kerbs and/or gutters.
1133.2 Finish, cure and texture base	m ² - The width and length as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. - Take no account of the allowable tolerances. - The sides of slabs are not included in the measurement of surface area.	All costs associated with finishing, curing and texturing the base.
1133.3 Supply and place wire reinforcing fabric	m ² of wire reinforcing fabric placed - The width and length are as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. - Take no account of the allowable tolerances or of any laps.	All costs associated with supplying and placing all wire reinforcing fabric.
1133.4 Supply and install steel bar reinforcement	Tonne of steel reinforcement - The mass is to be determined from the unit masses given in	All costs associated with supplying and installing reinforcement, except dowels and tie bars.

Pay items	Unit of measurement	Schedule rate scope
	AS/NZS 4671 and the actual length of bar measured in place. - Take no account of laps and splices.	
1133.5 Transverse contraction joints	Linear metre Measure the distance along the line of the joint.	All costs associated with the provision of transverse contraction joints.
1133.6 Transverse expansion and isolation joints	Linear metre Measure the distance along the line of the joint.	All costs associated with the provision of transverse expansion and isolation joints.
1133.7 Longitudinal tied joints	Linear metre Measure the distance along the line of the joint.	All costs associated with the provision of longitudinal tied joints including provision of tie bars.
1133.8 Longitudinal isolation joints	Linear metre Measure the distance along the line of the joint.	All costs associated with provision of longitudinal isolation joints including the provision of dowels where specified or shown on the drawings
1133.9 Slab anchors	m ³ The volume as shown on the drawings with adjustments for any authorised variation. The depth is to be measured from the top of the subbase.	All costs associated with the construction of slab anchors including excavation, disposal of material, supply and placing of reinforcement and the subsoil drain
1133.10 Bridge approach slabs	m ³ - The width, depth and length are as specified on the drawings, or as directed by the Superintendent. - Take no account of the allowable tolerances.	All costs associated with 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 is to be paid for at the schedule rate for Pay item 1133.4 .