



SPECIFICATION 1135

CONTINUOUSLY REINFORCED CONCRETE BASE

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Hornsby Shire Council

ABN 20 706 996 972

296 Peats Ferry Rd, Hornsby 2077

PO Box 37, Hornsby NSW 1630

Phone 02 9847 6666

Fax 02 9847 6999

Email hsc@hornsby.nsw.gov.au

Web hornsby.nsw.gov.au

SPECIFICATION 1135 – CONTINUOUSLY REINFORCED CONCRETE BASE

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1 GENERAL

1.1 RESPONSIBILITIES

Objectives

General: Provide continuously reinforced concrete base including trial sections and slab anchors incorporating supply and placing of concrete and steel reinforcement finished as documented.

Performance

Quality: Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies to conform with 0161 Quality (Construction).

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- 0136 General requirements (Construction).
- 0161 Quality (Construction).

1.3 REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

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 1141.4-2000	Bulk density of aggregate
AS 1141.6.2-1996	Particle density and water absorption of coarse aggregate - Pycnometer
AS 1141.11.1.1-2009	Particle size distribution – Sieving method
AS 1141.12-1996	Materials finer than 75 micrometre in aggregates (by washing)
AS 1141.13-2007	Material finer than 2 micrometre
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 1141.23-2009	Los Angeles value
AS 1141.24-1997	Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1141.32-2008	Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS 1141.37-2007	Iron unsoundness
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 sulphate content of a natural soil and the sulphate 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 2350 various	Methods of testing portland and blended cements
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 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-dip galvanised (zinc) coatings on fabricated ferrous articles
SAA HB 155 – 2002	Guide to the use of recycled concrete and masonry materials
Other publications	
<i>AUSTROADS</i>	
AP-C87-2010	Austrroads Glossary of terms
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
<i>ASTM Standards</i>	
ASTM C793-2010	Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
ASTM C794-2010	Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
ASTM D792-2008	Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D2240-2005	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2628-91:2005	Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835-89: 2007	Standard Specification for Lubricant for Installation of Preformed Compression Seal in Concrete Pavements
<i>NSW RTA Test Methods</i>	
T 240 - 2006	Texture depth of coarse textured road surfaces
T 1160 - 2001	Low temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1161 - 2001	High temperature recovery of preformed 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>US Military Specification</i>	
SAE AMS-S-8802 2011	Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion

1.4 STANDARDS

General

Standard: To AS 1379.

1.5 SUBMISSIONS

Acceptance criteria

General: All submissions and activities to satisfy **HOLD POINTS** and **WITNESS POINTS**, will be subject to the approval of the Superintendent.

Documents

Submit the following for approval:

- Design:
 - . Design and control of concrete mixes to achieve approval of the nominated mix.
 - . Proposed changes to the nominated mix.
 - . Proposed methods of handling materials and mixing concrete
- Drawings:
 - . Subbase placement plan: As part of Quality Plan to show placements and daily out-puts.
 - . Joint details.
- Calculations:
 - . Curing compound: Application rate calculated by test and certified.
 - . Base levels: As derived from design finished levels.
- Execution details:
 - . Concrete mixing procedures.
 - . Concrete placing and finishing.
 - . Trial base.
 - . Concrete curing and protection.
 - . Conformity with dimensions and quality.
 - . Subbase work as executed survey.
 - . Joint sealant.
 - . Variation to subbase level.
- Materials: Technical data of materials as specified for the following:
 - . Cement.
 - . Flyash.
 - . Admixtures.
 - . Water.
 - . Aggregates.
 - . Steel reinforcement.
 - . Sealant.
 - . Curing compound.
- **Technical data:** [complete/delete]
- **Warranties:** [complete/delete]

1.6 INSPECTION

Notice

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

Summary of HOLD POINTS

Clause/Item	Requirement	Notice for inspection	Release by
Design and control of concrete mixes			
Nominated mixes	Details of nominated concrete mix and/or changes to approved mix	28 days before ordering concrete	Superintendent
Certificates of compliance	Submit NATA certificates of compliance	28 days before ordering concrete	Superintendent
Establishment			

Clause/Item	Requirement	Notice for inspection	Release by
Subbase survey	Work as executed survey of the subbase to the full extent of the works	2 working days prior to commencing any works	Superintendent
Subbase survey	Redesign due to non-conforming levels	2 working days prior to commencing any works	Superintendent
Trial concrete base			
Trial section	Construct a trial section to demonstrate capability	At least 5 working days of proceeding with the remaining works	Superintendent
Trial section	Submit test results for trial	Within 14 days of placement	Superintendent
Procedure after placement	Review of deficiencies in the trial section or removal	2 working days after carrying out works	Superintendent
Procedure after placement	If trial section does not conform then reject	At least 5 working days of proceeding with the remaining works	Superintendent
Slab anchors			
General	Submit compacted excavated surface	1 working day prior to concreting	Superintendent
Installation of steel reinforcement			
Placing and cover requirements	Approval of placement and fastening of reinforcing steel	Not less than 4 working hours prior to placement of concreting	Superintendent
Production and transport of concrete			
Handling, storing and batching	Proposed methods and equipment for handling, storage, batching materials	Not less than 4 weeks prior to planned commencement of work	Superintendent
Placing and finishing			
Equipment and methods	Submit full details of placing and finishing concrete together with a paving plan	4 weeks before works to commence	Superintendent
Surface texture	Submit details of proposed texturing device and demonstration of method	Before commencement of texturing	Superintendent
Joints			
Permanent sealing	Submit method for permanent joint sealing	Not less than 4 weeks prior to planned installation	Superintendent
Removal and replacement of base			
Removal and disposal	Method of removal to preserve adjoining base and underlying subbase	Not less than 7 days before works to start	Superintendent

Summary of WITNESS POINTS – Off site activities

Clause/subclause	Requirement	Notice of inspection
Design and control of concrete mixes		

Clause/subclause	Requirement	Notice of inspection
Compressive strength	Provide test results	Within 1 working day of availability
Cement		
Nominated cement	Nominate brand, quality and source	With nominated mix
Flyash		
Nominated flyash	Nominate powerhouse source	With nominated mix
Admixtures		
Nominated admixture	Nominate proprietary source, concentration, type and name. NATA Certificate of Compliance	With nominated mix
Aggregates		
Nominated aggregates	Nominate sources and geological type. NATA Test Report on quality and grading	With nominated mix
Steel Reinforcement		
- General	Compliance with AS/NZS 4671	Before delivering to site
- Bar chairs	Demonstrate load bearing conformity	Before delivering to site
Sealants		
Neoprene compression sealants	Submit NATA certificate of compliance for sealant	4 weeks prior to joint work carried out on site
Silicone sealants	Submit NATA certificate of compliance for sealant	4 weeks prior to joint work carried out on site
Curing compound		
- General	Submit NATA certificate of compliance for compound	4 weeks prior to curing

Summary of WITNESS POINTS – On site activities

Clause/ subclause	Requirement	Notice of inspection
Aggregates		
Storage	Storage and handling to preserve quality of aggregate	Progressive
Concrete quality requirements		
Compressive strength	Modify mix and/or production methods of non conforming concrete	Progressive
Trial concrete base		
Trial section	Notify the Superintendent for demonstration of trial mass concrete subbase	5 working days prior to demonstrating the works
Slab Anchors		
General	Locations as shown on drawings or as directed	Progressive
Installation of steel reinforcement		
Reinforcement	Approval of location and fixing method	Progressive
Production and transport of concrete		
Agitation	Submit times of addition of cement	Progressive

Placing and finishing		
Equipment and methods	Notice of planned commencement	Not less than 7 days
Consistency	Submit test results for review	Progressive
Evaporation and moisture loss	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
Alignment and surface tolerances	Survey of alignment and edge thickness	3 working days after works
Protection of work	Details of protection methods for low concrete temperatures	Progressive
Protection of work	Details of rain protection and remedial method	Progressive
Traffic considerations	Provide traffic management measures	Progressive
Joints		
Location	Locations as shown on drawings or as approved	Prior to works
Curing		
Application method	Check curing compound application rate	Progressive
Acceptance of concrete strength, compaction and thickness		
Concrete cylinders	Submit test results	Progressive
Conformance for thickness	Check thickness using a probe	Progressive
Restoration after coring	Restore holes with non-shrink cementitious concrete and guarantee integrity	After coring

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 ensure that where jointed concrete shoulders are specified, the continuously reinforced concrete pavement is constructed first.
- Provide survey data on subbase finished surface to provide data for base thickness. See **Conformance for thickness**.

2.2 DESIGN AND CONTROL OF CONCRETE MIXES

Nominated mixes

Approval: Submit details of concrete mix(s) and the constituent materials including source, moisture condition of the aggregates (oven dry, surface saturated dry or other specified moisture content), setting time, soundness, compressive strength, shrinkage, fineness and nominated compatibility index (in range 60 -90). This is a **HOLD POINT**.

On approval: Each such mix will be known as a 'nominated mix'.

Certificates of compliance

Submission: Submit NATA Certificates of compliance for each constituent and nominated mix.

Verification: Provide certificates from a NATA registered laboratory. All phases of any particular test must be performed at one laboratory. All relevant test results to accompany the certificate and be within twelve months of the submission date. This is a **HOLD POINT**.

Compressive strength

Submission: Submit the compressive strength gain curve showing the compressive strengths at ages 3, 7, 10 and 28 days determined to AS 1012.9. Carry out NATA testing at 3, 7, 10 and 28 days for three specimens of concrete produced from a batch of the nominated mix. Take the compressive strength as the average of individual results within 20 MPa of the median. This is a **WITNESS POINT**.

Slump for trial batch: The concrete for compressive strength cylinders to 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.

Acceptance criteria: Between 36 and 42 MPa at 28 days.

Approved mix(es)

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

Prior approval: A mix may be approved due to 'prior approval' 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 approved nominated mixes and materials

Approval required: Any change to the approved mix, its method of production or source of supply of constituents requires approval prior to proposed implementation.

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

Costs: Borne by the Contractor.

Approval without trials: If the variations to the quantities of the approved mix are less than 10 kg for cement and flyash and 5% by mass for each other constituent, except admixtures, per m³ of concrete.

2.3 SITE ESTABLISHMENT

General

Provide the following:

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

3 MATERIALS

3.1 CEMENT

Standard

Type: GP cement to AS 3972 and tested to AS 2350 (various).

Nominated cement

Brand and source: Nominate the brand and source of the cement when submitting details of the nominated mix in accordance with **Nominated mixes**. Use only the nominated cement in the work.

This is a **WITNESS POINT**.

Proof of quality: Provide documentary evidence of the quality and source of the cement upon request at any stage of the work.

Storage time: Prior to use, re-test cement that has been stored for a period in excess of three months from the time of manufacture to ensure the cement still complies with AS 3972.

Costs: Borne by the Contractor.

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

3.2 FLYASH

General

Standard: Fly ash to AS 3582.1.

Nominated fly ash

Powerhouse source: Nominate the powerhouse source of the fly ash in accordance with **Nominated mixes**. On approval of a nominated mix, use only the fly ash from the nominated powerhouse.

This is a **WITNESS POINT**.

Proof of quality: Provide documentary evidence of the quality and source of the fly ash upon request at any stage of the work.

3.3 WATER

General

Standard: Chloride ion to AS 3583.13 and sulphate ion to AS 1289.4.2.1.

Quality: Water used in the production of concrete to be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

Limits: The water used must not contain more than:

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

3.4 ADMIXTURES

General

Standard: Chemical admixtures to comply with AS 1478.1.

Quality: Provide admixtures free from calcium chloride, calcium formate, or triethanolamine or any other accelerator. Do not use admixtures or combinations of admixtures without prior written approval.

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

Nominated admixture

Source and type: Nominate the proprietary source, type, dose rate, name and method of incorporation of each admixture to be used in accordance with nominated mixes. Submit NATA certificates of compliance and the proposed dosage chart. On approval of a nominated mix, use only the admixture and dosage that is approved.

Variation to mixture: If the Contractor proposes to vary the admixture between warm and cool seasons such variation is to constitute a proposed change to an approved mix for the purposes of **Variations to approved mixes**. This is a **WITNESS POINT**.

Proof of quality: Provide documentary evidence of the quality upon request at any stage of the work.

Types of admixtures

Air entraining agent: An air-entraining agent to **Concrete quality requirements** to be included.

Excess air content: Reject fresh concrete with an air content not complying with Concrete quality requirements.

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 WRRe) as approved to control slump within the limits stated in 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 WRRe complying with AS 1478.1).

3.5 AGGREGATES

General

Standards: AS 2758.1 and Austroads AGPT04J.

Quality: Provide at least 40 % by mass of the total aggregates in the concrete mix of quartz sand aggregate having a nominal size of < 5 mm and containing at least 70 % quartz, by mass.

Durability: All constituent, fraction of constituent or aggregates to conform to AS 1141.22 and the following:

- Wet Strength not less than 80 kN.
- 10% Fines Wet/Dry Variation not to exceed 35%.

Chert fragments: Chert fragments will be regarded as 'quartz' for the purpose of this worksection, provided that the chert content does not exceed quartz content.

Recycled concrete aggregate (RCA): The use of coarse aggregates from demolition concrete or RCA to conform with SAA HB155 and Austroads AGPT04E.

Blending: If blending coarse RCA with natural aggregates ensure substitution rates are below 30 %.

Slipform grading requirements: In addition, for concrete mixes proposed for slipforming, the grading of the combined total aggregates is to have a proportion by mass passing the Australian Standard sieves as shown in **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
75 µm	0–2

Nominated aggregates

Source and type: Nominate the sources of aggregate to be used and submit details of the geological type of each aggregate.

Proposed grading: Provide NATA Certified Laboratory Test Reports on the quality and grading of the aggregate proposed to be used. The grading to be known as the 'Proposed Grading'.

Blending of aggregates: Test reports for each constituent material to be submitted showing the proportions in which the various sizes are to be combined. The aggregate from each source and the combined aggregate to comply with the requirements of this Clause. This is a **WITNESS POINT**.

The grading to be known as the 'proposed coarse aggregate grading'.

Fine aggregate

Standard: Conform to the following:

- Nominal size: Less than 5 mm.
- Standard: To AS 2758.1 for bulk density, water absorption (maximum 5 %), material finer than 2 µm, impurities and reactive materials.

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

Sodium sulphate soundness: To AS 1141.24 and not exceeding the limits shown in the **Sodium sulphate soundness limits table**.

Sodium sulphate 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: If two or more fine aggregates are blended, the above limits apply to 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

Standard: To 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.

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

Properties: Conform to the **Course aggregate grading and properties table**;

Grading: To AS 1141.11.1.1, and within the limits given in the **Coarse aggregate grading and properties table**.

Coarse aggregate grading and properties table

Property		Requirement		Test method
Particle density		minimum 2100 kg/m ³		AS 1141.6.2
Bulk density		minimum 1200 kg/m ³		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 1141.11.1.1
	26.50 mm	100		
	19.00 mm	95–100	± 2	
	13.20 mm	35–80	± 5	
	9.50 mm	0–25	± 5	
	4.75 mm	0–10	± 3	
	2.36 mm	0–2		
Material finer than	75 µm	≤ 2.0%		AS 1141.12
	2 µm	≤ 1.0%		AS 1141.13
Particle shape	2:1 ratio	≤ 35%		AS 1141.14
	3:1 ratio	≤ 10%		
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

Storage areas: All storage areas to have a concrete floor and prevent the aggregates becoming intermixed or mixed with foreign materials or segregated.

Exclusion of foreign matter: The storage area and mixing plant to be located to ensure delivery vehicles, loaders and trucks cannot introduce foreign matter to the aggregates at any time.

Cease production: if foreign matter is introduced or if directed by the Superintendent due to possible contamination immediately cease production of concrete. Resume production of concrete and delivery of materials on approval of the rectified condition. This is a **WITNESS POINT**.

3.6 STEEL REINFORCEMENT

General

Standards: To AS/NZS 4671.

Type and size: As shown on the drawings.

Cleanliness: Free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but not brought to a smooth polished condition.

Proof of quality: Submit test certificates showing results of mechanical tests and chemical analysis. This is a **WITNESS POINT**.

Sample testing: Where there is not a test certificate available, sample and test to verify that all properties conform to AS/NZS 4671. Select randomly three specimens each at least 1.2 m in length as samples.

Costs: Borne by the contractor.

Bar chairs: Plastic bar chairs or plastic tipped wire chairs capable of withstanding a load of 200 kg mass on the chair for one hour at $23 \pm 5^{\circ}\text{C}$ without permanent distortion > 2 mm. Demonstrate that the proposed chairs conform to these requirements. This is a **WITNESS POINT**.

Galvanised bars: Hot-dipped to provide an average minimum coating thickness of 85 micrometre of not less than 98% by mass of zinc. If required, a direction for testing to prove compliance with AS/NZS 4680 may be given.

3.7 SEALANTS

Silicon

Submission: Submit a Certificate of Compliance from a NATA registered laboratory, showing the sealant meets all the requirements of **Silicone joint sealant requirements table**. Submit manufacturer information confirming compatible fit and suitability for designed joint dimensions and proposed method. This is a **WITNESS POINT**.

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
T1192 T1193	Durability	Extension to 70% Compression to 50%
ASTM C794	Adhesion to Concrete	35N 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

Storage: To the manufacturer's written instructions.

Neoprene

Standards: To ASTM D2628. NSW RTA Test Methods T1160, T1161 and T1163 or relevant State Road Authority requirements to determine compliance with these requirements.

Submission: Submit a NATA certificate of compliance showing that the sealant meets all the requirements of ASTM D2628 as well as evidence ensuring compatibility in width and depth between the compression seal and the formed or saw cut joints incorporated within works. This is a **WITNESS POINT**.

3.8 CURING COMPOUNDS

General

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

Efficiency index: Submit a current Certificate of compliance for the curing compound from a NATA Laboratory. Details to include the non-volatile content and confirmation of an Efficiency Index not less than 90% when tested to conform with AS 3799, Appendix B. This is a **WITNESS POINT**.

Alternative curing compounds

Type	Suitability with bituminous / asphaltic surfacing	
	Wearing surface	No wearing surface
White pigmented wax emulsion Class A Type 2. *		Yes
Wax emulsion non pigmented	Yes	
Debonding bitumen sprayed seal with 5-7mm aggregate	Yes	Yes
Notes: * For paving in NSW from November to March, a Type 2 compound must be used which contains a titanium dioxide reflective pigment. At all other times, a Type 1-D compound must be used. Different states may have different requirements for the alternative use of curing compounds. Refer to the specific State Road Authority for more information. * See AGPT04C Table 6.1.		

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General

Control of traffic: Conform to the following:

- Conform with worksection 1101 Control of traffic.
- Conform with **Traffic Guidance Scheme** in 1101 Control of traffic.

4.2 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 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. This is a **HOLD POINT**.

Nonconforming levels: In the case of high nonconforming levels locally redesign the pavement levels as directed by the Superintendent. This is a **HOLD POINT**.

4.3 CONCRETE QUALITY REQUIREMENTS

Cement and flyash

Minimum cement content: 270 kg/m³ of concrete

Minimum flyash content: 50 kg/m³ of concrete

Compressive strength

Standard: To AS 1012.9.

Value: Compressive strength at 28 days: 36 to 42 MPa.

Mix adjustment: Determine any need for mix adjustment throughout the progress of the work by carrying out a statistical check of the compressive strength of concrete.

Statistical check: Use consecutive 28 day test results representing 1000 m³ concrete placed in the work for each approved mix used.

Analysis: Analyse test results on the basis of groups of consecutive pairs of specimens, and submit the results within five weeks of the last placement included in the analysis.

Mix acceptance: The concrete mix and its method of production are satisfactory if the average compressive strength of any six consecutive pairs of specimens is within the range specified for maximum and minimum compressive strength.

Range: Specified minimum compressive strength plus one standard deviation.

Standard deviation: For 'n' consecutive pairs ≥ 30 then allowable standard deviation ≤ 3 MPa.

Modification: If any of the above compressive strength conditions are not met, modify the mix and/or improve the method of production of concrete. This is a **WITNESS POINT**.

Shrinkage

Limit: The drying shrinkage of the nominated mix, determined by AS 1012.13, not to exceed 450 $\mu\epsilon$ after 21 days of air drying.

Testing: Perform shrinkage tests to be performed on (the lesser of) every 150 cubic metres 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.

Consistency

Nominate slump: To AS 1012.3.1 and as follows:

- For mechanically placed concrete: Between 30 mm and 40 mm.
- For hand placed concrete: Between 55 mm and 65 mm.

VeBe reading of the nominated mix: A maximum of three seconds at the nominated slump less 10 mm when tested to AS 1012.3.3.

Air content

Tolerances: The air content of the concrete, determined by AS 1012.4.2, to be neither less than 3% or more than 6% when discharged from the transport vehicle ready for placement.

Rejected fresh concrete: Do not use fresh concrete with an air content outside these limits in the base.

Repeat testing: If the measured air content is not within the limits specified, one repeat test is to be made immediately from another portion of the sample. If the value from the repeat test falls within the specified limits, the sample is deemed to comply with the worksection. Concrete with air content outside these limits on the second test is not to be used in the base.

4.4 TRIAL CONCRETE BASE

Trial section

Submit notice: Notify the Superintendent for inspection of demonstration of the works involving the trial concrete base. This is a **WITNESS POINT**.

Requirement: Prior to the commencement of paving, submit a trial section of plain and reinforced concrete base including texturing, curing and construction and sawing joints and placement of the tie bars and dowels to demonstrate capability of constructing base to conform with this worksection. This is a **HOLD POINT**.

Trial section: Construct as follows:

- So that it may be incorporated in to the finished work.
- For mechanical paving between 50 and 100 m length, or lesser length as approved. Separate trials required for each paver.
- For manual paving between 15 and 50 m length, or lesser length as approved.
- Width as proposed for the work.

Trial results: Submit relative density and 7 day cylinder and core compressive strength to demonstrate allowance for compressive strength, compaction and thickness. This is a **HOLD POINT**.

Procedure after placement

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

Approved trial section: Continue the remaining works following the approval of the trial section.

Deficient trial section: If there are deficiencies in the trial concrete base, the trial section may not be approved. The method, equipment, materials and personnel will be reviewed and an explanation submitted. A further length of trial concrete base may be requested. This is a **HOLD POINT**.

Next trial: Next trial treated as the first. If after 3 trials work is still deficient then justify why procedure should not be changed.

New trial section: If changes are made in the equipment, materials, mix, plant or rate of paving for any other reason a new trial section may be requested.

Non compliance: If rejected by the Superintendent, remove the trial concrete base immediately to conform with **Removal and replacement of base**. This is a **HOLD POINT**.

Costs: Borne by the Contractor.

Payment: Payment made for the base at the schedule rates for appropriate **Pay items** if it has been constructed without deficiencies and is incorporated into the work as base concrete.

4.5 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: The associated transverse expansion joints must be no closer than 2 m to other transverse joints. A change in the spacing of transverse contraction joints may be directed to ensure that this minimum clearance is obtained. This is a **WITNESS POINT**.

Excavation

Dimensions: Excavate trenches to the dimensions and details shown on the drawings.

Trim and consolidate: Remove all loose material and trim the vertical faces to neat lines.

Compaction: Where required, re-compact the bottom of the trench, to the degree of consolidation of the adjacent undisturbed material. This is a **HOLD POINT**.

Spoil: Dispose of 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.

Damage: Do not disturb or damage the existing flexible pavement.

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

Costs: Borne by the Contractor.

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

Construction

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

Sequence: Pour slab anchors 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: Provide a transverse isolation joint on the downhill side of the slab anchor.

Steel reinforcement: Steel reinforcement type and size shown on the drawings and supplied and fixed to conform with **Steel reinforcement**.

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 with the requirements for base concrete.

Transverse expansion joints: Provide as shown on the drawings.

4.6 INSTALLATION OF STEEL REINFORCEMENT

Reinforcement

Conform to: Reinforcement must align to the following:

- Formed to the dimensions and shapes shown on the drawings.
- Bent to an internal bend radius at least twice the diameter of the bar.

- Do not bend or straighten in a manner that will damage the material.
- Do not use with kinks or bends not shown on the drawings.
- Do not heat for the purpose of bending.

Plan lengths: Conform to the following for length of lapped splices for unhooked bars not shown on the Drawings will be as follows:

- Plain bars, Grade 250: 40 bar diameters
- Deformed bars, Grade 500: 40 bar diameters
- Hard-drawn wire: 50 bar diameters
- Reinforcement fabric: Overlap between the outermost wire in each sheet of fabric transverse to the direction of the splice greater than the pitch of the transverse wires plus 25 mm.

Secure ends: The ends of the bars forming a lapped splice must be welded or securely wired together in at least 2 places. Welding to comply with AS 1554.3.

Splice dimensions: Splices in reinforcing fabric to be measured as the overlap between the outermost wire in each sheet of fabric transverse to the direction of splice. This overlap is not to be less than the pitch of the transverse wires plus 25 mm. This is a **WITNESS POINT**.

Storage: Protect reinforcement, during storage if not promptly incorporated into the concrete,

- By storage under a waterproof cover and supported clear of the ground, and
- Prevent damage and deterioration due to exposure.

Placing and cover requirements

Inspection: Submit for approval the placement and fastening of reinforcing steel prior to planned concrete placement. Allow adequate time in giving notice of inspection for all corrective works to be completed before placing concrete. This is a **HOLD POINT**.

Position: Conform to the following:

- Accurately place reinforcing bars and wire reinforcing fabric as shown on the drawings.
- Secure the reinforcement in position 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 > 1.25 mm diameter.
- Provide these supports in a regular grid not exceeding 1.0 m. Do not support steel on metal supports which extend to any surface of the concrete. Do not use wooden supports or pieces of aggregate.

Chair spacing: Arrange and space of chairs to ensure support in proper position with permanent deflection or displacement of the reinforcement no more than 2mm during placing and consolidation of the concrete.

Chair bearing: To prevent overturning.

Chair support: 200 kg mass without permanent distortion in excess of 2 mm.

Cover minimum: Not less than 50 mm from the supporting surface on which the chair rests to the exposed steel of the chair. Not less than 50 mm cover of any bar to the nearest concrete surface unless shown otherwise on the drawings.

Longitudinal steel: Conform to the following:

- Placement: Place longitudinal steel on top of transverse steel.
- Minimum top cover: 70 ± 10 mm unless otherwise shown on the drawings.

Tack welding: Tack welding instead of wire ties may be used if approved on reinforcing steel. Do not use cold-worked reinforcing bars.

Tie bars: Conform to with the following:

- Place tie bars in the pavement so that they remain in their specified location. Do not place tie bars through the finished upper surface of the pavement.
- Place tie bars 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.

Submission: Submit details of the proposed method of tie bar insertion for approval.

Anchoring: Anchor tie bars extending from any side face of base concrete or gutter in a manner which will develop 85 % of the yield strength of the bar in tension. Remove loose bars.

Dowelled joints: Conform to the following:

- Place dowelled joints, parallel to the pavement surface and normal to the line of the joint, unless shown otherwise 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 ensure 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: Burr free and circular in cross-section. Do not provide dowels possessing crimped or ovoid end faces into the works.

4.7 PRODUCTION AND TRANSPORT OF CONCRETE

General

Standard: To AS 1379 for mixers and agitation methods.

Handling, storing and batching

Submit: Proposed details for the following methods:

- Handling, storing and batching materials for concrete.
- Monitoring and measuring the constituent materials for concrete.
- Mixers and methods of mixing.
- Method of transport.

This is a **HOLD POINT**.

Verify scales accuracy: Submit certificates of calibration issued by a NATA registered laboratory as evidence of the accuracy of the scales prior to handling and batching of material.

Measurement: Weigh cementitious material in an individual hopper, with the cement weighed first.

Moisture content: Determine the moisture content of the aggregates at least daily immediately prior to batching. Make corresponding corrections to the quantities of aggregates and water.

Continuous weighing: If a continuous type mixer is used, measure the components by a method of continuous weighing as approved, except for liquids which may be measured by volume or flow rate meter.

Storage: Store materials only on sites specifically designated for the purpose. Do not use a new storage site without prior approval.

Mixing time

Stationary batch mixers: The minimum mixing time must not be less than 54 seconds plus 6 seconds for each cubic metre.

Mobile batch mixers: The minimum mixing time must be the full period of mixing provided at either the testing station or the point of placement. All other mixing or agitation must be ignored for the purpose of assessing the actual mixing time for a specific batch.

Maximum mixing time: 5 minutes for split drum mixers or 10 minutes otherwise.

Admixture addition

Pre-dilute: Admixtures must be separately and thoroughly pre-diluted in the mixing water prior to their introduction to other materials.

Manufacturer's instructions: Mixing to conform with the manufacturer's instructions and ensure no adverse interaction occurs.

Batch delivery docket

Identification number: The docket/Certificate must be pre-numbered and accompany each batch or load of concrete.

Record details: Including the time for completion of batching depending on the type of mixing. This will include time for charging and/or mixer discharge and/or slump adjustment.

Addition of water: The delivery docket must clearly indicate the amount of water added, but in no circumstance is the water/cement ratio to be exceeded.

Agitation

Addition of water: For truck-mixed concrete, add water in accordance with AS 1379 within ten minutes of completion of batching and within 200 m of the batching facilities.

Cement addition: After addition of the 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.

Outside of the time limitations: Legally dispose of any material delivered in excess of these time limitations with the cost borne by the Contractor.

Verify time added: Submit times of addition of cement to the aggregate and the means of verification. This is a **WITNESS POINT**.

Maximum size of batch: The size of the batch in an agitator vehicle not to exceed the manufacturer's rated capacity nor exceed 80 % of the gross volume of the drum of the mixer.

Maximum holding: If delays necessitate holding a batch in the mixer then mixing may continue for 10 minutes maximum or 5 minutes maximum for split drum mixers.

Longer holding: 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.

Testing and sampling

Discharge: When conducting mixer uniformity tests on a split drum mixer producing centrally mixed concrete, discharge the whole of the batch into the tray of a moving vehicle minimum tray length 8 m.

Sample method: Sample the concrete from the tray of the vehicle at points approximately 15 % and 85 % along the length of the tray.

Forming time

Maximum forming time: Determine for each nominated mix a maximum forming time by considering the prevailing weather conditions and concrete temperature.

Air temperatures less than 30°C: 90 minutes maximum.

Air temperatures greater than or equal to 30°C: 45 minutes.

Effects on forming time: Reduce the forming time as required due to the prevailing weather, mix type, or materials being used as directed.

4.8 PLACING AND FINISHING

General

Subbase surface condition: Clean and free of loose or foreign matter and prepared to conform with *1132 Mass concrete subbase*.

Slab anchors: If required, construct slab anchors prior to construction of the base.

Base thickness and levels: The Superintendent may alter the base thickness and levels by up to 30 mm before the commencement of each section of work.

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. This is a **HOLD POINT**.

Notice to commence: Give 7 days written notice of the intention to commence construction of the subbase on any section of work including the trial subbase. This is a **WITNESS POINT**.

Consistency

Requirement: Produce and place concrete of a consistent, dense, non-segregated mass with bleeding limited to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does flow, cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved.

Concrete edges: Produce the edge so as to maintain its shape without sag or tear.

Testing: Check the consistency of the concrete by use of a slump cone to AS 1012.3.1 on concrete samples obtained to AS 1012.1. Perform check 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 prior to discharge. Do not incorporate concrete which is non-conforming into the work. Check each truck load of concrete for consistency.

Slump tolerances:

- Mechanically placed concrete: Within 10 mm of the Contractor's nominated slump.
- Hand placed concrete: Within 15 mm of the Contractor's nominated slump.

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

Test results: Submit all consistency test results. This is a **WITNESS POINT**.

Costs: Borne by the Contractor.

Evaporation and moisture loss

Ambient conditions: Do not place concrete during rain or when the air temperature in the shade is below 10°C or above 30°C, unless appropriate heating or cooling procedures are adopted.

Concrete temperature limits: Within the range of 5°C to 35°C.

Conditions: Measure and record concrete temperature and wind velocity at the point of concrete placement, and continuously measure and record air temperature and relative humidity daily, at the site throughout the course of the work.

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

Costs of testing evaporation and moisture loss: Borne by the Contractor.

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. This is a **WITNESS POINT**.

Costs of precautionary measures: Borne by the Contractor.

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.

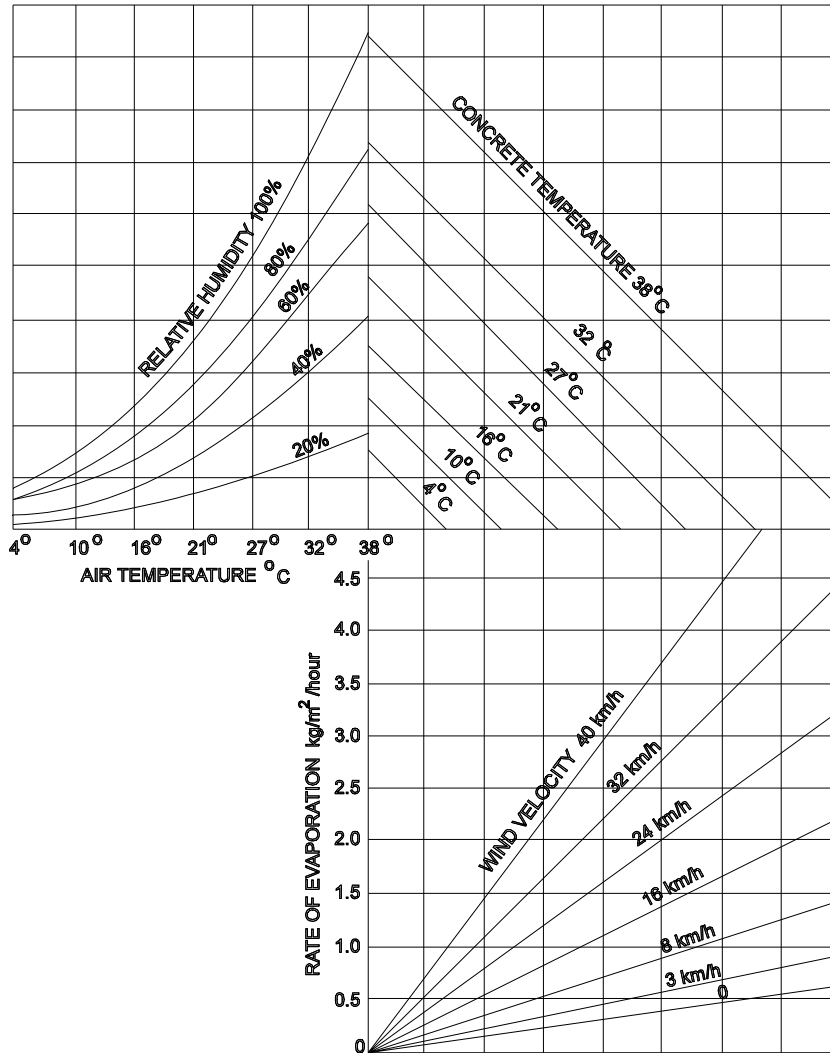


Figure - Rate of evaporation

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 permeability.

Continuity: Once spreading commences maintain a continuous concrete paving operation. Ensure a continuous supply of concrete so that the forward progress of the mechanical paver is not stopped due to lack of concrete.

Disruptions: If disruptions occur for any reason in both mechanical and hand paving, a direction may be given to form a construction joint before the recommencement of paving operations. This is a **WITNESS POINT**.

Costs: Borne by the Contractor.

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 conform with **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 the 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 width being paved.
- Without disturbing the reinforcement or its supports.
- Without segregating or otherwise adversely affecting the concrete.

Supporting surface: The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train is to be in a smooth and firm condition.

Hand placing

Restriction: Use hand placement only in areas where mechanical placement is impracticable or where approved prior to commencement of work.

Formwork: Conform to the following:

- Design and construct for removal without damaging the concrete.
- True to line and grade.
- Braced in a substantial and unyielding manner.
- Mortar tight and debonded to ensure non-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.

Buildup: Prevent any buildup of concrete between the forms and vibratory screed.

Alignment and surface tolerances

Horizontal alignment tolerances:

- Outer edges: Square to the subbase surface without deviation from the plan position at any point by more than 30 mm.
- Longitudinal joint: In conformance with **Longitudinal tied joints**.

Tolerances and rideability:

- Thickness of concrete: 0 mm below the specified thickness and in accordance with **Conformance for thickness** for excess thickness.
- Top of base level: + 10 mm / – 0 mm deviation from the design level and not below that shown on the drawings.
- Surface level: 5 mm maximum deviation from a 3 m straightedge, laid in any direction.
- Ponding: Not acceptable.

Inspection: Survey the alignment, surface and edge thickness for conformance with the above requirements. This is a **WITNESS POINT**.

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.

Reinforcing fabric: Unless otherwise shown on the drawings or directed, reinforce odd-shaped and mismatched slabs with SL82 reinforcing fabric placed with 50 mm to 60 mm cover to the surface of the base. 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

Transverse texture: Conform to the following:

- As soon as possible after placing, transversely texture the surface of the freshly placed concrete by means of a mechanical device for grooving plastic concrete.
- Utilise texturing equipment with rectangular-shaped tynes of flat spring steel, approximately 0.6 mm thick.
- Width of the tynes: 3 mm.
- Spacing of tynes: Random pattern.

Average texture depth: Between 0.30 mm and 0.65 mm when tested in accordance with RTA Test Method T240.

Corresponding individual groove depth: 1.5 mm to 3 mm.

Machine texture: For paving widths exceeding 2.5 m perform the texturing using 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 brushes or combs: At least 750 mm wide. Make provision 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. This is a **HOLD POINT**.

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

Saw groove dimensions: 3 mm wide x 3 mm deep, at random spacing as approved with a mean spacing neither less than 10 mm nor more than 21 mm.

Alternative: Where an asphalt surfacing is specified over the concrete base or as directed, texturing of the concrete surface may be by the use of a fine broom or hessian-drag.

Protection of work

Temperature control: Ensure that the temperature of the concrete does not fall below 5°C during the first 24 hours after placing.

Submit: Provide details of procedures and equipment proposed for use in the event of low air temperatures, for the protection of sections recently placed. This is a **WITNESS POINT**.

Non compliance: If the Contractor fails to maintain the temperature of the concrete at or above 5°C and if the concrete exhibits any deficiencies that may be due to their failure to comply with this Worksection, the concrete will be rejected.

Rain protection: Protect the work from rain damage and submit detailed proposals for procedures and equipment to be used for such protection and remedial on affected surfaces. This is a **WITNESS POINT**.

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 comply at a minimum with *1101 Control of traffic*.

Additional measures: If such measures are warranted due to site specific requirements provide traffic management either pedestrian or vehicular in excess of that specified. This is a **WITNESS POINT**.

Costs: Borne by the Contractor.

4.9 JOINTS

Location

General: Provide joints at locations indicated on the drawings or as approved by the Superintendent.

This is a **WITNESS POINT**.

Inspection of joints

Timing: The Contractor is to inspect each joint within 24 hours of its construction.

Remedial works: If non conformance is detected in relation to joint alignment and/or edge ravelling, undertake remedial action immediately.

Cost: Borne by the Contractor.

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 so as not to cause excessive ravelling of aggregate adjacent to the cut.

Equipment: Use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn and have sufficient standby equipment available on site to maintain continuity of sawing.

Tolerances: Continuous line with a maximum edge deviation from a 3 m straight edge of 10 mm.

Ravelling: Ensure 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.

Rejected sawcuts: Sawcuts, which do not conform to the documented requirements, will be rejected. Rejected sawcuts may be repaired by an approved method.

Cleaning of sawcut: Immediately after any sawing, clean the sawcut of all debris. Use a cleaning method that will not damage the sawcut or leave any substance deleterious to the concrete or to the adhesion of the joint sealants used.

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 by means of 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.

Tolerances: The top of the sealant to be between 5 mm above and 7 mm below the surface of the base and to overlay any longitudinal sealants.

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 written instructions.

Compliance: Notwithstanding any approval given to a proposed method for producing a permanent seal.

Treatment prior to asphalt overlay: If asphaltic surfacing over the concrete base is specified 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.

Compression: The maximum increase in length of a temporary sealant after installation to be 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.

Submit: Submit the method for permanent sealing 4 weeks before commencing sealing works. This is a **HOLD POINT**.

Transverse construction joints

Conform to the following:

- Provide only at discontinuities in the placement of concrete determined by the paving operations.
- Construct normal to the control line and to the dimensions and details shown on the drawings. The tie bars to comply with **Steel reinforcement**.
- Make smooth across the joint before texturing.
- Do not 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: Prior to 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.

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 approved alternative. Install to conform with the drawings and the manufacturer's recommendations except that reference to backer rods not to 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 with **Placing and cover requirements**.
- Locate and space as shown on the drawings.
- All parts of any tie bar to lie within 50 mm of its designed position.
- 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 having made due allowance for any planned curvature.

Corrugated joint face: If the longitudinal tied joint is formed or slipformed, corrugate the joint face to conform with 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 with **Longitudinal isolation joints**.

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

Sawn-induced joints

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

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

Sealant preparation: Insert a neoprene backing rod to conform to the details shown on the drawings.

Sealant insertion: Conform to the following:

- Coat the sealant with an approved lubricant-adhesive compound, coloured to approximately match the pavement.
- Insert the sealant into the groove using equipment which will not damage the sealant.
- The maximum increase in length of the sealant after installation to be 10 % of the original length, otherwise the sealant to be rejected.

Joints in sealant: Keep joints in the sealant to a minimum, cemented together by an adhesive recommended by the manufacturer.

The 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: To the dimensions and details 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 to ensure 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 an approved 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 accordance with the drawings and **Placing and cover requirements**.

Tolerances: Construct the line of the longitudinal joint to the tolerances to conform with **Longitudinal tied joints**.

Kerb and/or channel (gutter): Construct to conform 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 to be greater than 36 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.

4.10 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 compliance 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 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.
- Ensure that the sprayer 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 Compliance 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, certify and submit for approval. Check the amount of curing compound falling on three felt mats, each approximately 0.25 litres/m² in area, placed as directed. This is a **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.

Costs: Borne by the Contractor.

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

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

4.11 CONCRETE CRACKING

Planned cracks

Definition: Planned cracks in 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

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, then that area of concrete base is to be removed and replaced in accordance with **Removal and disposal of concrete base, Replacement of base and Rectification of finished surface and rideability non conformance.**

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

4.12 CONCRETE STRENGTH, COMPACTION AND THICKNESS

Concrete cylinders

Test specimen: Standard cylinders to AS 1012.8.1.

Moulds and laboratory: Supply a sufficient number of moulds to meet the requirements for the frequency of testing and arrange for a NATA laboratory to conduct the sampling of fresh concrete, curing, delivery and testing of specimens.

Test results: Submit to the Superintendent. This is a **WITNESS POINT.**

Sampling: Take samples of concrete for testing to conform with AS 1012.1.

Identical specimens: Mould the specimens from each sample so that they are as identical as practicable.

Making and curing specimens: To AS 1012.8.1 with compaction by internal vibration.

Identification marking: Include the sampler's name, date, batch number, and representative location of sample within works.

Costs: Borne by the Contractor.

Frequency: For each lot of base concrete placed at the one time, mould one (1) pair each of test specimens for the determination of the compressive strength at both 7 days and 28 days.

Lot size: A lot is defined as a continuous placement of up to 50 cubic metres of concrete placed.

Standard: Inspect, cap, crush and test to AS 1012.9.

Relative compaction: Before crushing, determine the mass per unit volume of the 7 day specimens to AS 1012.12.2 so that the relative compaction of the cores taken from the same lot of concrete base can be determined.

Compressive strength of concrete

Determination of compressive strength: The average compressive strength of a pair of specimens moulded from one sample unless the two results differ by more than 3 MPa, in which case, the higher result represents the compressive strength of the lot of concrete.

Statistical checking: Use the 7 day and 28 day test results for statistical checking of the nominated mix in conformance with **Compressive strength of concrete.**

Age adjustment: Adjust the compressive strength for the test specimen due to age as follows:

- Age factor: If any specimen is tested more than 28 days after moulding, determine the equivalent 28 day compressive strength by dividing the test compressive strength by the factor applying to the age of the specimen at the time of the test shown in **Concrete conversion factors table.**
- Intermediate ages: For intermediate ages the factor is to be determined by interpolation of the **Concrete conversion factors table.**

Concrete 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

Age of specimen at time of test (days)	Factor
196	1.20
224	1.22
308	1.24
365 or greater	1.25

Removal and replacement: If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa or greater than 45 MPa, remove the lot represented by the test cylinders and replace to conform with **Removal and disposal of concrete base and Replacement of base**.

Deductions: Concrete with a 28 day strength between 33 and 36 MPa may be accepted providing such concrete is subject to a deduction for supply and place concrete in the base in conformance with **Deductions** provided that such concrete represents isolated sections which comprise less than 5% of the area of the lot.

Rejection: If concrete with a 28 day strength less than 36 MPa comprises more than 5% of the area of the lot, reject the lot.

Strength and thickness acceptance: Acceptance of concrete with a 28 day compressive strength between 42 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, follow the procedures detailed in 1132 *Mass concrete subbase*.

Additional cylinders: Coring is required to verify the conformity of any lot, make arrangements 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, at his absolute discretion, use these results to calculate the equivalent 28 day compressive strength of the cores taken.

Acceptance criteria: After testing for compressive strength of cores, the compressive strength of the concrete for use will be approved as 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 placement of up to 50 m³ of base represented by a pair of test specimens cast from a sample of the concrete used in its construction.

Concrete uniformity statistical analysis

Tests: Make a statistical check of the compressive strength of machine placed concrete, using consecutive 7 day test results representing concrete placed in the work for each nominated mix used.

Test method: Mould and test Test specimens for determining the compressive strength of concrete at 7 days in conformance with **Concrete cylinders**.

Results: Analyse test results on the basis of groups of consecutive pairs of specimens.

Mix acceptance: Accept the concrete mix and its method of production are satisfactory if the average compressive strength of any six consecutive pairs of specimens is within the range specified for maximum and minimum compressive strength.

Results under strength: If results show under strength results, submit a report and modify the mix and/or improve the method of production of concrete.

Conformance for thickness

Pavement thickness determination: Assess the pavement thickness by survey level runs after placement, taken on a 5 m grid on the plan area and comparison with subbase survey.

Verification alternatives: As approved:

- To concrete cores cut from the pavement.
- Measurement at the edges.

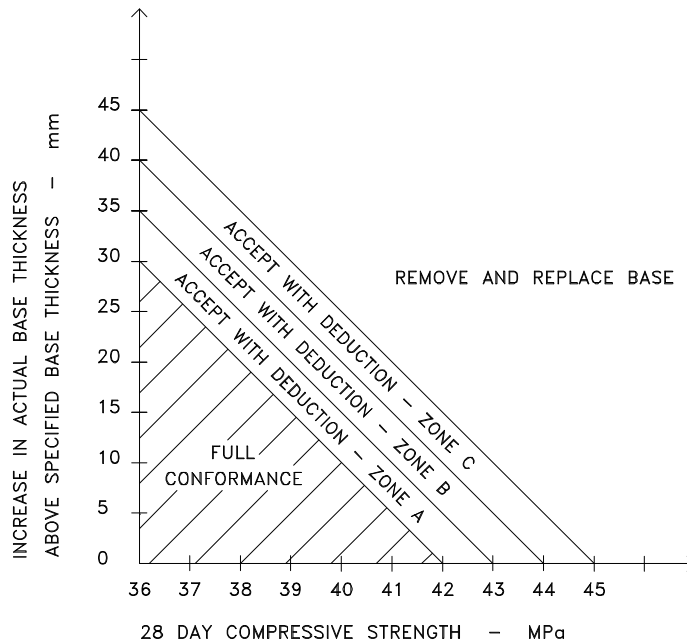
Measurement: Round off to the nearest 5 mm.

Audit checks: If required carry out audit checks using a suitable probe whilst the concrete is being placed. Round off readings to the nearest 5 mm. This is a **WITNESS POINT**.

Remove: Remove base which is more than 10 mm below the specified thickness and replace in conformance with **Removal and disposal of concrete base and Replacement of base**.

Deduction: 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 is subject to a deduction in accordance with **Deductions**.

Excess thickness: If the thickness of the base exceeds the specified thickness, conformance of the base is dependent on both thickness and strength, as shown in **Base conformance criteria (thickness/strength)**.



Base conformance criteria (thickness/strength)

Relative compaction of concrete

Cores: Use cores cut from the work as Test specimens for determining the relative compaction of the concrete placed in the work.

Cutting cores: Cut cores from the full depth of the concrete base in conformance with AS 1012.14, with the following exceptions:

- The requirement that the concrete to be at least 28 days old before the core is removed does apply. However, concrete must not be less than six days old before coring. This period may be adjusted with approval.
- The nominal diameter of the cores not to be less than 75 mm.

Location of cores: To exclude joints, steel reinforcement or tie bars from the core. Mark cores for identification.

Storage: Place cores immediately either in a tank of lime saturated water or in an individual plastic bag and seal 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 or to temperature less than 10°C, until delivered to the testing laboratory.

Frequency of coring:

- Minimum: Take a minimum of one core specimen from each lot of concrete base represented by standard cylinders.
- Hand placed concrete: Take two cores to represent a section of work. A section of work to be confined between construction joints.

- Machine placed concrete: 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.

Restore all core holes: 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. This is a **WITNESS POINT**.

Surface condition of the restored hole: Similar to the surrounding surface in texture and colour.

Guarantee period: Guarantee the integrity of the restored core for a period of 6 months. Repair any damage exhibited within this period.

Costs: Borne by the Contractor.

Curing: Wet condition the core specimens in conformance with AS 1012.14 for not less than 24 hours immediately prior to testing for compaction. Carry out testing to determine specimen mass per unit volume at age seven days.

Relative compaction: 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. The mass per unit volume of both standard cylinders and cores to be determined to AS 1012.12.2.

Costs: Borne by the Contractor.

Rejection: If the relative compaction is less than 97%, remove and replace the lot represented by the core in conformance with **Removal and disposal of base and replacement of base**.

Conditional acceptance: If the relative compaction is between 97% and 98% , acceptance to be conditional on the 28 day strength of a core specimen. Obtain cores for compressive strength testing, unless the concrete base is at least 25 days old at the time of removing the specimen.

Core preparation: Wet-condition, test and prepare core specimens for compressive strength testing in conformance with AS 1012.14. Do not re-use cores obtained for compaction for compressive strength testing.

Adjustment for age: Adjust the test strength for age at test in conformance with **Compressive strength of Concrete** and for length/diameter by multiplying by the correction factor in **Core shape correction factors table**.

Core compressive strength: If the 28 day compressive strength of the core is less than 33 MPa, remove and replace the lot represented by the compaction core in conformance with **Removal and Replacement of base**.

Core shape correction factors 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

4.13 REMOVAL AND REPLACEMENT OF BASE

Removal and disposal

Submission of method: If removing and replacing nonconforming base, submit the proposed method before commencing such work. This is a **HOLD POINT**.

Timing: Do not proceed with breaking up of concrete until adjoining concrete each side of the section (including adjacent paving lengths) for removal has achieved the specified 28 day compressive strength.

Adjoining slab: Remove and replace any adjoining slab damaged by the Contractor.

Transverse sawcut

Location: At each end of the section for removal, make a transverse sawcut in conformance with the following:

- In a straight line continuous between adjacent longitudinal joints.

- Perpendicular to the control line or longitudinal joint,
- Depth: Full depth.
- Not closer than 500 mm to an existing transverse crack in the concrete which is to remain.
- Not closer than 1.5 m to an existing contraction joint.

Face of the construction joint: Leave scabbled below the top 25 mm. Treat as a tied joint

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

Longitudinal joint or edge

Extent: Remove the concrete as follows:

- To an existing longitudinal joint or edge.
- In such a way that the exposed face complies with the criteria for longitudinal construction joints as defined in this worksection.

Sawcut: Do not extend the sawcut 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, do not extend these additional sawcuts beyond the limits of the removal into either the adjacent base or the underlying subbase.

Oversawing: No oversawing is permitted on any additional internal sawcuts the Contractor may make to aid the removal of the base.

Disposal: Dispose of the removed base slabs at an approved location.

Replacement

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

Transverse joint: Deeply scabble the joint faces on the adjoining slab at the transverse sawcuts below. Leave smooth the top 25 mm.

Tie bars: Provide tie bars to form a transverse construction joint in conformance with **Transverse construction joints**.

Longitudinal joint: Deeply scabble the lower two-thirds of the depth of the longitudinal joint faces and remove any concrete considered unsound by the Superintendent.

Formed longitudinal joints: Attach a crack inducer ribbon to the surface of any formed longitudinal joint in the replacement base.

Epoxy resin: Use a hydrophilic epoxy resin to set tie bars placed into hardened concrete. Use 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.

Alignment rectification: Rectify individual locations identified as nonconforming in accordance with **Alignment and tolerances** to achieve conformance by grinding with purpose-built equipment employing sawblades. Do not use impact methods such as rotomilling.

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 title
Water		
Chloride Ion	Less than 300 ppm	Water/General
Sulphate Ion	Less than 400 ppm	Water/General
Aggregates		
General	Mass of the total aggregates in concrete mix to consist of at least 40% quartz sand	Aggregates/General

Activity	Limits/tolerances	Worksection Clause/subclause title
Combined aggregate	Grading limits. Combined aggregate grading table	Aggregates/General
Fine aggregate - Grading	To be within the limits as per Fine aggregate grading table	Aggregates/ Fine aggregates
Coarse Aggregate - properties	To be as per the course aggregate grading and properties table-	Aggregates/ Coarse aggregates
Concrete quality		
Cement content	At least 270 kg/m ³ of concrete	Concrete quality requirements/ Cement and flyash
Flyash	The maximum flyash content not to be more than 50 kg/m ³ of concrete.	
Compressive strength	The minimum 28 day compressive strength to be 36 MPa and the maximum 42 MPa.	Concrete quality requirements/ Compressive strength
Shrinkage	Not to exceed 450 µε after 3 weeks of air drying	Concrete quality requirements/ Shrinkage
Consistency	- For mechanically placed concrete not between 30 and 40 mm. - For hand placed concrete not between 55 and 65 mm. The VeBe reading to be a maximum of 3 seconds at the nominated slump less 10 mm	Concrete quality requirements/ Consistency
Air content	To be 3% to 6% when discharged from the transport vehicle ready for placement	Concrete quality requirements/Air content
Steel reinforcement		
Wire chairs	Chairs to withstand load of 200 kg mass on the chair for one hour at 23 ± 5°C without permanent distortion >2 mm	Steel reinforcement
Spacing of chairs	Placed in a regular grid not exceeding 1 m	
	Placed such that permanent deflection or displacement of the reinforcement is no more than 2 mm during placement and consolidation of concrete	
Fabric splice	Not less than the pitch of the transverse wires + 25 mm	
Longitudinal steel	Minimum cover: 70 ± 10 mm	
Any bar	Minimum cover: 50 mm	
Tie bars	Anchorage Strength > 85% of the yield strength of the bar	
Dowels	Bitumen coated end to have minimum clearance of 30 mm in preformed cap	
Concrete thickness	- With 5 mm less than specified thickness, deduction in scheduled rate	Concrete strength, compaction and thickness
	- With 10 mm less than specified thickness deduction in scheduled rate	
	- Where excess thickness occurs, conformance is dependent upon thickness and strength as per the Figure Base conformance criteria (thickness / strength) .	
Mixing and transport		

Activity	Limits/tolerances	Worksection Clause/subclause title
Truck mixed concrete	Water to be added within 10 minutes of completion of batching	Production and transport
Haul time	Concrete not delivered within allowable haul time to be rejected	
Size of batch	Batch in agitator vehicle not to exceed 80% of gross volume of drum of mixer	
Mixing time	Max. 10 minutes (Split drum mixers, max. 5 minutes)	
Paving machine		Placing and finishing – Mechanical paving
Gross operating mass	> 4 tonnes/lin. metre of paved width	
Paving speed	Capable of 1 m/min or less	
Concrete placing		Placing and finishing – Evaporation and moisture loss
Air temperature	> 5°C, < 38°C	
Concrete temperature	If concrete temperature < 10°C or > 32°C, concrete not to be used	
Alignment and surface		Placing and finishing – Alignment and Tolerances
Horizontal alignment	The outer edges of the base not to deviate from the plan position at any point by more than 30 mm	
Surface level	The top surface of the base not to vary by more than + 10 mm or – 0 mm from that shown on the Drawings. The top surface of the base not to deviate from a 3 m straightedge, laid in any direction, by more than 5 mm.	
Surface texture	Fine broom or Hessian-drag	
Concrete protection		
Temperature	Do not permit the temperature of the concrete to fall below 5°C during the first 24 hours after placing	Placing and finishing – Protection of works
Joints		
Transverse construction	The line of the transverse construction joints not to deviate from a 3 m straightedge placed along the joint by more than 10 mm. Joints to be constructed at 90°± 5° to the longitudinal joint.	Joints - Transverse construction joints
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. The line also not to deviate from a 3 m straightedge by more than 10 mm having made due allowance for any planned curvature	
Ribbon-induced joints	- The inducer ribbon to be a minimum of 0.5 mm thick and when placed it is to be within 5° of the vertical plane	Joints - Ribbon-induced joints
Sawn-induced joints	- The surface not to exhibit more than 5 mm width of vertical or horizontal edge ravelling. The cumulative length of such edge ravelling not to exceed 300 mm in any 1 m length of joint on each edge	Joints - Sawn-induced joints

Activity	Limits/tolerances	Worksection Clause/subclause title
Isolation joints	- The line of the longitudinal isolation joint not to deviate from the specified position by more than 10 mm. The line of the joint not to deviate from a 3 m straightedge by more than 10 mm	Joints - Isolation joints
Concrete relative compaction		
Core size	Nominal diameter of cores > 75 mm	Concrete strength, compaction and thickness
Frequency of coring	Minimum of one core specimen for each lot of concrete represented by standard cylinders	
Repair of core holes	- Compressive strength not less than that in base	
	- Max. nominal aggregate size 10 mm	
Relative compaction values	Should the relative compaction be less than 97% the portion of the base represented by the core to be rejected, removed and replaced. Should the relative compaction be between 97% and 98% acceptance to be conditional on the 28 day strength of the core specimen	

5 MEASUREMENT AND PAYMENT

5.1 GENERAL

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 provisions made in Contract Document.

5.2 DEDUCTIONS

General

Concrete with a 28 day compressive strength between 33 and 36 MPa (**Compressive strength of concrete**) is to be subject to a deduction of 4% of the applicable schedule rate 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 as per Figure (**Conformance for thickness**), are to 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 to be subject to a deduction to the schedule rate, 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.