CESSNOCK
CITY COUNCIL

AUS-SPEC

Infrastructure Specifications

1133 Plain and reinforced concrete Base

1133 PLAIN AND REINFORCED CONCRETE BASE

IMPORTANT: This document has been adapted from the NATSPEC suite of specification templates for use in the Cessnock City Council area by both Council and industry. NATSPEC regularly updates the base templates (currently in April and October each year), and Council may incorporate changes into its version of AUS-SPEC from time to time. To assist in highlighting any changes made by Council to the NATSPEC templates, the following conventions are used.

- See ANNEXURE M at the end of this document which contains (where practical) Cessnock City Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown in brown text like this.
- Where content is deleted or excluded from the main body of the document, it is to be shown ~~struck through like this~~. Such clauses are to have no effect.

Where there is a conflict between main body text and Cessnock City Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 RESPONSIBILITIES

General

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

1.2 CROSS REFERENCES

General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *0136 General requirements (Construction)*.
- *0152 Schedule of rates (Construction)*.
- *0161 Quality management (Construction)*.
- *1101 Traffic management*.
- *1102 Control of erosion and sedimentation (Construction)*.
- *1121 Open drains*.
- *1132 Lean mix concrete subbase*.
- *1172 Subsoil and formation drains*.

1.3 STANDARDS

General

Standard: To AS 1379 (2007), AS 3600 (2018), Austroads AGPT08 (2019) and Austroads AGPT04C (2017).

1.4 INTERPRETATION

Abbreviations

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

- PCP: Plain concrete pavement.
- SCM: Supplementary cementitious material.

Definitions

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

- Batch and load: Varies according to mixer types as follows:
  - Central batch mixers: For mixers discharging into a tipper truck, a load may comprise more than one batch.
  - Mobile batch mixers: A batch is deemed to be a load, a load must not comprise more than one batch.

  - Continuous mixers: A batch is a load produced in a single discrete operation.
- Control line: A line generally at or near the centreline of a road on which the design is based and from which measurements for setting out may be conveniently made.
- Efficiency index: The effectiveness of a curing compound in retaining moisture, assessed as a percentage of water retained in the test specimens relative to the uncoated specimens.
- Geopolymer binder: Polymeric binder formed by reacting alumina-silicate pre-cursers with alkaline activator(s).
- Geopolymer concrete: Geopolymer binder aggregates, water and additives.
- Load: A single truckload of concrete comprising one or more batches.
- Mix: The proportions of component materials in a quantity of concrete.
- Nominated mix: The designed mix submitted for approval.
- Plan area: The Works area.
- Relative compaction: The ratio between the field bulk density and the bulk density of the job mix when compacted in the laboratory.
- Slab: A portion of concrete base bounded by joints or free edges.
- Slab, odd-shaped: A slab is considered odd-shaped if any of the following conditions apply (TfNSW specification TS 03265.1):
  - It contains blockouts, for example, for drainage structure.
  - It is not quadrilateral in plan view.
  - The longest side of he quadrilateral shape exceeds the shortest side by more than 50%.
  - The angle between any two adjacent sides of the quadrilateral differs from 90° by more than 6°.
  - The dimensions measured normal and parallel to the longitudinal joints, are variable within a slab, the maximum value of the ratios applies.
- Slab, mismatched: Where any joint meets a slab and is not continued across that slab.
- Transition zones: Hand paved concrete which is cast in otherwise mechanically paved concrete, such as at transverse construction joints in mechanically paved work.
- Trial mix: Trialling of the nominated mix to demonstrate that the mix design conforms to the documented requirements.
- Vebe testing: A flow test on a vibrating table, used as a measure of workability in a stiff mix.

1.5 TOLERANCES

Alignment and surface tolerances

Horizontal tolerances at outer edges: ±20 mm.

Thickness: -0 mm and +10 mm maximum.

Surface levels: Conform to the following:

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

Concrete consistency

Maximum permissible difference in slump, tested within 40 minutes of completing batching:

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

Nominated slump: ±5 mm of the slump measured in the trial mix.

Joints

Maximum deviation from the documented position: 10 mm.

Maximum deviation from a 3 m straightedge: 10 mm.

Concrete production tolerances table

Description	Tolerance (% by mass)
Particle size distribution (AS sieve):	
19.00 mm	±2
13.20 mm	±5
9.50 mm	±5

Description	Tolerance (% by mass)
4.75 mm	±3
2.36 mm	±5
1.18 mm	±5
600 µm	±5
300 µm	±5
150 µm	±2
75 µm	±0.5
Cement	±2.0
SCM	±4.0
Water	±15.0

1.6 SUBMISSIONS

Execution details

Work method statement: Submit details of the proposed work method including the following:

- Handling, storing and batching of materials for concrete.
- Monitoring and measuring of constituent materials for concrete.
- Mixing and transporting of concrete.
- Placing and finishing of concrete base, including a paving plan showing paving widths, sequence and estimated daily outputs.
- Concrete texturing: Details of texturing device and method of achieving the required texture.

Non-conforming trial section: Submit details of changes proposed for constructing the new trial section including the equipment, materials, mix, plant or rate of paving, to rectify non-conformance.

Removal and replacement of base: Submit details of proposed work method for the removal and replacement of non-conforming base, including control measures for preventing damage to the adjoining base and underlying subbase.

Products and materials

Nominated mix: Submit details of the following:

- Constituent materials:
  - Cement: Brand and source.
  - Fly ash: Powerhouse source.
  - Water: Source.
  - Admixtures: Proprietary source, type, name, dosage recommended by the manufacturer and evidence of conformance to AS 1478.1 (2000).
  - Aggregates: Source, geological type, moisture condition, blend proportions and grading for each type of aggregate.
  - Soluble salt content.
- Mix design:
  - Constituent quantities per m^3 of concrete.
  - Nominated particle size distribution of aggregates, including fine, coarse and combined particle size distribution.
  - Forming time for each nominated mix.
- Trial mix test results: For each nominated mix, determined at the nominated slump, showing conformity for the following, as appropriate:
  - Content of cement, flyash and content of cementitious material per yielded m^3 of concrete.
  - Compressive strength at 28 days.
  - Vebe reading.
  - Drying shrinkage after 21 days air drying.
  - Air content, if air entraining agent is used.

Sealants: Submit details, from the manufacturer, of the proposed sealing method, testing results, evidence that the sealant is compatible with the materials to be sealed and suitable for the documented joint dimensions.

Steel reinforcement: Submit evidence of conformity with AS/NZS 4671 (2019).

Records

Subbase survey: Submit a work-as-executed survey of the subbase to **SITE ESTABLISHMENT**, **Subbase survey**.

Alignment and surface tolerances: Submit survey to verify that the base alignment, surface levels, joints and edges conforms to the requirements of this worksection.

Samples

Curing compounds: Submit reference sample for testing.

Tests

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES**.

Requirement: Submit results, as follows:

- Uniformity testing: Evidence of conformity.
- Trial concrete base paving: To demonstrate conformance for compressive strength, compaction and thickness.

Variations

Approved nominated mix: If change to the mix is proposed, submit details of the alternative mix, including its production method and source of constituent materials.

1.7 INSPECTIONS

Notice

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

- Trial mix: Mixing of the trial mix.
- Trial section construction: Completed trial concrete base.
- Non-conforming trial section: If the original trial section is deemed non-conforming, completed new trial section.
- Placing steel reinforcement: Steel reinforcement and embedment in place before placing concrete.
- Repairing core holes: Completed restoration of cored areas where testing specimens were extracted.
- Base sawcuts: Completed removal of non-conforming base before replacing with new base.
- Replacement of base: Completion of remedial work for non-conforming base thickness.

2 MATERIALS

2.1 GENERAL

Nominated mix

Variations to the nominated mix: Any change without approval is subject to removal from the Works, and replacement or repair required.

Storage and handling

Cement more than 3 months old (from date of manufacture): If required, retest to verify cement conforms to AS 3972 (2010) before using.

Transportation: Transport cement in watertight packaging, protected from moisture.

Storage and handling facilities: Prevent the aggregates becoming intermixed, mixed with foreign materials or segregated.

Non-conforming storage and handling facilities of concrete mix: If found, stop concrete production and delivery of materials until condition is rectified.

Storing cement bags: Under cover and clear of the ground.

- Cement storage area flooring: Concrete.

2.2 CEMENT

General

General purpose and blended cement: To AS 3972 (2010).

Caked or lumpy cement: Do not use.

Minimum cement content: 300 kg/m^3 of concrete yielded.

Geopolymer concrete

Geopolymer concrete: To SA TS 199 (2023) and supply of geopolymer concrete to Austroads ATS 5330 (2020).

2.3 FLY ASH

General

Requirement: Fine grade fly ash to AS/NZS 3582.1 (2016).

2.4 WATER

General

Mixing water: To AS 1379 (2007) clause 2.4.

Requirement: Clean potable water, free from any material which may be harmful to the concrete or reinforcement including oil, acid, alkali, organic or vegetable matter.

Limits of impurities in mixing water: To AS 1379 (2007) Table 2.2 and the following:

- Chloride ion: Maximum 300 parts per million to AS 1478.1 (2000) Appendix C.
- Sulfate ion: Maximum 400 parts per million to AS 1289.4.2.1 (2020).

2.5 ADMIXTURES

General

Chemical admixtures: To AS 1478.1 (2000).

Requirement: Free of calcium chloride, calcium formate, or triethanolamine or any other accelerators.

Chemical admixture dosage: To the manufacturer's recommendations for the air temperature and setting time.

Combining admixtures: Do not combine without verification from the admixtures manufacturers that they are compatible.

Mixes with less than 50% flyash: Make sure total alkali contribution from all admixtures does not exceed 0.20 kg/m^3.

Superplasticisers and high range water reducers Type HWRRe: May be used in non-paving applications including anchors and subgrade beams.

2.6 AGGREGATES

General

Properties: To AS 2758.1 (2014) and the following:

- Clean, durable materials sourced from natural gravel, crushed stone, air-cooled iron blast furnace slag and sand. Do not use steel-plant slag.

Samples for testing: Take from dedicated stockpiles or from materials delivered to site.

Combined aggregate: Make sure the particle size conforms to the **Combined aggregate grading table**.

Blending of aggregates: If blending two or more fine aggregates or two or more coarse aggregates, make sure the aggregate from each source conforms to the **Fine aggregate properties table** or **Coarse aggregate properties table**, as appropriate.

Combined aggregate grading table

AS sieve	% passing by mass
19.00 mm	95 – 100
13.20 mm	75 – 95
9.50 mm	55 – 75
4.75 mm	36 – 50
2.36 mm	30 – 42

AS sieve	% passing by mass
1.18 mm	22 – 34
600 µm	16 – 30
300 µm	5 – 15
150 µm	0 – 7
75 µm[a]	0 – 4[b]
2 µm[b]	0 – 1.0[b]
a. Determine to AS 1141.12 (2015) (calculated washed blend). b. Assess conformance to **Fine aggregate**. Note: The aggregate grading is based on materials of equal particle densities in a saturated surface dry condition. If particle densities vary by more than 20%, adjust the grading accordingly.	

Fine aggregate

Requirement: Clean, hard, tough, durable, uniform, uncoated grains. Conform to AS 2758.1 (2014) for bulk density, water absorption, materials finer than 2 µm, impurities and reactive materials.

Size: 4.75 mm maximum.

- Permissible deviations: To AS 2758.1 (2014) Table 2.

Fine aggregates properties table

Property	Test: Individual or Total fine[a]	Requirement	Test method
Bulk density (compacted)	Individual	1200 kg/m^3 minimum	AS 1141.4 (2000) Procedure 7.2
Water absorption	Individual	5.0% maximum	AS 1141.5 (2000)
Soundness (sodium sulfate)	Individual	6.0% maximum weighted average loss	AS 1141.24 (2018)
Organic impurities	Total fine	Pass/fail (AS 1141) and 0.5% maximum (AS 1289) [b]	AS 1141.34 (2018) and AS 1289.4.1.1 (2019)[b]
Sugar content	Total fine	< 1 part in 10,000	AS 1141.35 (2019)
Acidic insoluble residue[d]	Total fine	60% minimum[d]	Texas DOT test Tex-612-J (2000)
Micro-decal loss[d]	Total fine	15% maximum[d]	ASTM D7428 (2015)
Fine cone time[c]	Total fine	27 seconds maximum	RMS T279 (2012)
Glass content[e]	Total fine	15% maximum[d]	RMS T279 (2012) and AS 1141.5 (2000)
a. Total fine: Calculate based on Individual component results with proportioning as per the nominated mix, or test the mixed total fine aggregate blend. b. Test initially to AS 1141.34 (2018). If organic impurities are present, test to AS 1289.4.1.1 (2019). c. Fine cone testing is not mandatory if the manufactured fine aggregates is less than 20% (by mass) of the total fine aggregate. d. As a proportion of the total fine aggregate component. e. Supply of recycled crushed glass to Austroads ATS 3050 (2022).			

Coarse aggregate

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

Aggregate size: Less than AS 26.50 mm sieve.

- Permissible deviations: To AS 2758.1 (2014) Table 1.

Alkali-aggregate reactivity (AAR): Determine the AAR to Austroads AGBT/T701 (2020) and conform to the following for the appropriate classification:

- Non-reactive: No action required.
- Slowly reactive: Limit alkalis in the mix to 2.1 kg/m^3.

- Reactive: Using the nominated supplementary cementitious materials (SCM) and aggregates, test to AS 1012 to demonstrate that they are non-reactive.

Coarse aggregate properties table

Property	Requirement	Test method
Bulk density	≥ 1200 kg/m^3	AS 1141.4 (2000)
Particle density	≥ 2100 kg/m^3	AS 1141.6.1 (2000), SSD[a] method
Water absorption	≤ 2.5%	AS 1141.6.1 (2000)
Material finer than 75 µm	≤ 1%	AS 1141.12 (2015)
Material > 9.50 mm: Particle shape, 2:1 and 3:1 ratios	≤ 25% and 10%	AS 1141.14 (2007)
Material ≤ 9.50 mm: Ratio AGD/ALD[b] for all fractions 2 - 9 mm	≤ 2.25	AS 1141.20.1 (2000) and AS 1141.20.2 (2000)
Wet strength	≥ 80 kN	AS 1141.22 (2019)
Wet/dry strength variation	≤ 35%	AS 1141.22 (2019)
Weak particles	≤ 0.3%	AS 1141.32 (2019)
Light particles	≤ 1.0%	AS 1141.31 (2015)
Fractured faces (2 or more)	≥ 80%	AS 1141.18 (2022)
Foreign matter contents	≤ 0.1%	RMS T276 (2012)
a. SSD = Saturated surface dry b. Ratio AGD/ALD = Ratio of Average Greatest Dimension to Average Least Dimension		

Recycled concrete aggregate

Coarse aggregates from demolition concrete: To the recommendations of Austroads AGPT04E (2022) and ARRB Best Practice Guide 1 (2020) - *Road materials*.

2.7 STEEL REINFORCEMENT

General

Steel reinforcing materials: To AS 3600 (2018) clause 17.2 and Austroads AGPT04C (2017) clause 5.

Supply and placement of reinforcing steel: To Austroads ATS 5310 (2020).

Grade, type, shape, dimensions and lapped splices: As documented. Make sure grade, type and size can be readily identified on the reinforcement.

Surface condition: Free from loose mill scale, rust, grease, tar, paint, oil, mud, mortar or any other material which may reduce the bond between the reinforcement and the concrete. Do not bring surface to a smooth polished condition.

Bar chairs: Plastic bar chairs or plastic tipped wire chairs to AS/NZS 2425 (2015) and capable of withstanding a load of 200 kg mass on the chair for one hour at 23 ±5°C without malfunction.

Galvanized bars: Hot-dip to AS/NZS 4680 (2006).

Cold-worked reinforcing bars: Do not use.

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

Tie bar minimum lengths: 1.0 m with drill ties minimum 0.75 m long.

Dowels

Fabrication and mechanical properties: To AS/NZS 3679.1 (2016).

Condition: Straight and free of irregularities, including burrs and protrusions which may hinder their movement.

Length: 450 mm.

2.8 SEALANTS

Silicone joint sealant requirements table

Attribute	Requirements	Test method
Specific gravity	1.1 to 1.55	ASTM D792 (2020) (Method A)
Extrusion rate	90 to 250 g/minute	ASTM C603 (2014)

Attribute	Requirements	Test method
Tack free time	Track free at 5 hours	ASTM C679 (2015)
Durometer hardness	≤ 25 at -29°C ≤ 30 at +23°C	ASTM C661 (2015)
Adhesion to concrete	Extension to 70%, compression to 50%. After 500 cycles, note more than 10% failure over the cross-sectional area.	RMS T1192 (2012)
Accelerated ageing	Condition of specimen after one ageing cycle.	RMS T1193 (2012)
Adhesion to concrete	Minimum 35 N average peel strength	ASTM C794 (2018)
Accelerated weathering	No surface crazing, hardening, chalking or bond loss at 5000 hours	ASTM C793 (2023)
Colour	Grey, compatible with pavement concrete	N.A.

2.9 CURING COMPOUNDS

General

Compounds for curing: To Austroads AGPT04C (2017) clause 6 and the following:

- Bituminous emulsions: To AS 1160 (1996).
- Liquid curing compounds: To AS 3799 (1998).

Water retention efficiency index: Minimum 90% when tested to AS 3799 (1998) Appendix B.

Reference sample testing: To AS 3799 (1998) Test for conformity to the following tolerances in AS 3799 (1998):

- Non-volatile content.
- Efficiency index.
- Density.
- Drying time.
- Viscosity.
- Infrared spectrum.

Curing compound properties table

Compound type	Class to AS 3799 (1998)	Use limitations
Hydrocarbon resin (HCR)	Class B with ≥ 30% NV resin content	Do not use where a bitumen seal or asphalt will be placed
Waterborne hydrocarbon resin (WHCR)	Class B with ≥ 30% NV resin content	Do not use where a bitumen seal or asphalt will be placed
Styrene butadiene resin (SBR)	Class B	Do not use where a bitumen seal or asphalt will be placed
Blended bitumen and waterborne hydrocarbon resin (B-HCR)	Class Z with ≥ 40% bitumen	Make sure it is compatible with the primer that will be applied later
Wax emulsion (WE)	Class A with ≥ 30% NV resin content	Do not use on the top surface. Use only for debonding joints.

2.10 CONCRETE PROPERTIES

General

Properties: To AS 3600 (2018) Section 3.

Compressive strength

Sampling and testing: To **TESTING** and **Trial mixes**.

Minimum concrete strengths table

Description		Compressive strength (MPa)	Flexural strength[a] (MPa)
Non-SCM mixes[b]	In the trial mix	45.0	5.0
	In the Works	40.0	4.8
SCM mixes[b]	In the trial mix	40.0	4.8
	In the Works	35.0	4.5
Test specimen size		100 mm diameter cylinder	100 x 100 x 350 mm beam
a. Applicable to base pavement mixes only. Not applicable to non-pavement mixes such as anchors and kerbs. b. SCM: Mixes containing supplementary cementitious materials.			

Drying shrinkage

Testing: To AS 1012.13 (2015) and the following:

- Testing time: In the trial mix.

Preparation of test specimen: To AS 1012.8.4 (2015).

Assessment of conformity: The specimen is only required to conform for shrinkage at one age, either after 21 or 56 days drying period. If the test results do not conform at 21 days, extend testing to 56 days.

Maximum shrinkage strain table

Mix type	Shrinkage strain (με)	
	21 days drying period	**56 days drying period**
GGBFS mixes[a]	580	680
Other mixes	450	580
a. GGBFS: Having minimum 40% ground granulated iron blast-furnace slag by mass.		

Consistency

Requirement: As required to allow the production of a dense, non-segregated mass with bleeding limited to prevent bleed water flowing over the slab edge under the conditions of pavement. Make sure the slab edge will maintain its shape and not sag or tear.

- Bleed water flowing over the edge: Stop paving until the mix is adjusted or redesigned to approval.

Testing time: Check consistency within 30 minutes of adding cement to aggregate. If actual haul time exceeds 45 minutes, check consistency immediately before discharging.

Slump range:

- For mechanically placed concrete, except at transitions: 15 to 50 mm.
- For hand placed concrete: 50 to 70 mm.
- Paving in transition zones: 15 to 70 mm.

Non-conforming concrete: Do not incorporate into work.

Air content

Content: 3 to 6% when discharged from the transport vehicle ready for placement.

Non-conformance: If air content is not within the required limits, repeat testing immediately from another portion of the sample.

Compaction

Testing: Conform to **TESTING, Relative compaction of pavement**.

Minimum relative compaction: 98%.

Other concrete attributes

Chloride ion content: Maximum 0.8 kg/m^3 of concrete.

Sulfate ion content: Maximum 5% relative to cement mass, excluding supplementary cementitious materials such as flyash and slag.

Bleeding: Maximum 3%, tested in the trial mix.

2.11 TESTING

Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Quality verification: If material/product quality verification can be obtained from the supplier, documented tests need not be repeated.

3 EXECUTION

3.1 NOMINATED MIX

Trial mix

Requirement: Before starting production of each mix, mix a trial batch of each nominated mix for testing as follows:

- Sampling: To AS 1012.1 (2014).
- Preparation of cylinders: Inspected, capped and crushed to AS 1012.9 (2014).
- Unit mass: Determine to AS 1012.12.1 (1998) or AS 1012.12.2 (1998) after dressing of voids in the specimen.

Compressive strength testing: Use 3 specimens conforming to the following:

- Cylinders: 28 days old concrete.
- Size: 100 mm nominal diameter.
- Sampling: From the same concrete.
- Specimens more than 28 days old: Adjust the age to the **TESTING**, **Concrete age conversion factors table**.

Testing: To the **Ready-mixed concrete production and supply table** in the **ANNEXURES**.

Date of testing: Maximum 18 months before starting paving.

3.2 PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE

Standard

Handling, storing and batching of materials, mixing, transport and consistency of concrete: To AS 1379 (2007) Section 4 and Appendix A.

Mixers: To AS 1379 (2007) clause 3.5.

Storage and handling

Aggregate stockpiling: Stockpile on clear, even, well-drained, firm ground or constructed floor, separate from each other so that there is no cross contamination or segregation.

- Lots: Organise separate stockpile for each lot.
- Signposting: Identify lot number, aggregate type and quantity of material.

Aggregate moisture content: Determine at least twice daily immediately before batching and make corrections to quantities of aggregate and water, as appropriate.

Cementitious material: Weigh separately with an individual hopper, weighing the cement first.

Continuous type mixer: If used, measure using a continuous weighing method, except for liquids which may be measured by volume or flow rate meter.

Volumetric batching of water: Measure with a device calibrated in one litre increments.

Concrete for manually placed concrete: Deliver concrete in agitator vehicles.

Steel reinforcement: Protect from the weather with a waterproof cover and store above the ground.

Mixing and batching

Stationary mixers producing centrally mixed concrete: If used, discharge the whole batch into the tray of a moving vehicle for the purpose of performing mixer uniformity tests to AS 1379 (2007) Appendix A.

- Mixer uniformity tests sampling points: Approximately 15% and 85% along the length of vehicle tray.

Truck-mixed concrete: Water may be added, to AS 1379 (2007) within 10 minutes of completion of batching and 200 m of batching facilities.

Size of batching in an agitator: Do not exceed the manufacturer's rated capacity or exceed 80% of the mixer drum gross volume.

Continuous type mixer: If used, do not run plant at a greater rate than the manufacturer's recommended rated capacity. Reduce production rate if the quality of concrete produced shows a longer mixing time is required.

Mixing time – stationary batch mixers: Measured from when at least 90% of the total water content and all other ingredients are in the mixing drum, until mixing stops or after the required revolutions. Up to 10% of the total water may be added after the defined mixing time if:

- Split drum mixers: There is minimum 30 seconds of mixing after final addition of water.
- Twin shaft mixers: There is minimum 15 seconds of mixing after final addition of water.

Mixing time – mobile mixers: Measured as from when all the ingredients are in the mixing drum, until mixing stops or after the required revolutions. If additional water is required, conform to **Retempering**.

Minimum mixing time: Conform to the following:

- Twin shaft mixers: Mixing time after charging not less than 30 seconds +5 sec/m^3.
- All other stationary batch mixers: Mixing time after charging not less than 54 seconds +6 sec/m^3.
- Mobile batch mixers: Mixing time not less than that shown on the mixer identification plate or 3.0 minutes, whichever is the greater.

Maximum mixing time: Conform to the following:

- Generally: 10 minutes.
- Split drums and twin shaft mixers: 5 minutes.

Retempering

Addition of water: To AS 1379 (2007) clause 4.2.3.

Adding admixture

Requirement: Separately predilute with mixing water before adding to other materials. Incorporate using a method that does not cause adverse interaction, as recommended by the admixture manufacturer.

Adding to mix water: Use one of the following methods:

- Add into water weighhopper.
- Direct add into water feed line during water batching.

Adding to a mobile mixer after completion of batching: Immediately after adding, remix adjusted batch for minimum 55 revolutions at minimum mixing speed of 30 revolutions, as required to re-establish mix uniformity.

Production and transport

Transport and production equipment: Use equipment which:

- Prevents segregation or loss of materials.
- Supplies a homogenous product.
- Provides concrete workability compatible with the capacity of the paving equipment to achieve the required compaction and nominal finish, and requires only nominal manual finishing.

Equipment capacity for slipform paving: Use mixing, agitation and transportation equipment with sufficient capacity for continuous paving at the required speed.

Forming time

Maximum forming time: Determine time required for each mix to achieve the required concrete workability, taking into consideration prevailing weather conditions and concrete temperature.

Monitoring: Monitor and record forming time for any batch exceeding the following:

- Air temperature < 30°C: 90 minutes.
- Air temperature ≥ 30°C: 60 minutes.

Conformity of batch: Determined conditional on the compressive strength of the cores from that batch.

Uniformity testing

Uniformity tests: To AS 1379 (2007) Appendix A.

Uniformity conformance: The mixer is deemed to conform if:

- Central batch and continuous mixers:
  . Testing of batches result in 3 consecutive passes.

  - . In each batch, the highest and lowest value does not exceed those in AS 1379 (2007) Table A1.
  - . No slump value is outside the required range.
  - . Coefficient of variation for compressive strength (CoV_C): Less than 4.5%.
  - . Coefficient of variation for mass unit volume (CoV_{MUV}): Less than 1.0%.
- Mobile batch mixers: To AS 1379 (2007) Table A1.

Concrete delivery

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

- Batch number: Issued sequentially with the batching order.
- Supplier name and location.
- Volume of material supplied, including amount of water.
- Product identification.
- Dispatch time and date.

Segregated or non-uniform mix: Do not deliver.

3.3 CONSTRUCTION PLANT AND EQUIPMENT

Paver machine

Mechanical paver: Use pavers conforming to the following:

- With an automatic control system, including a sensing device for controlling line and level to the documented tolerances.
- With internal vibrators capable of compacting the full depth of the concrete.
- With adjustable extrusion screed and/or conforming plate for forming the slab profile and producing the required finish on all surfaces.
- Capable of paving the documented slab widths or a combination of slab widths and slab depths.
- Able to spread the mix uniformly and regulate the flow of mix to the vibrators without segregation of components, to produce a dense and homogenous slab with a smooth uniform finish, requiring minimal hand finishing.

Spreading device

Requirement: Use before using mechanical paver as follows:

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

3.4 SITE ESTABLISHMENT

Subbase survey

Measuring base invert levels: If spray sealing is required for the underlying layer, take levels on the top of the seal after removal of foreign or loose material such as aggregate.

Survey method: Survey on a 5.0 m grid or a plan area, reporting levels to the nearest mm.

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

Non-conforming levels: Adjust pavement levels locally, this may include trimming and adjusting the paving layer.

3.5 CONCRETE BASE PAVING TRIAL

Trial section construction

Requirement: Before starting normal concrete base paving, construct a trial section of the concrete base on the carriageway as follows:

- So that it may be incorporated in the finished work.
- Construct separate trial sections, for each concrete base type, in a continuous operation without intermediate construction joints.
- Length:
  - . 50 to 100 m for mechanical placing in one continuous operation.
  - . 15 to 50 m for manual placement with a 20 m^3 minimum volume.

- Width: Same as that documented for the Works.
- Demonstrate methods proposed for applying curing compound, construction and sawing of joints, and the placement of tie bars and dowels.

Materials and methods: Use the same materials, concrete mix, equipment and methods for the entire works.

Non-conforming trial section

Requirement: If the trial concrete base is deemed non-conforming, remove the non-conforming base, rectify any damage caused by the removal, and construct the new trial base in conformance with **REMOVAL AND REPLACEMENT OF BASE**.

3.6 SLAB ANCHORS

General

Bonded anchors: To Austroads ATS 5860 (2023).

Location: Construct anchors normal to the control line, extending over the full width of the base, to the documented dimensions and locations.

Associated transverse expansion joint spacing: Minimum 2 m from other transverse joints.

Excavation

General: Remove all loose material, trim the vertical faces to neat lines and recompact the bottom of the trenches, where required, to match the degree of consolidation of the adjacent undisturbed material.

Excavated material: Dispose off-site.

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

Remediation: Rectify any disturbance or damage to the flexible pavement.

Subsoil drains: Provide a subsoil drain at the bottom of the trench conforming to *1172 Subsoil and formation drains*.

Construction

Anchor types: Construct anchors as follows Types are generally based on those in RMS QA Specification TfNSW TS 03271.1R83 Concrete Pavement Base and the RMS Pavement Standard Drawings, with modifications as documented in the project Drawings:

- Bridge approaches: Use Type 12 or 18.
- Flexible pavement transverse interfaces: Use Type 6 or 12 as documented.
- On steep grades: Use Type 12 at documented locations as documented.

Method: Produce, transport and place concrete to **CONCRETE PLACING AND FINISHING, Hand paving**.

Sequence: Cast anchors minimum 24 hours before constructing the overlying base. Pour slab anchors separately from the base slabs up to the top surface of the subbase.

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

Steel reinforcement: Conform to **STEEL REINFORCEMENT** and as documented on drawings.

Concrete: Use concrete with the following properties:

- Strength grade: N32.
- Aggregate: 20 mm.
- Slump: 40 to 80 mm at the point of placement.

Concrete placement: Place concrete and compact using internal vibration conforming to **Hand paving**.

Anchor stirrups: Lap to the base reinforcement.

At junctions with an existing flexible pavement: Make a straight sawcut for the full depth of any asphalt in the flexible pavement, along the joint line. Excavate trench without disturbing or damaging the existing pavement. Rectify any damage or disturbance.

3.7 INSTALLATION OF STEEL REINFORCEMENT

General

Construction requirements of reinforcing steel: AS 3600 (2018) clause 17.2.

Reinforcement: Do not carry out the following:

- Bend or straighten so that it will damage the material.
- Use with kinks or bends which are not documented.

Tack welding: To AS/NZS 1554.3 (2014). If required, obtain approval for locations.

Placing steel reinforcement

Placing and securing: Secure the reinforcement in position by blocking from the forms, by supporting on bar chairs or metal hangers and by tying together with annealed tie wire.

- Perimeter enclosing bar chair: Provide minimum 25% voids.
- Gap in chair below the reinforcement: Minimum 1.5 times the maximum nominal size aggregate in the concrete mix.
- Order: Place longitudinal steel on top of the transverse steel.

Supports: Concrete, plastic or wire chairs. Do not use the following:

- Wooden supports, pieces of aggregate or metal supports which extend to any surface of the concrete.
- Support chairs likely to impede compaction of the enveloping concrete.

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

Bearing at chair base: Sufficient to prevent overturning.

Mass loading without distortion: Capable of supporting a 200 kg mass without permanent distortion more than 2 mm.

Mass of reinforcing steel supported by one bar chair: Maximum 10 kg.

Support layout: In a maximum 0.9 m regular grid.

Ends of bars: Securely wire together bars forming a lapped splice in minimum two places.

Steel mesh reinforcement: Place mesh as follows:

- Within 80 mm ±20 mm of the finished top surface of the base slab.
- 80 mm ±20 mm clear of all joints and edges.

Concrete cover

Minimum bottom cover: as documented, or if not documented, 50 mm to the nearest concrete surface or as documented.

Minimum top cover: as documented, or if not documented, 70 mm ±10 mm.

Tie bars

Method of inserting tie bars: Place bars in conformance with the following:

- So that they remain in their required location after concrete placement.
- So that there is no disturbance to the finished concrete surface.
- Do not place tie bars through the finished upper surface of the pavement.
- Place either manually before placement of concrete, by a bar vibrator into the edge of the joint or by an automatic tie bar inserter on the mechanical paver.
- For fixed form paving, vibrate tie bars in their final position by either internal vibration or by vibrating screed board.
- So that bars extending from any face of base concrete or gutter is anchored to develop 85% of the yield strength of the bar in tension.

Longitudinal tied joints: Place tie bars conforming to the following:

- Not closer than 300 mm to a transverse untied joint, contraction or isolation joint.
- Not closer than 200 mm to a transverse tied joint.
- Within the central third of the slab depth but with minimum clearance of 30 mm to any crack inducer or sawcut.
- At documented spacing ±20 mm on spacing of individual bars.

Transverse joints: Place bars not closer than 300 mm to a longitudinal joint or slab edge.

Dowels

Before installing: Coat one end of the dowel with a tough, durable debonding agent as follows:

- Coating thickness: 0.75 mm ±0.25 mm.
- Coating length: Minimum 275 mm.
- Sanding: Sand coated ends, as required, to allow free movement of the concrete base slab when the temperature varies.
- At formed joints: Debond within the second placed slab.

Dowelled joints: Install dowels before paving. Conform to the following:

- Place at mid-depth ±20 mm, parallel to the pavement surface and normal to the line of the joint, as documented.
- Use a dowel support assembly. Make sure no part of the assembly, except the dowel, crosses the joint.
- At expansion joints: Debond end to provide a clearance for movement equal to the width of the joint plus 15 ±5 mm.
- Equally position about the line of the intended joint within a tolerance of ±25 mm.
- Do not place closer than 150 mm to a longitudinal joint or slab corner.
- Average bonding stress: Maximum 0.15 MPa.

Alignment tolerance of individual dowel location:

- In the dowel assemble: ±2 mm.
- In the finished slab: ±2 mm.

Bending

Requirement: Bend without impact or damage to the bar.

Bend procedure: To AS 3600 (2018) clause 17.2.3.1 using one the following:

- Cold bending around pins.
- Applying uniform heat not exceeding 450°C to the portion to be bent.

Internal diameter of reinforcement bend and hooks table

Type of bar	**Minimum internal diameter of bend**
(a) Normal bends:	
Fitments: Bar grade 250 and wire grade 450	3 db
-Fitments: Bar grade 500	4 db
-Mesh and bars other than (b) and (c)	5 db
(b) Bends designed to be straightened or rebent subsequently:	
-db < 28 mm	5 db
-db ≥ 28 mm	6 db
(c) Bends in reinforcement epoxy coated or galvanized before or after bending:	
-db ≤ 16 mm	5 db
-db ≥ 20 mm	8 db
Note: db = Nominal diameter of a bar or wire.	

Lapped splices

Requirement: Weld or securely tie together in at least 2 places the ends of bars forming a lapped splice.

Minimum length of lapped splices: To AS 3600 (2018) clause 13.2.

Splices in reinforcing fabrics: To AS 3600 (2018) clause 13.2.3 so that the two outermost transverse wires of one sheet overlap the two outermost transverse wires of the lapping sheet.

- Orientation of sheets: Make sure sheets mechanically engage each other.
- Sheet overlap: Not less than the pitch of the transverse wires plus 25 mm.

Splice lengths

Bar type	**Bar diameter (mm)**	**Splice lengths (mm)**
Deformed	12	360

Bar type	Bar diameter (mm)	Splice lengths (mm)
	16	525
	20	600
	24	900
	28	1050
	32 and 36	1200
Plain (fitment)	db < 13 mm	50 db or 30 mm, whichever is greater
Note: db = Nominal diameter of a bar or wire.		

Odd-shaped and mismatched slabs

Reinforcement: Minimum SL 82 reinforcing fabric at top layer or as documented. Place fabric clear of all transverse and longitudinal joints by 50 to 100 mm.

Minimum cover: 50 to 60 mm to the surface of the base.

3.8 CONCRETE PLACING AND FINISHING

Subbase

Subbase surface condition, at time of base paving: Clean and free of loose or foreign matter, including sealing aggregate, and does not hold pond water.

Subbase treatment: Conform to the following, as appropriate for the subbase material:

- Lean mix concrete subbase: Treat with a debonding agent conforming to **CURING AND DEBONDING** in the *1132 Lean mix concrete subbase* worksection.
- Asphalt subbase: Make sure the surface condition, at time of base paving, minimises mortar and water absorption from the base concrete.
- Other subbase: Seal with a bituminous spray or bituminous emulsion.

Ambient conditions

Concrete placing: Do not place if:

- Rain appears imminent or during rain.
- Air temperature in the shade is below 5°C or above 35°C.
- Concrete temperature at the point of discharge is less than 10°C or more than 32°C.

Concrete temperature: Measure and record the concrete temperature at the point of placement.

Diurnal temperature changes ≥ 20°C: Make sure the upper limit of the concrete temperature is not more than 30°C before placing.

Surface temperature: Monitor the concrete surface temperature for the first 24 hours after placement, make sure it does not fall below 5°C.

- Measurement: Using a purpose-made thermometer, measure at 2 or more locations within each day's paving.

Evaporation and moisture loss

Evaporation limit: If the rate of evaporation exceeds 0.50 kg/m^2/hr, when determined from **ANNEXURE – RATE OF EVAPORATION**, prevent excessive moisture loss using approved measures or cease work.

Evaporation retarder: If required to prevent excessive moisture loss, apply by fine uniform spray after all finishing operations have been completed, except minor manual bull-floating. If re-application is required, carry out after level floating without incorporating the retarder into the surface mortar.

Monitoring and inspection: Regularly inspect plastic concrete to monitor the effectiveness of the procedures.

Paving generally

Requirement: Place, pave and finish concrete as follows:

- Prevent segregation or loss of materials.
- Prevent premature stiffening.
- Produce a uniform, dense, homogenous slab throughout the pavement.
- Expel entrapped air and make sure reinforcement and embedments are closely surrounded.

- Produce the documented thickness and surface finish.

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

Non-monolithic concrete: If subsequent testing at the location of an interruption indicates the presence of non-monolithic concrete, remove and replace concrete to **REMOVAL AND REPLACEMENT OF BASE**.

Ponding: Not acceptable.

Mechanical (slipform) paving

Requirement: Spread, compact, screed and finish freshly placed concrete to form a dense, homogenous slab with a smooth uniform finish requiring minimal hand finishing.

Slab edge produced: Able to maintain its shape without sagging or tearing. If excessive bleed water occurs, by flowing over the slab edge, stop paving until the mix consistency has been adjusted to prevent the flow.

Supplementary manual vibration: If mechanical paving is unable to fully compact and finish the concrete, such as at transverse construction joints, use manual vibration.

Paving continuity: Make sure the supply of concrete and concrete paving operations are continuous so that the mechanical paver does not require stopping once spreading commences.

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

Hand paving

Application: Use hand placement in areas where mechanical placement is not practical.

Formwork: Construct formwork conforming to the following:

- So that it can be removed without damaging the concrete.
- True to line and grade.
- Braced sufficiently to support wet concrete.
- Mortar tight.
- Debonded to prevent adhesion of concrete to the forms.
- Set to tolerances equivalent to that required for the finished subbase finish.

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

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

Standby vibrators: ¼ of the vibrator number in use, with a minimum of 1 vibrator.

Internal vibration: Compact concrete using internal vibrators to operating parameters suitable for site conditions. Use systematic spacing and duration for producing a homogenous slab with uniform and thorough compaction conforming to **TESTING**, **Relative compaction of pavement**.

Internal vibrators: Use vibrators with the following operating parameters:

- Minimum diameter: 50 mm.
- Operating frequency: 8000 to 12000 vibrations/minute (130 to 200 Hz).
- Method of vibration: Vibrate using either the drip, drag or modified drag method.

Following internal vibration: Compact and finish the concrete by minimum two passes of a hand-guided vibratory screed conforming to the following:

- Traversing the full width of the slab on each pass.
- Screed length: Compatible with the slab width under construction.
- Construction: Tubular steel trusses or rigid metal and/or timber.
- Operating frequency: 3000 to 6000 vibrations/minute (50 to 100 Hz) and minimum amplitude of 0.3 mm.

Concrete head in front of the screed: Maintain a suitable head over the whole screed length to allow uniform transmission of vibration into the slab.

Concrete surface disturbance: If there is a significant disturbance, such as walking in the mix, provide at least two passes of the screed.

Power trowelling: Do not use on the surface.

Terminal slabs

Placement location: Construct at adjoining bridge approach slabs and where there is a change from a rigid pavement to a flexible pavement, as documented.

Surface texture

Requirement: Texture the concrete surface by hessian drag and tining except where:

- Tining is not required beneath bituminous or asphalt surfacing.
- Light brooming is required instead of hessian drag.

Hessian drag and brooming (initial texturing): Adjust drag length or broom type, as required, to produce the documented finish. Maintain or replace, as appropriate, to produce a uniform consistent texture.

Tining: As soon as possible after placing concrete or initial texturing, apply additional texture to the concrete surface with a mechanical device for grooving plastic concrete. Conform to the following:

- Paving less than 2.5 m wide: A manual tining comb may be used for transverse tining.
- Texturing equipment: With rectangular shaped tines of flat spring steel, approximately 0.6 mm thick, 3 mm wide and minimum 200 mm free length.

Transverse tining: Conform to the following:

- Spacing of tines: Randomly spaced between 10 and 21 mm, with average spacing of 13 to 14 mm.
- Texturing brush or comb width: Minimum 750 mm.
- Texture direction: 90º to the direction of linemarking.
- Machine tining: If used, make provisions for downward adjustment to compensate for tine wear.

Longitudinal tining: Conform to the following:

- Tine spacing: Uniformly space 15 ±3 mm.
- Texture direction: Parallel with the linemarking.
- Tining method: Tine with a machine. Make provisions for vertical adjustment to compensate for tine wear.

Machine texture: Use a machine spanning the concrete slab and guided for level and direction, by the rails (for fixed form construction) or paver guide wires (for slipform construction).

Asphalt surfacing: If required over the concrete base, texture the surface with a fine broom or hessian-drag.

Remedial grooving: For areas with less than the allowable average texture depth, transversely sawcut grooves conforming to the following:

- Width: 3 mm.
- Depth: 3 mm.
- Groove spacing: Randomly spaced between 10 mm and 18 mm, with an average spacing of 12 to 15 mm.
- Texture alignment: Parallel with the tining.
- Procedure: Remove grooving residue from pavement and do not allow residue to travel into the drainage system or across public lanes.

Average texture depth: Conform to the following, tested to RMS T192 (2012):

- Longitudinal: 0.65 mm ±0.15 mm.
- Transverse: 0.60 mm ±0.10 mm.
- Hessian drag with no tining or grooving: 0.40 ±0.05 mm.

Texture depth testing: For tining and grooving, test orthogonal to the direction of texturing for minimum 7 m long.

Assessment of base thickness

Base survey: Survey runs, for the full extent of works, to the nearest 5 mm, taken on a 5 m grid and compare with the subbase survey conforming to **SITE ESTABLISHMENT**, **Subbase survey**.

Alternative methods:

- Concrete cores.
- Measurement at the pavement edge.

- Audit checks: Using a suitable probe whilst the concrete is being placed measured to the nearest 5 mm.

Non-conforming base thickness

Non-conforming thickness: If thickness is 10 mm or more below the documented thickness, remove and replace base in conformance with **REMOVAL AND REPLACEMENT OF BASE**.

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

Protection of work

Traffic restrictions: Do not allow traffic or construction equipment, other than those associated with testing, sawcutting, groove cleaning or joint sealing, heavier than 0.5 tonne, on the finished base until the joints have been permanently sealed and the concrete has reached a compressive strength of at least 20 MPa.

Trafficking after the concrete reaches 20 MPa strength: The following limits apply:

- Axle group loads: Single 5.0 T, tandem 8.0 T and triaxle 9.0 T.
- Tracked vehicles: 15 T/m^2 pressure over the track area, with the concrete protected from damage.

Compaction of granular verge material against edge of base: Do not allow until the concrete has reached a compressive strength of at least 20 MPa.

Steel implements: Do not allow implements such as grader blades and loader buckets to impact joints or edges of base.

Rain protection: Do not expose concrete to rain within the period from tipping to application of curing compound. If the concrete is exposed, it will be deemed non-conforming. Beyond this period, acceptance of conformity will be assessed based on the surface finish.

3.9 JOINTS

General

Location: As documented.

Scabbing: If required, expose coarse aggregate over a large portion of the scabbled face, avoid the documented arrises, to achieve a rough surface with indentations 4 to 6 mm deep.

- Scabbled joints: Subsequently debond but do not debond joints in anchors.

Joint sealant: Handle and install to the manufacturer's recommendations.

- Asphalt surfacing placed over the base: Use a silicone sealant confirmed by the manufacturer suitable for the application.

Transverse construction joints

Location: Conform to the following:

- Provide at discontinuities in placement of concrete, determined by the paving operations.
- Do not place closer than 1.5 m to a transverse contraction joint.
- Construct 90 ±6° to the longitudinal joint line, with joint face corrugated and square to the finished top surface of the base.
- Smooth across the joint before texturing. Construct joint continuous over the paved width without steps or offsets in any axis so that the line of the joint does not deviate by more than 20 mm from a 3 m straightedge.
- Odd-shaped slabs: Align joints so that the skew angle is not increased.

In joint bases: Install tie bars conforming to **INSTALLATION OF STEEL REINFORCEMENT**. If ties are installed by drilling and fixing in hardened concrete, an epoxy mortar may be used to give minimum anchorage strength of 85% of the yield strength of the bar.

Initially non-conforming or damaged joints: Reinstate or repair before placing adjoining concrete. Do not place repair material integrally with the adjoining concrete.

Face of joint: Debond, for new and existing concrete pavement, to prevent intimate microtexture bond.

First-placed slab face condition: Dense, fully compacted, and free of honeycombing and re-entrant angles. If non-conforming or edge is damaged, reinstate or repair before placing adjoining concrete.

Scabbling adjoining edge before placing concrete: Roughen the surface to expose coarse aggregate. Wash clean the roughened surface and the projecting reinforcement, and remove all excess water and loose material.

Curing compound application: Respray first-placed face with a wax emulsion and a single spray application at a minimum rate of 0.20 L/m^2, maximum 10 days before placing adjoining concrete, conforming to **CURING**.

- Reinforcement: Do not spray wax or bitumen compounds on the reinforcement.
- Coating: Intact and effective at time of subsequent concrete placement.

Transverse contraction joints

Requirement: Continuous across the full width of the base without steps or offsets in any axis so that the line of the joint does not deviate by more than 10 mm from a 3 m straightedge.

Location: Normal to the control line, as documented. If required, the joint may be skewed to maximum 1:10 to accommodate construction joints and slab anchors.

Joint formation: Saw using either a two-cut or single-cut operation.

Deflection angle: If documented, saw so that alignments do not extend beyond the intended limit defined by intersecting joints such as longitudinal joints.

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

Sealing: Provide preliminary and/or temporary and permanent seal to all formed edges, including vertical faces. Maintain joint free of incompressible foreign materials. Also seal any underlying induced cracks.

Sawcutting

Two-cut operation: Saw joints as follows:

- Initial cut: 3 mm wide for the full depth of the base slab.
- Second cut: A widening sawcut.

Timing: Between 6 and 24 hours after initial paving to prevent excessive ravelling of aggregate adjacent to the cut and cracking of the base concrete other than the bottom of the 3 mm wide sawcut.

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

Ravelling: Conform to the following:

- Surface of transverse contraction joint edge ravelling: 10 mm maximum for vertical or horizontal edges.
- Length of edge ravelling greater than 3 mm: 300 mm maximum in any 3 m length of joint on each edge.
- Vertical face at edge of slab: Does not show ravelling greater than 20 mm in any axis at any point of intersection with the sawn joint.
- Wash saw debris from the joint and pavement immediately after sawing.

Non-conforming sawcuts: Rectify or repair.

Cleaning

Cleaning sawcuts: Immediately after any sawing, clean sawcut to remove debris before residue dries or hardens.

Method: Use a pressurised liquid or liquid/air oil-free jet conforming to the following:

- Do not damage sawcut or arrises.
- With sufficiently high pressure to maintain dust-free faces when dry.
- Do not gravity feed cleaning liquid from tanks.
- Does not leave any substance deleterious to the concrete or to adhesion of joint sealant.
- Removes all sawing residue without it entering the joint.

Preliminary sealing

Requirement: Within 2 hours of cleaning the initial sawcut, seal joint to prevent drying and contamination by installing a continuous closed-cell polyethylene backer rod, including to the vertical faces of the slab at the end of the sawcuts.

Top of seal position: Not higher than the concrete surface or more than 5 mm below it.

Seal condition: Maintain in a sound and effective condition at the top of the seal until joint is temporarily or permanently sealed.

- Damaged rods or rods removed for sealing: Replace within one day.

Two-cut operations: Maintain preliminary seal in place until start of widening sawcut. At start of widening, push to the bottom of the initial sawcut so that it is effective in preventing sawcut residue entering the underlying joint.

Single-cut operations: Maintain preliminary seal in place until permanent sealing.

Temporary sealing

Sealing after widening sawcut: Within 2 hours of cleaning, seal joint to prevent drying and contamination by installing a continuous closed-cell polyethylene backer rod, including to the vertical faces of the slab at the end of the sawcuts.

Top of sealant position: Not higher than the concrete surface or more than is 5 mm below it, and passing over any longitudinal joint seal already in place.

Before grooving: Provide temporary joint seal robust enough to prevent the applied stresses.

Rod diameter: As required to prevent sawcut residue entering the underlying joint.

Seal condition: Maintain in a sound and effective condition at the top of the seal until joint is temporarily or permanently sealed.

- Damaged rods or rods removed for sealing: Replace within one day.

Permanent sealing

Requirement: Install an in situ cast silicone sealant, stored and installed to the manufacturer's recommendations.

Extent of seal: Install at slab edges and formed joints, extending down the vertical faces of joints and any underlying cracks.

Installation timing: Place seal 7 to 14 days after initial sawing, unless grooving is proposed, or immediately after removal of temporary sealant.

Before sealing: Make sure the joint faces are clean and surface dry. Do not place sealant within 24 hours of the concrete surface having been wet.

Preparation: Before placing silicone sealant, carry out the following:

- Backer rod: Install to **Preliminary sealing** and/or **Temporary sealing**.
- Cleaning: Clean out groove to remove foreign or disturbed material from the joint and from the top of the backer rod by dry air jet. Do not use grit blasting.
- Forming backer rod: Depress the backer rod so that the bottom of the silicone sealant is at the required location and of the correct shape. If the backer rod is damaged in any way, replace for the full length of the joint.
- Installing sealant: If recommended by the sealant manufacturer, use a joint primer. Tool sealant to the required shape before surface skin forms.

Before asphalt overlay: If asphaltic surfacing over the concrete base is required, provide initial 3 mm wide sawcut only and fill with silicone joint sealant.

Isolation and expansion joints

Location: As documented ±25 mm.

Construction: Continuous across the full width of the base, without steps or offsets in any axis so that the line of the joint does not deviate by more than 20 mm from a 3 m straightedge.

- Joint faces: ±5° to the finished top surface of the base.
- Spacing: 2.0 m minimum to other transverse joints.

Joint filler: Jointing material conforming to the **Silicone joint sealant requirements table**.

Installation: To the manufacturer's recommendations and as documented.

Seal condition: Maintain joint so that it is free of incompressible and foreign materials and as follows:

- At free edges: Extend permanent seal down the vertical face of the joint.
- Other edges: The filler prevents ingress of concrete and other foreign materials to the joint space during subsequent works.

Joint faces not constructed by sawing: Prepare joint cavity for permanent sealant using one of the following methods:

- Sawing: Clean and provide second cut as for a two-cut operation to **Cleaning** and **Sawcutting**.
- Wire brushing: Clean the full joint face area with a mechanised rotary wire brush or similar abrasive contact equipment. Remove residue and arris spalling to **Sawcutting**.

Longitudinal joints generally

Requirement: Continuous over the full length of the base without steps or offsets in any axis so that the line of the joint does not deviate by more than 20 mm from a 3 m straightedge.

Formed joints: Conform to the following:

- Joint face: 90 ±6° to the finished top surface of the base and corrugated.
- Debonding: Debond joint face to prevent intimate microtexture bond.
- Non-conforming or damaged joints: Reinstate or repair before placing adjoining concrete. Place repair material integrally with adjoining concrete.

Longitudinal tied joints

Location: As documented, parallel to the control line.

Method: Form or induce 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, inserted to **INSTALLATION OF STEEL REINFORCEMENT**, **Tie bars**.
- Location and spacing: Where asphalt surfacing is required and as documented, with all parts of bar lying within 50 mm of the required position.
- Tie bars within 500 mm of a transverse joint: Omit.
- Installing in existing concrete: Use a hydrophilic epoxy resin with the required setting system to develop anchorage strength at least 85% of the yield strength of the bar.

Corrugated joint face: If joint is formed or slipformed, corrugate joint face as documented.

Asphalt surfacing over sawn longitudinal tied joints: Depress sealant 10 mm minimum below concrete surface. After thorough cleaning, seal joint flush with the concrete surface with bituminous rubber compound compatible with the narrow groove.

Sawn-induced longitudinal tied joints

Location and dimensions: As documented.

Sawcutting: To Sawcutting.

Joint surface condition: Conform to the following:

- Horizontal and vertical edge ravelling: Not more than 10 mm wide.
- Cumulative length of ravelling more than 3 mm wide: Maximum 300 mm in any 3 m length of joint edge.

Joint cleaning and preparation: Remove all debris within 24 hours of sawing and insert a closed-cell polyethylene backer rod, as documented.

Sealant insertion: Conform to the following:

- Permanently seal the vertical face at the ends of sawcuts.
- Coat sealant with an approved lubricant-adhesive compound, coloured to match the pavement.
- Insert the sealant into the groove using equipment which will not damage the sealant.
- Maximum increase in sealant length after installation: 10% of the original length.

Joints in sealant: Minimise and cement together using an adhesive to the manufacturer's recommendations.

Top of 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.

Longitudinal joint with kerb and/or channel (gutter)

Application: Kerbs and/or gutters constructed within the shoulder of a concrete base, formed directly onto the concrete subbase, and cast integrally with the concrete base or separately.

Location: Parallel to the control line (parallel to the centreline for ramps) and, as documented.

Joint construction: To **Isolation and expansion joints**.

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

- First placed joint face: If initially non-conforming or damaged, reinstate or repair before placing adjoining concrete. Do not place repair material integrally with the adjoining concrete.

Tied joints: If constructed separately, tie kerbs and/or gutters to the concrete base using 12 mm diameter deformed steel tie bars Grade 250N or 500N, 1000 mm long at 1 m centres. Insert the tie bars, as documented, conforming to **INSTALLATION OF STEEL REINFORCEMENT**, **Tie bars**.

Untied joints: Seal as documented.

Kerb and/or channel (gutter) construction: Conform to *1121 Open drains*, with concrete strength greater than 35 MPa.

- SA, SB, SC, SE, SO and SL kerb types: If these kerb types are required beside the concrete, do not extrude. Conform to this worksection or AS 1379 (2007) for normal class concrete with strength grade N32 and 20 mm aggregate.
- Rounding of kerb or gutter lip: Maximum 5 mm.

Inlet pits: Separate from adjoining base concrete with a Type 15 isolation joint (unbeamed), as documented.

Re-entrant angles

Requirement: Reinforce re-entrant angles exceeding 190° with SL82 reinforcing fabric.

3.10 CURING

Application

Application method: Apply curing compound to form a continuous film with two uniform fine sprays as follows:

Generally: Apply as follows:

- First application: Within 15 minutes of the surface reaching the low-sheen bleed water condition.
- Second application: 10 to 30 minutes after the first application.
- Fixed form surfaces: Apply as follows:
  - First application: Within 30 minutes of stripping.
  - Second application: 10 to 30 minutes after the first application.

Spraying equipment: Spray curing compound transversely and longitudinally with a mechanical sprayer with the following:

- A spray broom fitted with nozzles spaced to give uniform coverage for the full paving width in a single pass.
- Device for continuous agitation and mixing of compound in its container during spraying.
- Spray nozzles that prevent compounds dripping on the concrete surface after shut off.

Minimum application rate: Conform to the following rates at each pass:

- For paving wider than 4.5 m: Using a mechanical sprayer with multi-nozzled spray bar:
  - On tined texture: 0.30 L/m^2.
  - On hessian drag or light broom texture: 0.25 L/m^2.
- For paving less than 4.5 m wide: 0.30 L/m^2 using a hand lance or spray bar, regardless of texture. This is also applicable to faces of formed joints and sections of slipform edges supported by temporary forms.

Calculation of application rate: Calculate and check the amount of curing compound falling on three felt mats per test, each approximately 0.25 m^2 placed within an area of 50 m^2 of the testing surface.

Hand spraying: Spray with a hand lance small areas where mechanical spraying cannot be used and sides of formed slabs.

- Rate: 25% higher than that used on the main base.

Spraying area: In addition to the paving run, respray any hardened concrete less than 7 days old adjoining concrete, for minimum 7 m from the start of the paving run, with a single application.

Curing membrane: Conform to the following:

- Maintain membrane intact and unbroken for 7 days after placing concrete or until concrete strength of 25 MPa is achieved.
- Rectify any damage to the curing membrane by hand spraying affected areas.

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

Inoperable mechanical sprayer: Cease concrete paving by mechanical means and do not restart until sprayer becomes fully operable again.

Curing of other structural concrete

Requirement: Cure all structural concrete members, including anchors, kerbs and gutters, for minimum 7 days after placing.

Plastic covers: Cover the full concrete area to form a continuous barrier and secure around all edges to maintain a moist environment.

3.11 CONCRETE CRACKING

Planned cracks

Description:

- Plastic shrinkage cracks: Discrete cracks less than 500 mm long and with a depth less than 50% of the slab thickness and does not intersect a longitudinal or formed edge.

Remedial work: Not required, if slabs contain only:

- Plastic shrinkage cracks with a cumulative length of 1 m maximum.
- Plastic shrinkage cracks with a cumulative length of 1 m maximum and drying shrinkage cracks.

Unplanned structural cracks

Description: All cracks other than plastic shrinkage, including drying shrinkage in unreinforced slabs.

- Drying shrinkage cracks in mesh-reinforced slabs: Occurring in the central part of the slab, extending the full depth and continuous between joints and/or edges.

Treatment: If unplanned structural cracking occurs, remove and replace concrete base in conformance with **REMOVAL AND REPLACEMENT OF BASE**.

Repair work

Repair of concrete cracks: To Austroads ATS 5340 (2020) and Austroads ATS 5341 (2023).

3.12 TESTING

Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Test authority: A registered testing authority.

Assessment process of test results: To AS 1379 (2007).

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

Sampling, curing and testing of fresh concrete

Sampling method: To AS 1012.1 (2014).

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

Frequency of sampling: To AS 1379 (2007) and the following:

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

Test specimens: Mould at least two test specimens from each sample to AS 1012.8.1 (2014). Supply the number of moulds required for the documented frequency of testing. Inspect, cap and mark specimens before sending to testing laboratory.

- Initial curing: Carry out initial on-site (field) curing between 18 to 36 hours to AS 1012.8.1 (2014) clause 9.
- Transportation: Transport cylinders only after initial on-site curing.

Testing for compressive strength

Testing of specimens: Test each specimen for compressive strength to AS 1012.9 (2014).

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

Age of specimens: 7 and 28 days.

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

Concrete age correction factors table

Age of specimen at time of test (days)	Correction factor (AF)			
	Cylinders		Cores	
	SCM content (%)[a]			
	0	≥ 15	0	≥ 15
28	1.00	1.00	0.90	0.90
35	1.02	1.03	0.93	0.94
42	1.04	1.06	0.96	0.98
49	1.06	1.09	0.98	1.01
56	1.08	1.12	1.00	1.04
70	1.10	1.15	1.02	1.07
84	1.12	1.18	1.03	1.09
112	1.14	1.21	1.06	1.12
140	1.16	1.24	1.07	1.14
168	1.18	1.27	1.08	1.16
196	1.20	1.30	1.09	1.18
224	1.22	1.33	1.0.9	1.19
308	1.24	1.36	1.10	1.20
365 or greater	1.25	1.38	1.10	1.21
a. Relative to the total cementitious binder content.				

Acceptance criteria for compressive strength

Average compressive strength of samples representing the lot: Conform to **CONCRETE PROPERTIES**, **Compressive strength**.

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

Testing by specimens cut from the work

General: If the base concrete strength is non-conforming, obtain approval to core the in situ base for testing and provide specimens conforming to the following:

- Shape: Cylindrical cores.
- Preferred dimension of cores: 100 mm diameter.
- Minimum dimension of cores: 75 mm diameter or 2½ times the nominal size of the coarse aggregate, whichever is the greater.
- Tolerance in uncapped state: 5 mm.
- Minimum length: Same as the core diameter.

Coring: Assess the in situ properties of concrete by coring of hardened concrete to Austroads ATS 5317 (2023). Do not core until the concrete has hardened enough to allow removal without disturbing the bond between the mortar and the coarse aggregate.

Frequency of coring: One core for each lot or one core for the area of concrete base placed between any two consecutive construction joints, whichever is the lesser. Nominate the lot represented by each core at the time of sampling and record before testing.

Coring location: Select location so that joints, steel reinforcement and tie bars are excluded from the core.

Hand placed concrete: Provide 2 cores to represent a section of work, confined between construction joints.

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

Temperature control: Until delivered to the laboratory, do not subject cores to temperatures above the ambient temperature or 23°C, whichever is the greater, and temperatures lower than 10°C.

Curing of cores: Despatch cores to arrive at the testing laboratory within 24 hours of cutting from the subbase. Start wet curing within 24 hours of receipt of the cores.

Test method: To AS 1012.14 (2018) and the following:

- Adjust the test strength by a factor conforming to the **Shape correction factor table** and the **Concrete age conversion factors table**.
- Core strength: [Test strength x SF factor] ÷ AF factor.
- Only use wet conditioning.

Shape correction factor (SF) table

Length/diameter ratio	Correction factor (SF)
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.87

Acceptance criteria for cored concrete

Equivalent 28 days compressive strength of the specimens cut from work: Conform to **CONCRETE PROPERTIES**, **Compressive strength**.

Non-conforming concrete: Conform to **REMOVAL AND REPLACEMENT OF BASE**.

Relative compaction of pavement

Calculation of relative compaction: To RMS T381 (2014) clause 5.2(a).

Mass per Unit Volume (MUV): Determine to AS 1012.12.1 (1998) or AS 1012.12.2 (1998), as appropriate.

Representative cylinder unit mass (RCUM): Determine the mean of 28 day cylinders and round test result to the nearest 5 kg/m^3 as follows:

- Paving trial: The mean of 2 cylinders.
- The Works: The mean of up to 5 consecutive pairs of cylinders for each lot.

Test core specimens: Extract and prepare specimens to AS 1012.14 (2018).

Acceptance criteria for compaction

Fixed form paving: The base is deemed conforming if:

- It has been vibrated to **Hand paving**.
- Vibration procedure used limits lateral spreading of the mix.
- Disturbed areas in the compacted mix has been reinstated to **Hand paving**.
- The relative compaction is at least 98%.

Slipform paving: The base is deemed conforming if:

- It has vibrated in conformance with **Paver machine** and **Mechanical (slipform) paving**.
- Vibration procedure used limits lateral spreading of the mix.
- The relative compaction is at least 98%.

Under-strength slabs: If a slab conforms for all criteria other than relative compaction, carry out the following:

- Relative compaction is 97 to 98%: Take cores and test to **Testing by specimens cut from the work** on the basis of a 28 days core compressive strength.
- Relative strength less than 97%: Remove and replace to **REMOVAL AND REPLACEMENT OF BASE**.

Repair of core holes

Restoration method: Clean and restore all core holes taken in the base and fill with non-shrink cementitious concrete, with compressive strength of not less than that in the base and aggregate size of 10 mm nominal maximum.

Surface condition of restored hole: To match the surrounding surface texture and colour.

Chloride and sulfate

Requirement: Test using one of the following methods:

- Testing concrete constituents.
- Testing hardened concrete.

Testing concrete constituents: Conform to the following:

- Chloride ion testing:
  - Aggregates: To AS 1012.20.1 (2016).
  - Water and admixtures dissolved in water: To AS 1478.1 (2000) Appendix C and then calculate the total content in the mix.
- Sulfate ion testing:
  - Aggregates: To AS 1012.20.1 (2016).
  - Water and admixtures dissolved in water: To AS 1289.4.2.1 (2020).
  - Cementitious materials: To AS 2350.2 (2006) and then calculate the total content, as a percentage, in the mix.

Testing hardened concrete: Conform to the following:

- Test method: To AS 1012.20.1 (2016).
- Water: From the same source as the mixing water to be used in the Works.

Ride quality

Requirement: Test ride roughness in accordance with, and conform to, Clause M4.

3.13 REMOVAL AND REPLACEMENT OF BASE

General

Non-conforming base: Replace base in conformance with the following:

- Non-conforming section extending more than 25 m longitudinally: Replace by mechanical means unless the slabs are odd shaped or mismatched.
- Replace full slab widths between longitudinal joints and/or external edges.

Base adjoining removed slab: If damaged from the removal process, remove and replace.

Disposal of removed base: Remove from site.

Base sawcuts

Transverse sawcuts: Make sawcuts conforming to the following:

- At each end of the section of base to be removed, for the full depth of the base layer.
- Normal to the control line and not closer than 1.5 m to a transverse contraction joint in the base.
- Cut in a straight line, continuous between adjacent longitudinal joints, at an angle 90 ±6° to the longitudinal joint.

Longitudinal sawcuts: Make sawcuts conforming to the following:

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

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

Additional internal sawcuts: If required for the removal process, make sawcuts without oversawing into the underlying subbase.

Further damage to adjoining slab: Remove and replace in conformance with this clause.

Replacement of base

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

Replacement requirements: Conform to this worksection and the following:

- Joint faces on the adjoining slab at the transverse sawcuts: Deeply scabble, leaving the top 25 mm smooth.
- Seal all joints and cracks which become exposed with silicone sealant to prevent ingress of mortar and other incompressible materials.
- Tie bars: Provide to form a transverse construction joint conforming to **JOINTS**, **Transverse construction joints**.
- Transverse contraction joints: Continuous across the full width of the base containing the replaced section. Seal the length of the joint across the full width of the base with silicone sealant the **Silicone joint sealant requirements table**.

- Longitudinal joint faces: Deeply scabble the lower two thirds of the joint face and remove loose concrete. Attach a crack inducer ribbon to the surface of any formed longitudinal joint in the replacement base and provide tie bars to form a longitudinal tied joint to **JOINTS**, **Longitudinal tied joints**.
- Tie bars placed into hardened concrete: Set using a hydrophilic epoxy resin, using the required setting system to develop anchorage strength at least 85% of the yield strength of the bar.

Traffic restrictions: Conform to **PLACING AND FINISHING**, **Protection of work**.

Rectification of finished surface and rideability non-conformance

Requirement: Grind areas requiring surface rectification with a purpose-built diamond grinder. Do not use impact methods such as milling or profiling.

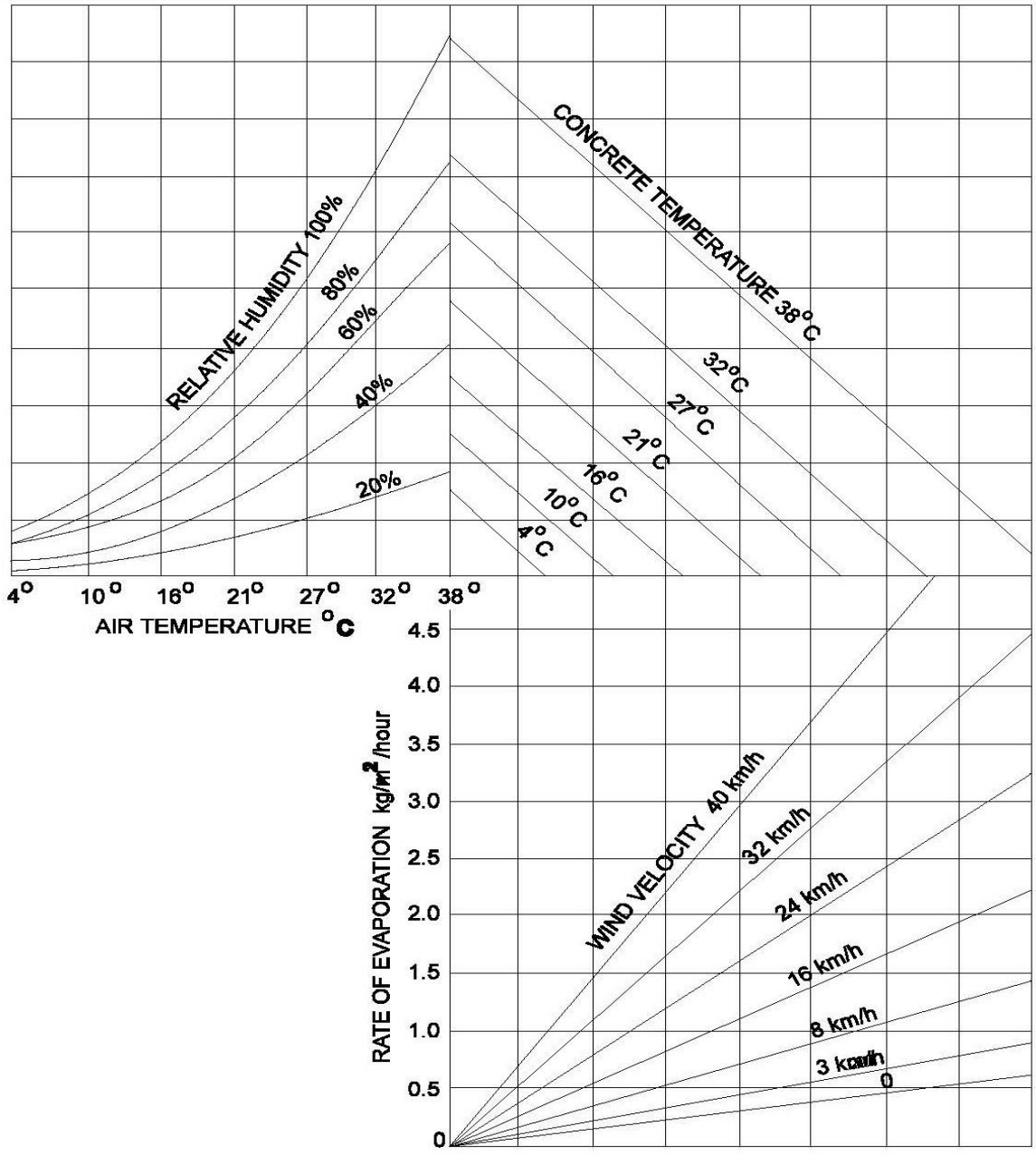
- Grinding equipment: Use equipment which creates longitudinal texture as follows:
  . Grooves: Uniformly spaced using a 3.2 mm wide blade separated by a 2.5 mm wide blade spacer.
  . Minimum average texture: To **CONCRETE PLACING, Surface texture**.

Timing: Do not carry out grinding until all slab replacements have been completed.

4 ANNEXURE A

4.1 ANNEXURE - RATE OF EVAPORATION

Rate of evaporation graph



Using the Rate of evaporation graph

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

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

- Enter the graph at the air temperature of 27°C.
- Move vertically to intersect the curve for relative humidity encountered 40%.
- Move horizontally to the respective line for concrete temperature of 27°C.
- Move vertically down to the respective wind velocity curve and interpolate for 26 km/hour.
- Then move horizontally to the left to intersect the scale for the rate of evaporation.
- The rate of evaporation would be 1.6 kg/m^2/hour.

4.2 ANNEXURE - SUMMARY OF HOLD AND WITNESS POINTS

For private developments, certain Hold and Witness Points where specifically noted below require representatives of both the Superintendent and the Principal Certifier (e.g. Council) to authorise release.

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
SUBMISSIONS, Execution details Work method statement	H	Details of proposed work method.	4 weeks before commencement	Commencement
SUBMISSIONS, Products and materials Nominated mix	H – Superintendent and Principal Certifier	Details of constituent materials, mix design and trial batch test results.	3 weeks before ordering materials	Ordering and delivery of material
INSPECTIONS, Notice Trial mix	W	Mixing of the trial mix.	2 days before mixing	Production of each concrete mix
SUBMISSIONS, Variations Approved nominated mix	H	Details of alternative mix.	3 weeks before implementing change	Ordering and delivery of material
SUBMISSIONS, Tests Uniformity testing	H	Evidence of conformity.	2 days before trial section paving	Trial section paving
SUBMISSIONS, Records Subbase survey	H	Work-as-executed subbase survey.	2 days before paving/trial paving	Paving/trial section
INSPECTIONS, Notice Trial section construction	H – Superintendent and Principal Certifier	Completed trial base.	5 days before paving	Trial section acceptance
SUBMISSIONS, Execution details Non-conforming trial section	H – Superintendent and Principal Certifier	Details of proposed changes to the trial section.	1 day after non-conformance has been identified	Paving
INSPECTIONS, Notice Non-conforming trial section	H – Superintendent and Principal Certifier	Completed new trial section.	1 day before the inspection	Paving
INSPECTIONS, Notice Placing steel reinforcement	W – Superintendent and Principal Certifier	Steel reinforcement and embedment in place.	2 days before placing concrete	-
SUBMISSIONS, Records	H	Survey of base surface levels and alignment.	2 days after paving	Base acceptance or rectification

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
Alignment and surface tolerances				
INSPECTIONS, Notice Repair of core holes	W	Completed restoration of cored areas.	1 day before the inspection	-
SUBMISSIONS, Execution details Removal and replacement of base	H	Details of proposed work method for removing and replacing non-conforming base.	5 days before removal	Removal and replacement of base
INSPECTIONS, Notice Base sawcuts	W	Completed removal of non-conforming base.	1 day before the inspection	-
INSPECTIONS, Notice Replacement of base	W	Completed replacement of base.	1 day before the inspection	-
Notes: H = Hold point, W = Witness point				

4.3 ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

Placement of plain and reinforced concrete base

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Concrete supply	To **Ready-mixed concrete production and supply**.			
	Concrete/air temperature	50 m³	1 per 50 m³	Measure
	Air content	50 m³	1 per 50 m³	AS 1012.4.2 (2014) Method 2
	Consistency – slump	50 m³	1 per load	AS 1012.3.1 (2014)
	Compressive strength (7 and 28 days)	50 m³	1 per pour	AS 1012.9 (2014)
Placement	Relative compaction			
	Machine placed	50 m³	1 per 50 m³[a]	To **TESTING**, **Relative compaction of pavement**.
	Hand placed	Area between 2 consecutive construction joints or 50 m³ (whichever is the lesser)	2 per lot	To **TESTING**, **Relative compaction of pavement**.
Ride quality	Profile factor	1000 m²	10/lane/lot	3 m straightedge
Surface texture	Texture depth	1000 m²	2 per lot	Survey
Curing	Material quality – supplier's documentary	1 contract	1 per production	AS 3799 (1998) Section 3

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	evidence		batch	AS 2341 series
	Application rate	1 day's work	1 per 1000 m^{2a}	
Joints	Sealant material quality supplier's documentary evidence and certification	1 contract	1 per production batch	
	Geometry	50 m^3	All joints	Survey
a. or part thereof, per lot.				

Ready-mixed concrete production and supply

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Raw materials supply	**Material quality – supplier's documentary evidence of**			
	Cement	1 month's production	1 per week	AS 3972 (2010) Table 2
	Fly ash	1 month's production	1 per month	AS/NZS 3582.1 (2016)
	Water	1 contract	1 per contract	AS 1289.4.2.1 (2020) and AS 1478.1 (2000) Appendix C
	Admixtures	1 month's production	1 per month	AS 1478.1 (2000)
	Fine aggregates			
	Grading	1 week's production	1 per 200 m^3 concrete[a]	AS 1141.11.1 (2020)
	Moisture content	N/A	1 per day	
	Sodium sulfate soundness	1 contract	1 per contract	AS 1141.24 (2018)
	Bulk density	1 contract	1 per contract	AS 1141.4 (2000)
	Unit mass (Particle density)	1 contract	1 per contract	AS 2758.1 (2014)
	Water absorption	1 contract	1 per contract	AS 2758.1 (2014)
	Material finer 2 µm	1 contract	1 per contract	AS 1141.13 (2007)
	Deleterious material (impurities/reactive)	1 contract	1 per contract	AS 2758.1 (2014)
	Coarse aggregates			
	Grading	1 week's production	1 per 200 m^3 concrete[a]	AS 1141.11.1 (2020)
	Moisture content	N/A	1 per day	
	Wet strength	1 contract	1 per contract	AS 1141.22 (2019)
	Wet/dry strength variation	1 contract	1 per contract	AS 1141.22 (2019)
	Sodium sulfate soundness	1 contract	1 per contract	AS 1141.24 (2018)
	Particle shape	1 contract	1 per contract	AS 1141.14 (2007)
	Fractured faces	1 contract	1 per contract	AS 1141.18 (2022)
	Bulk density	1 contract	1 per contract	AS 1141.4 (2000)
	Unit mass (Particle	1 contract	1 per contract	AS 2758.1 (2014)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	density)			
	Water absorption	1 contract	1 per contract	AS 2758.1 (2014)
	Material finer 75 µm	1 contract	1 per contract	AS 1141.12 (2015)
	Weak particles	1 contract	1 per contract	AS 2758.1 (2014)
	Light particles	1 contract	1 per contract	AS 2758.1 (2014)
	Deleterious materials (impurities/reactive)	1 contract	1 per contract	AS 2758.1 (2014)
	Iron unsoundness	1 contract	1 per contract	AS 2758.1 (2014)
	Falling/dusting unsoundness	1 contract	1 per contract	AS 2758.1 (2014)
Mix design	Compressive strength	1 contract mix	1 per mix per contract	AS 1012.9 (2014)
	Aggregate moisture content	1 contract mix	1 per mix per contract	RMS T262 (2012)
	Consistency – slump	1 contract mix	1 per mix per contract	AS 1012.3.1 (2014)
	Air content	1 contract mix	1 per mix per contract	AS 1012.4.2 (2014) Method 2
	Shrinkage	1 contract mix	1 per mix per load	AS 1012.13 (2015)
a. or part thereof, per lot.				

4.4 ANNEXURE - PAY ITEMS

This Annexure applies to Council projects. For private development works use of this schedule is optional, at the Superintendent's discretion.

Pay items	Unit of measurement	Schedule rate inclusions
1133.1 Supply and place concrete in base	m^3 - The documented width and length, including odd-shaped and mismatched slabs. - The depth is the depth documented across each section. - Do not account for the allowable tolerances.	All costs associated with all documentation and approvals and the supply and placing of concrete base, including all costs of providing transverse construction joints and longitudinal tied joints in association with kerbs and/or gutters.
1133.2 Finish, cure and texture base	m^2 - The documented width and length, including odd-shaped and mismatched slabs. - Do not account for the allowable tolerances. - The sides of slabs are not included in the measurement of surface area.	All costs associated with finishing, curing and texturing the base.
1133.3 Supply and place wire reinforcing fabric	m^2 of wire reinforcing fabric placed. - The documented width and length, including odd-shaped and mismatched slabs. - Do not account for the allowable tolerances or of any laps.	All costs associated with supplying and placing all wire reinforcing fabric.
1133.4 Supply and	Tonne of steel reinforcement.	All costs associated with supplying and

Pay items	Unit of measurement	Schedule rate inclusions
install steel bar reinforcement	- The mass is to be determined from the unit masses given in AS/NZS 4671 (2019) and the actual length of bar measured in place. - Do not account for laps and splices.	installing reinforcement, except dowels and tie bars.
1133.5 Transverse contraction joints	Linear metre. Measure the distance along the line of the joint.	All costs associated with the provision of transverse contraction joints.
1133.6 Transverse expansion and isolation joints	Linear metre. Measure the distance along the line of the joint.	All costs associated with the provision of transverse expansion and isolation joints.
1133.7 Longitudinal tied joints	Linear metre. Measure the distance along the line of the joint.	All costs associated with the provision of longitudinal tied joints including provision of tie bars.
1133.8 Longitudinal isolation joints	Linear metre. Measure the distance along the line of the joint.	All costs associated with provision of longitudinal isolation joints including the provision of dowels, as documented.
1133.9 Slab anchors	m^3 The documented volume with adjustments for any authorised variation. Measure the depth from the top of the subbase.	All costs associated with the construction of slab anchors including excavation, disposal of material, supply and placing of reinforcement and the subsoil drain
1133.10 Bridge approach slabs	m^3 - The width, depth and length are as documented. - Do not account for the allowable tolerances.	All costs associated with the construction of a bridge approach slab, including provision of a transverse expansion joint at the bridge abutment, but excluding the supply and fixing of steel which is to be paid for at the schedule rate for **Pay item 1133.4**.
Traffic management		To *1101 Traffic management*.
Erosion and sedimentation control		To *1102 Control of erosion and sedimentation (Construction)*.
Kerb and gutter		To *1121 Open drains*.
Subsoil drains at slab anchors		To *1172 Subsoil and formation drains*.

Deductions

Requirement: Conform to the following:

- Concrete with compressive strength of 33 to 35 MPa at 28 days: Subject to a deduction of 4% of the applicable schedule rate for Pay Item 1133.1 for the lot represented, for each 0.5 MPa or part that, deficiency in strength.
  - . Acceptance of this concrete is conditional of it representing isolated sections and such sections comprising less than 5% of the total area of the base.
- Concrete base which is 10 mm or less below the specified thickness: May be accepted, subject to a deduction to the schedule rate for Pay Item 1133.1, for the lot represented:
  - . 24% for areas with thickness 5 mm below the documented thickness.
  - . 60% for areas with thickness 5 to 10 mm below the documented thickness.

4.5 ANNEXURE - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

ARRB	2020	Sealed Roads Best Practice Guide
ARRB	2020	Unsealed Roads Best Practice Guide
AS 1012		Methods of testing concrete
AS 1012.1	2014	Sampling of concrete
AS 1012.3.1	2014	Determination of properties related to the consistency of concrete - Slump test
AS 1012.4.2	2014	Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1	2014	Method for making and curing concrete - Compression and indirect tensile test specimens
AS 1012.8.4	2015	Method for making and curing concrete - Drying shrinkage specimens prepared in the field or in the laboratory
AS 1012.9	2014	Compressive strength tests - Concrete, mortar and grout specimens
AS 1012.12.1	1998	Determination of mass per unit volume of hardened concrete - Rapid measuring method
AS 1012.12.2	1998	Determination of mass per unit volume of hardened concrete - Water displacement method
AS 1012.13	2015	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1012.14	2018	Method for securing and testing cores from hardened concrete for compressive strength and mass per unit volume
AS 1012.20.1	2016	Determination of chloride and sulfate in hardened concrete and concrete aggregates - Nitric acid extraction method
AS 1141		Methods for sampling and testing aggregates
AS 1141.4	2000	Bulk density of aggregate
AS 1141.5	2000	Particle density and water absorption of fine aggregate
AS 1141.6.1	2000	Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS 1141.11.1	2020	Particle size distribution - Sieving method
AS 1141.12	2015	Materials finer than 75 µm in aggregates (by washing)
AS 1141.13	2007	Material finer than 2 micrometer
AS 1141.14	2007	Particle shape, by proportional caliper
AS 1141.18	2022	Crushed particles in coarse aggregate derived from gravel
AS 1141.20.1	2000	Average least dimension - Direct measurement (nominal size 10 mm and greater)
AS 1141.20.2	2000	Average least dimension - Direct measurement (nominal sizes 5 mm and 7 mm)
AS 1141.22	2019	Wet/dry strength variation
AS 1141.24	2018	Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1141.31	2015	Light particles
AS 1141.32	2019	Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS 1141.34	2018	Organic impurities other than sugar
AS 1141.35	2019	Detection of sugar contamination in concrete aggregates
AS 1160	1996	Bitumen emulsions for the construction and maintenance of pavements
AS 1289		Methods of testing soils for engineering purposes

AS 1289.4.1.1	2019	Soil chemical tests - Determination of the organic matter content of a soil - Normal method
AS 1289.4.2.1	2020	Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379	2007	Specification and supply of concrete
AS 1478		Chemical admixtures for concrete, mortar and grout
AS 1478.1	2000	Admixtures for concrete
AS/NZS 1554		Structural steel welding
AS/NZS 1554.3	2014	Welding of reinforcing steel
AS 2341		Methods of testing bitumen and related roadmaking products
AS 2350		Methods of testing portland, blended and masonry cements
AS 2350.2	2006	Chemical composition
AS/NZS 2425	2015	Bar chairs in reinforced concrete - Product requirements and test methods
AS 2758		Aggregates and rock for engineering purposes
AS 2758.1	2014	Concrete aggregates
AS/NZS 3582		Supplementary cementitious materials
AS/NZS 3582.1	2016	Fly ash
AS 3600	2018	Concrete structures
AS/NZS 3679		Structural steel
AS/NZS 3679.1	2016	Hot-rolled bars and sections
AS 3799	1998	Liquid membrane-forming curing compounds for concrete
AS 3972	2010	General purpose and blended cements
AS/NZS 4671	2019	Steel for the reinforcement of concrete
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
SA TS 199	2023	Design of geopolymer and alkali-activated binder concrete structures
ARRB BPG1	2020	Road materials
Austroads AGBT/T701	2020	Test method - Alkali-silica reactivity of aggregate – Accelerated mortar bar test.
Austroads AGPT		Guide to pavement technology
Austroads AGPT04C	2017	Materials for concrete road pavements
Austroads AGPT04E	2022	Recycled materials
Austroads AGPT08	2019	Pavement Construction
Austroads ATS		Austroads technical specifications
Austroads ATS 3050	2022	Supply of recycled crushed glass sand
Austroads ATS 5310	2020	Supply and placement of steel for the reinforcement of concrete
Austroads ATS 5317	2023	Coring of hardened concrete
Austroads ATS 5330	2020	Technical specification for the supply of geopolymer concrete
Austroads ATS 5340	2020	Technical specification cementitious patch repair of concrete
Austroads ATS 5341	2023	Repair of concrete cracks
Austroads ATS	2023	Bonded anchors

5860		
RMS T192	2012	Determination of the texture depth of road surfacing by the TRL Mini Texture Meter
RMS T262	2012	Determination of moisture content of aggregates (Standard method)
RMS T276	2012	Foreign materials content of recycled crushed concrete
RMS T279	2012	Flow time and voids content of fine aggregate by flow cone
RMS T381	2014	Relative compaction of pavement concrete
RMS T1192	2012	Adhesion of sealant
RMS T1193	2012	Accelerated aging of cured sealant
ASTM C603	2014	Standard test method for extrusion rate and application life of elastomeric sealants
ASTM C661	2015	Standard test method for indentation hardness of elastomeric-type sealants by means of a durometer
ASTM C679	2015	Standard test method for tack-free time of elastomeric sealants
ASTM C793	2023	Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
ASTM C794	2018	Standard test method for adhesion-in-peel of elastomeric joint sealants
ASTM D792	2020	Standard test methods for density and specific gravity (relative density) of plastics by displacement
ASTM D7428	2015	Standard test method for resistance of fine aggregate to degradation by abrasion in the micro-deval apparatus
Tex-612-J	2000	Acid insoluble residue for fine aggregate
EN 15804	2012	Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
ISO 14025	2006	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 21930	2017	Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services

5 ANNEXURE M – CESSNOCK CITY COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's *Development Engineering Handbook*. Acceptance is to be obtained in writing from: an authorised representative of Council's Director of Infrastructure and Engineering Services.	**Variation procedure**
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	**DA Conditions**
M3.	Refer to the Cessnock City Council *Development Engineering Handbook* for final inspection, works-as-executed and handover requirements.	**Completion**
M4.	Test methods for ride quality: To RMS T182 (NAASRA roughness), T187 or T188 (International Roughness Index). Surface courses on new roads: Provide roughness measurement test results for review after trimming and before sealing. Results are to conform to the relevant RMS specification for the surface course material: • Unbound and Modified Base Courses (with or without Sprayed Bituminous Seal): To Table R71/B.3.	**Ride Quality**

	• Concrete Base Courses: To Table R83/27. • Asphalt Course: To **1144 Asphalt (Roadways)** worksection Clause 4.7. RMS specifications R116, R117, R118, R119, R121, R123 or R126, as applicable to the type of asphalt used, are supplementary reference material. Note: Test results generally less than or equal to 1.56m/km/lane (International Roughness Index) comply, and higher values may be acceptable in accordance with the RMS specifications. However, if specified under the Contract, an incentive payment or deduction amount is to be applied in line with the RMS values given. Guidance on threshold levels for maintenance intervention: Refer to ARRB Sealed and Unsealed Roads Best Practice Guides. Amendments: This clause is used in worksections *1113 Stabilisation*, *1133 Plain and reinforced concrete base*, *1141 Flexible pavement base and subbase*, and *1144 Asphalt (Roadways)*.	

6 AMENDMENT HISTORY

0	15/01/2024	First Published