0274 CONCRETE PAVEMENT

1 GENERAL

1.1 RESPONSIBILITIES

General
General: Provide finished surfaces as documented and as follows:
- Free draining and evenly graded between level points.
- Even and smooth riding.

Performance
Conformance: Comply with the local authority in respect of the levels, grades and the minimum details of thickness, reinforcement and concrete strength for pavements within the kerb-and-gutter property boundaries.

Design
Coordination: Determine the local authority requirements initially as they may affect grades, transition, zones for the works. Considerations include:
- Drainage.
- Tree’s (due to settlement).
- Adjacent structures.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- General requirements.
- Earthwork.
- Concrete – combined.

1.3 STANDARDS

Concrete
Specification and supply: To AS 1379.
Materials and construction: To AS 3600.

1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given in AS 1348 and the following apply.
- Absolute level tolerance: Maximum deviation from design levels.
- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Average ambient temperature: Average value of the maximum and minimum ambient temperatures over the relevant period at a site.
- Concrete class:
  - Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in conformance with AS 1379 clause 1.5.3.
  - Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in conformance with AS 1379 clause 1.5.4.
- Early age: A mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.
- Green concrete: Concrete which has set but not appreciably hardened.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface.
- Weather:
  - Cold: Ambient shade temperature < 10°C.
- Hot: Ambient shade temperature > 32°C.

1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Concrete formwork, reinforcement and dowels in position.
- Commencement of concrete placing.
- Completion of concrete placing.
- Evaluation of surface finish.

1.6 TOLERANCES

General
Edges abutting gutters: Within ± 5 mm of the level of the actual gutter edge.
Rigid pavement surface:
- Absolute tolerance: + 10 mm, - 0 mm.
- Relative tolerance: ± 5 mm.
Joint locations in plan (rigid pavement): ± 15 mm.

1.7 SUBMISSIONS

Products
Compliance certificate: As an alternative to testing a product, submit the manufacturer’s certificate together with the results of recent tests undertaken by the manufacturer, showing compliance with test criteria.

Aggregates: Nominate the source for all aggregates proposed.
Reinforcement: Submit the manufacturer’s certificate of compliance with AS/NZS 4671, or submit test certificates from an independent testing authority.
Liquid curing compounds: Submit certified test results, including the application rate and the efficiency index to AS 3799 Appendix B.
Curing by covering: Submit details of the proposed covering material.
Repair materials: Submit proposals for epoxy resin/grout and elastomeric sealant.
Concrete: Submit the concrete supply delivery dockets.
Subcontractors: Submit names and contact details of proposed pre-mixed concrete suppliers, and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.

Trial mix design report: Six weeks before commencing production, submit a report for each mix design containing the information required in AS 1012.2, the individual and combined aggregate particle size distribution, and the records and reports for the tests.

Execution
Work method statements: Submit proposals for the methods and equipment to be used for the pavement works, including the following:
- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Sources of materials.
- Material stockpiles.
- Methods of concrete manufacture.
- Temperature control, curing and protection methods for concrete.
Mix design variation: If a variation is proposed, submit a further mix design report.
Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:
- Addition of water at the site.
- Changes to the plastic concrete mix.
- Curing and protection methods.
- Cutting or displacing reinforcement, or cutting hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.
- Sequence and times for concrete pours, and construction joint locations and relocations.

Cores, fixings and embedded items: If required, submit shop drawings showing the proposed locations, clearances and cover, and indicate any proposed repositioning of reinforcement.

Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details.

Sawn joints: Submit proposed methods, timing and sequence of sawing joints.

Damaged galvanizing: If repair is required, submit proposals to AS/NZS 4680 Section 8.

Splicing: If splicing not documented is proposed, submit details.

Welding: If welding of reinforcement is proposed, provide details and give notice before welding reinforcement.

Joint sealants: Submit proposals for installation methods and sealant performance.

Concrete placing: Submit proposals for size of the area to be placed and the spacing of planned construction joints before placement commences.

Crack assessment: If unplanned cracks occur in the finished pavement, submit proposals for investigation.

Surface repair method: If required, submit details of the proposed method before commencing repairs.

Trial section: Submit trial pavement.

Testing
Test certificates and records: Submit test certificates, and also retain results on site.

2 PRODUCTS

2.1 REINFORCEMENT

General
- Steel reinforcement: Steel bars or mesh to AS/NZS 4671.
- Ductility class: L or N.

Identification: Supply reinforcement which is readily identifiable as to grade and origin.

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

Protective coatings

Protective coating: Coatings to reinforcement must not reduce the performance of the reinforcement. Do not galvanize reinforcement steel. For pavements containing protective coated reinforcement, provide the same coating type to all reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules.

Epoxy coating: Provide high build, high solids chemically resistant coating.
- Thickness: 200 µm minimum.

Steel fibres

Fibre reinforcement: To CIA CPN35.

Steel fibre content: 75 kg/m³.

Accessories

Bar chairs: Use plastic tipped wire bar chairs.

Tie wire: Galvanized annealed steel 1.25 mm diameter (minimum).

Dowels

General: Provide each dowel in one piece, straight, cut accurately to length with ends square and free from burrs.

Standard: To AS/NZS 4671.

Grade: 250R steel bars 450 mm long.

Tie bars

Type: Deformed bar, 12 mm diameter, grade 500N, 1 m long.
2.2 AGGREGATE

Characteristics

Standards: AS 2758.1.

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

Durability: All constituent, fraction of constituent or aggregates to conform to AS 1141.22 and the following:
- Wet strength not less than 80 kN.
- 10% Fines Wet/Dry Variation not to exceed 35%.

Recycled concrete aggregate (RCA): Use coarse aggregates from demolition concrete or RCA.

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

Slipform grading requirements: For concrete mixes proposed for slipforming, conform to the Combined aggregate grading table for the combined total aggregates proportion by mass passing the Australian Standard sieves.

Combined aggregate grading table

<table>
<thead>
<tr>
<th>Australian Standard sieve</th>
<th>% passing by mass of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.00 mm</td>
<td>95–100</td>
</tr>
<tr>
<td>9.50 mm</td>
<td>55–75</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>36–48</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>30–42</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>22–34</td>
</tr>
<tr>
<td>600 µm</td>
<td>16–27</td>
</tr>
<tr>
<td>300 µm</td>
<td>5–12</td>
</tr>
<tr>
<td>150 µm</td>
<td>0–3</td>
</tr>
<tr>
<td>75 µm</td>
<td>0–2</td>
</tr>
</tbody>
</table>

2.3 CEMENT

General

Standard: To AS 3972.

Transport: Cement in watertight packaging and protect from moisture until used. Do not use caked or lumpy cement.
- Age: Less than 6 months old.
- Storage: Store cement bags under cover and above ground.

2.4 FLY ASH

General

Standard: Fine grade fly ash to AS 3582.1.
Fly ash quantity: Nil to 70 kg/m$^3$.
Minimum binder content (fly ash plus cement): 300 to 330 kg/m$^3$.

2.5 WATER

General

Standard: Chloride ion to AS 3583.13 and sulphate ion to AS 1289.4.2.1.
Quality: Water used in the production of concrete to be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.
Limits: Not containing more than:
- 600 parts per million of chloride ion, as determined to AS 3583.13.
- 400 parts per million of sulphate ion, as determined to AS 1289.4.2.1.
2.6 ADMIXTURES

General
Standard: Chemical admixtures to AS 1478.1.

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

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

Types of admixtures
Air entraining agent: Adjust mix for workability allowing up to 5% air entrainment.

Warm season retarder: During the warm season, (October to March inclusive), use a lignin or lignin-based (ligpol) set-retarding admixture (Type Re or Type WRRe) as approved to control slump within the limits stated in Concrete mix, properties.

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

2.7 CURING COMPOUNDS

General
Curing compounds: To AS 3799 and AS 1160, Type 2, white pigmented or containing aluminium reflective pigments.

Covering with sheet materials: To ASTM C171, white opaque or clear polyethylene film, or white burlap-polyethylene sheet, or equivalent material.

2.8 OTHER MATERIALS

Tactile ground surface indicators
Standard: To AS/NZS 1428.4.1.

3 EXECUTION

3.1 SUBGRADE

Preparation
Conformance: Prepare subgrade in conformance with the Earthwork worksection.

Extent: Prepare a uniform subgrade for the full pavement formation, extending at least to the back of kerbs.

Reinstatement: Ensure uniformity for backfilling of any utility trenches.

3.2 SUBBASE

Thickness
Thickness to be as per the approved pavement design

Width
Subbase width: Extend the subbase at its full depth to at least the back of kerbs or other edge stops before their installation.

No integral kerbs: Extend granular unbound subbase at least 300 mm beyond each side of the carriageway.

Unbound subbase materials and installation: Conform to Pavement base and subbase worksection.

Bound subbase materials and installation: Conform to the Pavement base and subbase worksection.

Tolerance and friction reduction
Tolerance: Subbase finished surface level, + 0 mm to – 10 mm.

Friction reduction: Provide 200 µm thick polyethylene sheeting with 200 mm taped minimum laps and/or a 20 mm thick layer of sand (silt and clay material less than 5%) directly beneath the concrete pavement.
3.3 TRIAL PAVEMENT

Trial pavement: Demonstrate by placing a test section that the proposed method of placement will produce a conforming pavement. Remove test sections which do not comply with requirements and dispose of as directed.

3.4 CONCRETE MIX

Standard
Concrete mix and supply: To AS 3600 Section 17 and AS 1379.

Properties
Workability: Slump values to conform with the following:
- Fixed form paving with manual operated vibration: 50 – 60 mm.
- For slip form with no side forms: 30 – 50 mm.
- Drying shrinkage: Maximum 450 µε after 21 days of air drying.

Elapsed delivery time
General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the Elapsed delivery time table. Do not discharge at ambient temperature below 10°C or above 30°C.

Elapsed delivery time table

<table>
<thead>
<tr>
<th>Concrete temperature at time of discharge (°C)</th>
<th>Maximum elapsed time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 – 24</td>
<td>2.00</td>
</tr>
<tr>
<td>24 – 27</td>
<td>1.50</td>
</tr>
<tr>
<td>27 – 30</td>
<td>1.00</td>
</tr>
<tr>
<td>30 – 32</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Site mixed supply
Emergencies: If mixing by hand is carried out, provide details.
Plant: Mix concrete in a plant located on the construction site.

Pre-mixed supply
Addition of water: Do not add water.
Transport: Make sure that the mode of transport prevents segregation, loss of material and contamination of the environment, and does not adversely affect placing or compaction.
Concrete delivery docket: For each batch, submit a docket listing the information required by AS 1379 clause 1.7.3, and the following information:
- Any binders or additives.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.
- The concrete element or part of the works for which the concrete was ordered, and where it was placed.

3.5 TESTING

Standards
Sampling, identification, testing and recording: To AS 1012.
Specimens: Sample the concrete on site, at the point of discharge from the agitator.
Type and frequency: Conform to AS 1379.
Sampling frequency: To the Project assessment sampling table.
Test authority: Concrete supplier or NATA registered laboratory.

Concrete testing methods
Slump: Test at least one sample from each batch before placing concrete from that batch in the work.
- Standard: To AS 1012.3.1.
- Maximum slump variation: ± 10 mm.
Compressive strength: Test to AS 1012.8.1.
Drying shrinkage: Test to AS 1012.13.
Flexural strength: To AS 1012.8.2 and AS 1012.11.

Project assessment sampling table

<table>
<thead>
<tr>
<th>Number of batches for each type and grade of concrete per day</th>
<th>Minimum number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2-5</td>
<td>2</td>
</tr>
<tr>
<td>6-10</td>
<td>3</td>
</tr>
<tr>
<td>11-20</td>
<td>4</td>
</tr>
<tr>
<td>each additional 10</td>
<td>1 additional</td>
</tr>
</tbody>
</table>

Acceptance criterion: The average strength of any set of 3 consecutive project samples must be equal to or greater than the specified minimum value.

3.6 INSTALLATION

Junctions with existing pavements
Trimming: Where the pavement is to be joined to an existing pavement remove a strip of the existing pavement at least 300 mm wide for its full depth and trim the edge vertically before placing new pavement material.

Existing sealed pavement: Trim the seal to a neat edge.

Fixed formwork
Description:
- Steel forms.
- Seasoned, dressed timber planks, free of warps, bends or kinks, with the full width of their top edges covered with steel angle sections finishing flush with the form face.

Depth: Equal to the edge thickness of the slab and in one piece.

Tolerances on position:
- Absolute level tolerance: ± 5 mm.
- Relative level tolerance: ± 5 mm.
- Horizontal tolerance: ± 10 mm (maximum departure of face from a plane surface).
- Verticality: 3 mm departure from vertical.

Staking: Stake forms in position using at least 3 steel stakes per form, not more than 1.5 m apart. Lock joints between form sections to prevent movement.

Release agent: Before placing reinforcement, apply a release agent compatible with the contact surfaces, to the interior of the formwork, except where the concrete is to receive an applied finish for which there is no compatible release agent. Clean the reinforcement to remove all traces of release agent.

Re-use: Clean and recoat the forms each time before placing concrete.

Keyways: Form the keyways of keyed construction joints using steel form strips accurately located at the mid-depth of the slab and securely fastened flush against the formwork face.

Reinforcement
Tolerances in fabrication and fixing: To AS 3600.
Locate reinforcement: Place reinforcement in the top half of the pavement.
Minimum cover to reinforcement: 30 mm.

Splicing mesh: Overlap a minimum of 2 crosswires.
Supports: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:
- To withstand construction and traffic loads and maintain the concrete cover, as documented.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.
- Minimum spacing:
  - Bars: ≤ 60 diameters.
  - Fabric: ≤ 800 mm.
- Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

- Projecting reinforcement: If starter or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.

- Tying: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.

- Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

**Cores, fixings and embedded items**

Position: Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolation: Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

### 3.7 CONCRETE PLACING AND COMPACTION

**Concrete placing**

General: Place concrete uniformly over the width of the slab or lane and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.

Remove: Any water ponding on the ground.

Placing sequence: Commence from one corner (usually the lowest point) and proceed continuously out from that point.

Weather: Do not place concrete in temperatures above 30°C or below 10°C without adequate precautions.

**Compaction**

Thickness 100 mm or less: Compaction through placing screeding and finishing processes. If required use a hand-held vibrating screed at the surface. Do not use immersion vibrators.

Thickness more than 100 mm and downturns: Use an immersion vibrator.

**Placing records**

General: Keep on site and make available for inspection a log book recording each placement of concrete, including the following:

- Date of concrete placement.
- Delivery dockets noting the specified grade and source of concrete.
- Slump measurements to AS 1012.3.1.
- The portion of work.
- Volume placed.

**Rain**

General: During placement and before setting, do not expose concrete to rain.

Protection: Protect surface from damage by covering until hardened.

**Concrete placing in cold weather**

Cement: Do not use high alumina cement.

Placing concrete: Maintain the temperature of the freshly mixed concrete at 5°C.

Formwork and reinforcement: Before and during placing maintain temperature at 5°C.

Severe weather: If severe weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.

Maximum temperature of water: 60°C when it is placed in the mixer.

Plastic concrete: Prevent plastic concrete from freezing, without using salts or chemicals.
Concrete placing in hot weather
Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete in conformance with the **Elapsed delivery time table**.

Placing concrete: Maintain the temperature of the freshly mixed concrete in conformance with the **Hot weather placing table**.

Formwork and reinforcement: Before and during placing maintain temperature at 35°C.

Severe weather: If ambient shade temperature more than 38°C, do not mix concrete.

Temperature control: Select one or more of the following methods of maintaining the specified temperature of the placed concrete:
- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water.

**Hot weather placing table**

<table>
<thead>
<tr>
<th>Concrete element</th>
<th>Temperature limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal concrete in footings, beams, columns, walls and slabs</td>
<td>35°C</td>
</tr>
<tr>
<td>Concrete in sections ≥ 1 m in all dimensions except for concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness</td>
<td>27°C</td>
</tr>
</tbody>
</table>

Evaporation control barriers: Erect barriers to protect freshly placed concrete from drying winds.

### 3.8 CONCRETE PRIMARY FINISH

**General**

Finishing: Do not commence finishing until all bleed water has evaporated from the surface.

Commence: Immediately after placement and spreading and compaction of the plastic concrete, start finishing operations to achieve the documented finish.

**Unformed surfaces**

General: Strike off, screed and level slab surfaces to finished levels, to the tolerance class and finish documented in the **Unformed surface finishes schedule**.

**Formed surfaces**

Damage: Do not damage concrete works through premature removal of formwork.

Curing: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

### 3.9 CONCRETE CURING

**General**

Curing: Commence curing as soon as possible after finishing and extend for a minimum period of 3 days.

End of curing period: Prevent rapid drying out at the end of the curing period.

Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

**Cold weather curing**

General: Maintain concrete temperature between 10 – 20°C for curing period.

**Hot weather curing**

Curing compounds: If it is proposed to use curing compounds, provide details.

Protection: Select a protection method as applicable.
- If the concrete temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant.
- If ambient shade temperature is more than 35°C, protect from wind and sun using an evaporative retarder until curing is commenced.
Immediately after finishing, either cover exposed surfaces using an impervious membrane or hessian kept wet until curing begins, or apply a curing compound.

**Curing methods**

- **Covering sheet method:** Immediately after finishing operations cover concrete using damp hessian or cotton mats overlapped at least 150 mm and anchored against displacement by wind or other interference. Keep the mats continuously damp until covered by the covering sheet material. Repair tears immediately.

- **Moist curing method:** Immediately after finishing operations and once concrete has set sufficiently to be not damaged by the curing process keep the concrete surface continuously damp by ponding or spraying constantly with water, fog, or mist, using suitable spraying equipment. Continue wetting for the curing period.

- **Self levelling toppings:** To AS 3799, if also used for curing.

- **Coloured concrete:** Do not cure with plastic sheeting, damp sand or wet hessian. Use only chemical curing compounds compatible with the sealer or simply use a sealer (It must then comply with the requirements of a chemical compound sealer).

**Curing compound**

Application: Provide a uniform continuous flexible coating to AS 3799 without visible breaks or pinholes. Ensure coating remains unbroken at least for the required curing period after application. Respray defective areas within 30 minutes. Respray within 3 hours after heavy rain.

### 3.10 JOINTS

**General**

General: Construct expansion, contraction and construction joints straight and plumb. Make transverse joints normal to longitudinal joints. Extend transverse expansion and contraction joints continuously from edge to edge of the pavement through interconnected slabs.

Joint layout: Install joints as documented.

**Contraction joints**

Installation: Construct transverse and longitudinal contraction joints by early age power sawing or by placing an insert in the fresh concrete.

**Dowelled joints**

Dowelled contraction joint: Place dowels at 300 mm centres orthogonal to the joint direction and parallel to the pavement surface, accurate alignment is critical, ensure proper field supervision.

Dowel assembly: Use a dowel-assembly support frame firmly secured to the subbase during concrete placement. Prevent the dowel assembly support frame from passing through the joint. Do not insert dowels during the placement of concrete.

Debond dowel: Coat with a debonding coating to 0.5 length + 25 mm. Embed the unpainted half of the dowels in the slab placed first.

Movement: Do not distort or displace beyond the alignment tolerances under testing or during construction. Do not remove and replace dowels in pre-formed holes.

**Tie bar joints**

Longitudinal contraction joints: Place tie bars at 800 mm centres. Alignment accuracy of tie bars is not critical.

**Construction joints**

Installation: Place header board on the subbase or subgrade at right angles to the pavement centre line.

- Planned location: Terminate each day’s placing operation at a transverse construction joint located to coincide with a planned contraction or expansion joint.

- Unplanned joints: If placement is interrupted for 30 minutes or longer, form a tied transverse construction joint within the middle third of the distance between planned joints but no closer than 1.5 m to the nearest planned joint. If necessary remove placed concrete back to the required location.

**Expansion joints**

Expansion joints: Provide formed full depth joints around structures and features which project through, into or against the pavement, and elsewhere as required.

Doweled expansion joints: Cap dowels at one end with a compressible material.
**Formed joints**

Full depth joints: Form the edge of the concrete placed first to provide a smooth, vertical face. After stripping and cleaning fix the joint filler with a suitable waterproof adhesive to the face of the slab, and place the adjoining concrete after the adhesive has set.

Weakened plane joint: Cut a crack-inducing groove by using a suitable tool into the plastic concrete during finishing of the concrete surface. Compact and refinish the plastic concrete around the groove after forming the joint.

Rebated groove joints: Form the rebate by securely fixing removable steel or timber form strips to the form or forms on the slab which is placed first, so that the top of the steel strip is flush with the top of the form. After stripping and cleaning, fix the joint filler in the rebate after placing the adjoining concrete.

**Sawn joints**

Weakened plane joint: Saw the hardened concrete to depth at least $\frac{1}{4}$ to $\frac{1}{3}$ of the pavement thickness and to a uniform width in the range of 3 – 5 mm as follows:

- **Timing:** Commence sawing, regardless of time or weather conditions, as soon as the concrete has hardened sufficiently to permit cutting with only minor ravelling of the edges of the saw cut. Complete sawing no later than 24 hours after concrete placement.
- **Sequence:** If possible, saw every third transverse joint initially, then saw the intermediate joints. Start where concrete placement has commenced.
- **Cracking:** If the concrete has already cracked near the location chosen for a joint, do not saw a joint in that location. If a crack develops ahead of the saw cut, discontinue sawing and submit proposals for extra sawn joints. If uncontrolled cracking occurs, suspend concrete placing.
- **Stand-by machines:** Provide one stand-by sawing machine for each machine planned to be used.
- **Cleaning and protection:** Immediately after each joint is sawn, flush the saw cut and adjacent concrete surface using water, until the waste from sawing is removed from the joint. Temporarily caulk the joint using plastic or rubber tubing, or a suitable Tee shaped extrusion. Leave the caulking in place until grooving and sealing.

Rebated groove joints: Saw straight, parallel sided grooves for joint seals on top of and centred on the sawn weakened plane joints.

- **Timing:** Commence sawing after the curing period has ended, immediately before joint sealing. Saw during daylight hours.

Protection: Where there is a time elapse after sawing and before joint sealing, install a thin-splined rubber strip with a free width slightly larger than the saw cut at the bottom of the saw cut after washing slurry from sawn groove to temporarily prevent ingress of solid material.

**Preparing joints**

Stripping time: At least 12 hours.

**Clean:** Immediately before installation of the sealer ensure that the joint space is dry, clean and free from loose material. Remove laitance, curing compound and protrusions of hardened concrete from the sides and upper edges of the joint.

**Joint sealing**

Sealant type: Provide silicone sealant in conformance with manufacturer's recommendations.

Backing rod: Compressible closed cell polyethylene foam with a bond breaking surface.

3.11 SURFACE SEALERS

**Slip resistance**

Sealer: Apply surface sealer after the curing period and when concrete has dried to allow the sealer to penetrate into the concrete surface.

Curing sealer compound: If using the sealer as a curing compound, apply directly after finishing.

**Concrete finishes**

Conform to: Finishes in the *Concrete-combined* worksection.

**Surface repairs**

Surface repair method: If surface repairs are required, submit proposals.
3.12 COMPLETION

Protection
General: Keep traffic, including construction plant, off the pavement entirely during curing, and thereafter permit access only to necessary construction plant vehicles that conform to the predetermined load limits appropriate to the use of the concrete.

Reinstating adjacent surfaces
General: Reinstall surfaces next to new pavements and associated elements. Where an existing flexible road pavement has been disturbed, trim it back to a straight and undisturbed edge 250 – 300 mm from and parallel to the new concrete for the full depth of the slab. Backfill with asphalt rammed solid, using suitable rammers.

Traffic on pavement
General: Give notice before opening the pavement to traffic before the work is completed. Provide protection.

Testing
Concrete pavement: Check tolerances. Where pavement does not conform submit rectification proposal.

Unplanned cracking:
- 0.3 mm wide crack is acceptable.
- > 1 mm must be assessed, submit a proposal for possible cause and rectification processes.