# BRISBANE CITY COUNCIL

# REFERENCE SPECIFICATIONS FOR ENGINEERING WORK

# S200 CONCRETE WORK

## AMENDMENT REGISTER

|  |  |  |  |
| --- | --- | --- | --- |
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| 1.3 | References added |
| 1.9 | Definition for *Proprietary joint system* included. |
| 4.3 | Technical reference updated |

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## GENERAL

### Section Content

Specified in this section: Concrete work generally including precast and prestressed concrete, formwork, reinforcement, joints, underlays, membranes and integral finishes.

### Standards

|  |  |  |
| --- | --- | --- |
| Australian Standard | AS 1012 | Methods of testing concrete |
| Australian Standard | AS 1214 | Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) |
| Australian Standard | AS 1349 | Bourdon tube pressure and vacuum gauges |
| Australian Standard | AS 1379 | Specification and supply of concrete |
| Australian Standard | AS 1397 | Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium |
| Australian/New Zealand Standard | AS/NZS 1554.3 | Structural steel welding - Welding of reinforcing steel |
| Australian/New Zealand Standard | AS/NZS 1627.5 | Metal finishing - Preparation and pretreatment of surfaces – Pickling |
| Australian Standard | AS 2758.1 | Aggregates and rock for engineering purposes-Concrete aggregates |
| Australian Standard | AS 2870 | Residential slabs and footings |
| Australian Standard | AS 3600 | Concrete Structures |
| Australian Standard | AS 3610 | Formwork for concrete |
| Australian Standard | AS 3610 Supplement 2 | Formwork for concrete – Commentary  (Supplement to *AS 3610-1995*) |
| Australian Standard | AS 3735 | Concrete structures retaining liquids |
| Australian Standard | AS 3799 | Liquid membrane-forming curing compounds for concrete |
| Australian Standard | AS 3850.1 | Prefabricated concrete elements – General requirements |
| Australian Standard | AS 3850.2 | Prefabricated concrete elements – Building construction |
| Australian Standard | AS 3850.3 | Tilt-up concrete and precast concrete elements for use in buildings – Guide to the erection of precast concrete members |
| Australian Standard | AS 3972 | General purpose and blended cements |
| Australian Standard | AS 4100 | Steel structures |
| Australian Standard | AS 4671 | Steel Reinforcing Materials |
| Australian Standard | AS 4672 | Steel Prestressing Materials |
| Australian Standard/New Zealand | AS/NZS 4680 | Hot-dip galvanized (zinc) coatings on fabricated ferrous articles |
| Australian/New Zealand Standard, International Standards Organization | AS/NZS ISO 9001 | Quality management systems – Requirements |

### References

|  |  |  |  |
| --- | --- | --- | --- |
| One Steel Reinforcing | Design Guide |  | Fibresteel Technical Manual |
| BOSFA |

Refer to the following other Reference Specifications for Engineering Works:

|  |  |
| --- | --- |
| S110 | General Requirements |
| S120 | Quality |
| S150 | Roadworks |
| S155 | Road Pavement Marking |
| S205 | Centres Honed Concrete Paths |

### Interpretation

Definitions

Hot weather: Surrounding outdoor shade temperature >32°C.

Grouted pre-packed aggregate: Concrete made by grout intrusion into pre-packed aggregate.

Construction joint: A joint that is located in a part of a structure for convenience of construction and made so that the load carrying capacity and serviceability of the structure will be unimpaired by the inclusion of the joint.

Contraction joint: An unreinforced joint with a bond breaking coating separating the concrete joint surfaces.

Expansion joint: An unreinforced joint with the joint surfaces separated by compressible filler.

Control joint: A weakened plane contraction joint created by forming a groove, extending at least one-third the depth of the section, either by using a grooving tool, by sawing, or by inserting a pre-moulded strip.

Isolation joint: A joint without keying, dowelling, or reinforcement, which imposes no restraint on movement.

Articulated path joint: A transverse joint that is capable of transferring load between adjoining path slabs while accommodating slab rotation or lifting and/or contraction or expansion

Proprietary joint system: A proprietary joint and/system that is designed to fulfil one or many of these joint types:

* Construction joint;
* Contraction joint;
* Expansion joint;
* Control joint;
* Isolation joint;
* Articulated path joint

Joint system must be accepted by Council prior to installation.

Precast units: Concrete elements manufactured in other than their final position including elements manufactured on site such as tilt-up panels.

## QUALITY

### Quality System

The supplier must maintain a Quality Assurance System with third party accreditation to *AS/NZS ISO 9001*.

### Inspection

Witness points

*Refer annexure*. Give sufficient 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.
* Completed formwork, reinforcement, tendons, cores and embedments fixed in place.
* Completed scabbled construction joints.
* Commencement of concrete placing.
* Used formwork, after cleaning and before reuse.
* Precast units completed at factory.
* Placement of precast units.
* Commencing initial or incremental stressing.
* Grouting tendons.
* Surfaces or elements to be concealed in the final work before covering.
* Evaluation of the finish.

Rejection

Remove rejected concrete from the site.

### Testing

Embedded pressure pipes

Leak tests: Before embedment, leak test pipes which will contain liquid or vapour at a pressure >10 kPa.

### Sample Panels

General

Supply sample panels to *AS 3610* for the application specified. Do not proceed with the related work until the test panels have been approved and, for surface treatments, the accepted range of treatments determined. *Refer annexure*.

Manufacture

Cast the panels using the formwork, concrete, compaction equipment, form release agents, curing and formwork removal methods which are to be used in the final work.

Storage

Maintain the panels on site undamaged and protected from the weather, as samples for future evaluation of completed work.

### Contractor’s Submissions

Subcontractors

Concrete: Submit names and contact details of proposed ready mixed concrete suppliers, and alternative source of supply in the event of breakdown of ready mixed or site mixed supply.

Prestressing: Submit the proposed system and the name and contact details of the prestressor.

Precast units: Submit name and contact details of proposed manufacturer of precast concrete units.

Design

Loading: Submit calculations to justify the adequacy of the structure to sustain any construction loads. *Refer annexure*.

Bending schedules: Submit marking plans and schedules showing location, shape, size and grade of reinforcement.

Prestressing: Submit calculations of tendon jacking forces, extensions and losses for each stressing stage. Submit the method of tensioning and deflecting pre-tensioned tendons.

Shop drawings

Fixings and embedded items: If the locations of embedded items are not shown or are shown diagrammatically, submit shop drawings showing the proposed locations, clearances and cover.

Prestressing: Submit shop drawings of post-tensioned work showing details of the proposed system, including the following:

* Profiles, sizes and details of tendons, proprietary anchorages, ducts, duct formers, sheathing, end block reinforcement and other associated components.
* Stressing requirements including sequence of stressing, jacking forces, tendon elongations, gauge pressures, and the basis of assumed loss calculations.
* Number, size and position of grout openings, vents and drain holes in the ducts (maximum spacing 15 m).
* Proposed fabrication, handling and fixing methods for tendons and sheathing.

Precast units: Submit shop drawings of precast units showing the proposed details for their design, manufacture, assembly, transport and installation, including the following:

* Project title and manufacturer's name.
* Shape or profile drawings (submit these before fabrication of moulds and tooling).
* Calculations showing method of complying with the specified performance requirements.
* Concrete mix and type of cement for special class concrete.
* Formwork type.
* Surface finish class and surface treatment, if applicable.
* Curing and protection methods.
* Marking plan.
* Equipment and methods for handling, transport and installation.
* Calculated maximum loadings on lifting and bracing inserts and attachments.
* Evidence of load capacity of lifting and bracing inserts and attachments in the form of test reports or calculations.

Tests

Dissemination of production information: Submit legible copies of the reports.

Embedded pressure pipes: Submit the results of leak tests.

Reinforcement: Submit either the manufacturer's certificate of compliance with the relevant standard, or an independent testing authority's test certificates demonstrating compliance.

Grout: Before grouting submit certified test results for compressive strength and shrinkage of the proposed grout mix.

Anchorages: Submit performance test certificates for each type and size of anchorage and coupler.

Materials

General: Submit details of proposed sources of materials.

Foamed concrete: Submit details, including aggregate grading and mix proportions.

Curing compounds: If it is proposed to use a liquid membrane forming curing compound submit the following information:

* Certified test results for water retention to *AS 3799 Appendix B*.
* Evidence that an acceptable final surface colour will be obtained.
* Evidence of compatibility with applied finishes, if any.
* Methods of obtaining the required adhesion for toppings and render.

Grout: Submit proposed grout mix including additives, if any.

Certificate of compliance: Submit the manufacturer's certificate of compliance with the relevant Australian Standard for each delivery of prestressing steel and each delivery of anchorage components.

Grouted pre-packaged aggregate: Submit proposed details including aggregate grading and grout materials and proportions.

Epoxy grout: Submit proposed formulation.

Execution

Formwork: Submit formwork documentation and details of proposed form linings, form coatings, release agents and, where applicable, reuse of formwork. *Refer annexure*.

Formwork reshoring: If intended, submit proposals.

Surface repair method: Before commencing repairs, submit the proposed method.

Slip formwork: Show on formwork drawings the method of lifting the forms during construction and the average rate of movement. Demonstrate that the proposed average rate will permit the production of concrete of the specified quality and surface.

Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:

* Site storage, mixing and transport methods and equipment, if applicable.
* Addition of water at the site.
* Handling, placing, compaction and finishing methods and equipment.
* Temperature control methods.
* Curing and protection methods.
* Target strength, slump and proposed mix for each type and grade of concrete.
* High early strength cement.
* Placing under water.
* Cutting or displacing reinforcement, or cutting hardened concrete.
* Sequence and times for concrete pours, and construction joint locations.

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

Reinforcement changes: Submit proposed changes, if any, in the reinforcement shown on the drawings, including additional splicing.

Mechanical splices: If mechanical bar splices are proposed or required submit details and test certificates for each size and type of bar to be spliced.

Damaged galvanising: If repair is intended, submit proposals.

Post-tensioning equipment: Submit details of proposed stressing and grouting equipment. Submit current calibration certificates for tensioning and tension measuring equipment.

Ready mixed supply

Delivery docket: For each batch, submit a docket listing the information required by *AS 1379*, and the following additional information:

* The concrete element or part of the works for which the concrete was ordered.
* The total amount of water added at the plant and the maximum amount permitted to be added at the site.
* The amount of water, if any, added at the site.

Records

Post-tensioning: Record and submit the following data:

* Concrete mix and quality.
* Details of placing and curing including dates.
* Details of placing of reinforcement and tendons.
* Date of post-tensioning operation.
* Name of operator.
* Type and identification numbers of equipment used.
* Piston areas.
* Identification of tendons.
* Stressing method (single or double end, monostrand or multistrand).
* Calculated tendon extension at each stressing stage.
* Initial force or pressure where tendons are marked for measurement of elongations.
* Final force or pressure and elongation on completion of tensioning.
* Elongation remaining after release of jacks.
* Tendon breakage.
* Ramming pressure, if applicable.

Grouting: For each duct grouted, record and submit a record identifying the duct and tendons, giving the stressing and grouting dates, and showing the composition of the grout (water: cement ratio, admixtures), grout tests, and details of grouting (including interruptions, topping up).

Precast concrete lifting

Early lifting: If it is proposed to lift the units by their designated lifting points before the 28 day strength has been achieved, submit evidence to demonstrate that the unit is strong enough to carry its own weight without residual deflection on removal of the suspension.

Attachments for handling purposes: If it is proposed to locate these on visible faces of units, submit proposals.

Lifting units: If it is proposed to lift or support units at other than specified points, submit proposals.

### Prototypes

Storage

Maintain prototypes on site, undamaged and protected from discolouration for comparison with manufactured precast units. *Refer annexure*.

Performance testing

Test each prototype for the specified properties. *Refer annexure*.

Structural testing

Static load tests: If structural performance requirements are specified for the precast unit, perform static load tests on the prototype. *Refer annexure*.

Additional tests: Static load tests may be required on units that fail to meet specific acceptance criteria for structural performance. *Refer annexure*.

## FORMWORK

### General

Requirement: Design and construct formwork so that the concrete, when cast in the forms, must have the dimensions, shape, profile, location and surface finish required by the Contract. Make provision for dimensional changes, deflections and cambers resulting from the application of prestressing forces, applied loads, temperature changes and concrete shrinkage and creep.

Openings: In vertical forms provide form openings or removable panels where necessary for inspection and cleaning.

Cleaning: Remove free water, dust, debris, stains and the like from the forms and the formed space prior to placing concrete.

Stripping of formwork: The more stringent requirements of *AS 3600* or *AS 3610* apply. Forms must be left on columns as long as possible to protect against damage during construction operations unless other precautions are taken.

Post-tensioned concrete: Do not strip formwork supporting post-tensioned concrete members until sufficient prestress has been added.

Reshoring: Do not reshore without approval.

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. Where necessary, clean the reinforcement to remove all traces of release agent.

Responsibility: The Contractor is responsible for the sufficiency of the formwork, except to the extent, if any, that formwork design is shown on the drawings or specified.

Defective formwork: If formwork fails to meet the requirements of the Contract, any concrete that has been cast in it may be rejected. In that case, remove the rejected concrete, form construction joints, reconstruct the formwork and recast the concrete.

Permanent loading: Do not place permanent loads, including masonry walls, on the concrete structure while it is still supported by formwork.

Formwork removal: Remove formwork, other than steel reinforcement decking, including formwork in concealed locations.

### Dimensional Tolerances

Position: Construct formwork so that the position of finished concrete is within the tolerances stated in *Clause 3.3*.

### Position Tolerances

Maximum deviation from the correct position for formwork classes to *AS 3610*:

* Class 1: 10 mm
* Class 2: 15 mm
* Class 3: 20 mm
* Class 4: 25 mm

### Formed Surface Finish

Surface finish class: Use the applicable class from *AS 3610 Table 3.3.1*. *Refer annexure*.

Visually important surfaces: For concrete of surface classes 1, 2 or 3, set out the formwork to give a regular arrangement of panels, joints, bolt holes, and like visible elements in the formed surface. Form 45°, 25 mm bevels at corners and angles.

Colour control: Where colour control is specified, use form linings not inferior to those described as “suitable” in *AS 3610 Supplement 2 Table C5.4.1*.

Evaluation: Colour control evaluation must be carried out in the presence of the Superintendent.

### Form Tie Bolts

Removable bolts: Remove the bolts without causing damage to the concrete. Tie wires passing through the concrete are not permitted.

Cover: Position formwork tie bolts left in the concrete so that the tie does not project into the concrete cover.

Bolt hole filling: Use cement mortar mix that matches the surface colour. Fill or plug the recessed hole to 6 mm below the surface.

### Slip Formwork

Requirement: Use slip formwork or moving formwork which consists of suitable equipment, constructed and operated by personnel experienced in its use.

Height of the forms: 1500 mm maximum.

Provision for inspection: Provide a hanging scaffold below the moving formwork on all faces, from which surface treatment and inspection may be carried out.

### Lost Formwork

Requirement: Use permanent or lost formwork, if required, which does not contain chlorides, and which will not impair the structural performance of the concrete members.

### Void Formers

Requirement: Deflection during placing and compaction of the concrete is less than the span of the beam or slab divided by 1000.

### Steel Reinforcement Decking

Material: Bondek or equivalent. Hot dipped zinc-coated sheet steel to AS 1397, minimum G500 – Z200, which acts as both permanent formwork and positive tensile reinforcing steel in one-way reinforced concrete slab construction.

Installation: Provide temporary propping while placing concrete, and for 28 days thereafter, where required or specified. Fix sheeting to structural steel supports by puddle welds, or by welded shear studs in composite construction. *Refer annexure*.

## MATERIALS

### Concrete

Generally

Cement content: All mixes must contain a minimum mass of portland cement equal to 60% of the total mass of cementitious material. *Refer annexure*.

Aggregates: Maximum water absorption 2.5%. Durability assessment method to be wet strength and wet/dry strength variations.  *Refer annexure*.

Admixtures: Do not use calcium chloride as an admixture. The total alkali contribution (measured as Na2O equivalent) of all admixtures used in mix must not exceed 0.20 kg/m3. Where air entrainment is specified, the air content of the concrete delivered on site must have a maximum value of 6%.  *Refer annexure*.

Plastic cracking: Design the concrete mix to minimise plastic settlement and shrinkage cracking.

Bagged cement: Do not use bagged cement more than 6 months old.

Ready mixed supply

Notification: For structural concrete (other than standard manholes and the like), register the project with the supplier and nominate the Superintendent as the person to receive the production assessment information.

Method: Use the batch production process. Deliver in agitator trucks.

Addition of water: Obtain approval before adding water at site.

Elapsed delivery time: Elapsed time between the wetting of the mix and the discharge of the mix at the site must not exceed the criteria specified in *Clause 4.2*.

Site mixed supply

Plant: Mix concrete in a plant located on the construction site.

Emergencies: Do not mix by hand.

### Elapsed Delivery Time

Do not exceed the following maximum elapsed times for the corresponding concrete temperatures at the time of discharge:

* Temperature <24°C: 2.0 hours.
* Temperature 24 - 27°C: 1.5 hours.
* Temperature 27 - 30°C: 1.0 hour.
* Temperature >30°C: 45 minutes.

### Concrete Types

Foamed concrete

Cement, fine aggregate, water and foam. *Refer annexure*.

Steel fibre concrete

Design: Refer to *BOSFA/One Steel Reinforcing Fibresteel Technical Manual* or similar publications.

Materials: Cement, coarse aggregate, fine aggregate, water and steel fibres. Admixtures and fly ash may be included. *Refer annexure*.

Synthetic polymer fibre concrete

Design: Refer to *fibre supplier documentation*.

Materials: Cement, coarse aggregate, fine aggregate, water and polymer fibres. Admixtures and fly ash may be included. *Refer annexure*.

Cellulose polymer fibre concrete

Base material: Specialty virgin cellulose polymer fibre with protective coating

Design: Refer to fibre supplier documentation. Typical dose rate of 2 bags per m3 (0.9 kg/m3) unless supplier recommends differently.

Mixing: To be conducted at the plant as to manufacturer’s instructions. Examples below.

Option A:

1. Add the appropriate number of bags containing the fibres directly into the empty concrete mixing truck
2. Let the mixing truck receive all the concrete ingredients.
3. After all the concrete ingredients have been added, turn the mixing truck for 3 minutes at full mixing speed.

Option B:

1. Lay the bags of fibres on the aggregate belt so that when it first runs to feed into the concrete mixing truck, the bags of fibre will go into the truck immediately with the aggregate.
2. Let the mixing truck receive all the remaining concrete ingredients.
3. After all the concrete ingredients have been added to the mixing truck, turn the mixing truck for 3 minutes at full mixing speed.

Materials: Water, specialty virgin cellulose polymer fibre with protective coating, large aggregates, fine aggregates, sand, cement, admixtures and fly ash. Specialty virgin cellulose polymer fibre and cement work positively together to condition and enhance concrete characteristics, whereas fly ash addition acts neutrally with the fibre in the concrete.

Glass fibre reinforced concrete

Materials: Cement, fine aggregate, water, and alkali-resistant glass fibres from an approved source. Admixtures and fly ash may be included.  *Refer annexure*.

Density: Minimum 1900 kg/m3.

Modulus of rupture (characteristic value): 21 MPa.

Limit of proportionality (characteristic value): 8 MPa.

Glass fibre content (by weight): Minimum 5%.

Proportions: Achieve and maintain uniform mixing of the glass fibres and cement during application.

Grouted pre-packed aggregate

Materials: Concrete made by grout intrusion into pre-packed aggregate. Submit details including aggregate grading and grout materials and proportions.

No fines concrete

Materials: Cement, water and coarse aggregate. The water/cement ratio must be within the range 0.5 to 0.6 by mass. Grading limits and quantity of cement to comply with Table 4.1.

Table 4.1 – Grading limits and cement contents

| A.S. metric sieve | Percentage passing by weight | |
| --- | --- | --- |
| Nominal size 20 mm | Nominal size 10 mm |
| 26.5 mm | 100 | - |
| 19.0 mm | 85 - 100 | - |
| 13.2 mm | - | 100 |
| 9.5 mm | 0 - 20 | 85 - 100 |
| 4.75 mm | 0 - 5 | 0 - 20 |
| 2.36 mm | - | 0 - 5 |
| 75 mm | 0*-*2 | 0*-*2 |
| Cement (kg/m3) | 210 | 250 |

Compaction: Where no fines concrete is placed inside formwork, it must be rodded sufficient only to ensure the form is completely filled. It must be screeded to the required surface level without tamping or vibrating.

Curing: No fines concrete must be moist cured for at least 4 days by covering with wet hessian, polythene sheet or other similar material. The use of wet sand or any other material, which can enter the voids, is not permitted.

Shotcrete

Process: Apply shotcrete using an approved established process using either the “dry method” (water added at the nozzle) or “wet method” (water added at the mixer).

Compressed air: Provide compressed air free of oil and relatively dry. Select capacity of air compressor to suit the nozzle size, taking into account of losses through lines from the compressor to the point of delivery and incorporate allowance for additional air for blowing away rebound material.

Test panel: Prior to commencing work on the job, submit a minimum 1 m2 test panel made by the applicator using the materials, equipment and operators proposed to be used on the job.

Concrete: Characteristic compressive strengths at 28 days of 20 MPa for unreinforced concrete, and 25 MPa for reinforced concrete.

Slump: To suit the requirements of the shotcreting pump.

Aggregate size: To suit the requirements of the shotcreting pump.

Steel reinforcement: Steel reinforcing fabric to be centrally placed unless specified otherwise.

Surface preparation: For newly constructed embankments, slightly overfill during embankment construction and trim to the correct profile just before placing shotcrete protection. Lightly compact the trimmed face. Trim cut faces neatly to the lines shown on the drawings. Remove any laitance or loose material using appropriate air or water blast from the nozzle.

Execution: Apply uniform operating air pressure that provides proper nozzle velocity for good compaction. Hold nozzle at the proper distance as nearly as normal to the surface, to secure maximum compaction with minimum rebound. Cut out any sand or slough pockets and replace with shotcrete.

Contraction joints: Extend to full depth of concrete and discontinue reinforcing fabric at joints. Provide as specified.

Weep holes: Provide as specified.

Surface finish: Wood float and broom finish.

Tolerances: Gap beneath a 3 m straightedge placed anywhere on the finished surface does not exceed 25 mm.

## Reinforcement

### Steel reinforcement

General

Extent: Provide reinforcement, including tie wires, support chairs, spacers and accessories.  *Refer annexure*.

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

Dowels

Standard: To *AS 4671* Grade 250R.

General: Provide each dowel galvanised and in one piece, straight, with square cut ends free from burrs. Heavily grease or bitumen coat one half and fit an expansion cap to that end.

Tolerances: Location to ± half the diameter of the dowel, alignment 2 mm in 300 mm.

Welding

General: Give notice before welding reinforcement. Do not weld reinforcement within 75 mm of a section that has been affected by bending or re-bending.

Standard: To *AS/NZS 1554.3*.

Protective coated reinforcement

Extent: For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating. *Refer annexure*.

Galvanising: Minimum coating 700 g/m2.

Preparation: Pickling to *AS/NZS 1627.5*.

Damage: If damage occurs to the coating replace the damaged reinforcement.

Unencased reinforcement: Generally provide protection for "starter bars" and other items projecting from cast concrete for future additions, and exposed to the weather.

Fixing reinforcement

General: Secure the reinforcement against displacement by tying at intersections with either annealed iron 1.25 mm diameter (minimum) 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, and at other points as required.

Beams: Tie ligatures to bars in each corner of each ligature. Fix other longitudinal bars to ligatures at 1 m maximum intervals.

Columns: Secure longitudinal column reinforcement to all ligatures at every intersection.

Bundled bars: Tie bundled bars together so that the bars are in closest possible contact. Use tie wire at least 2.5 mm diameter at centres £24 times the diameter of the smallest bar in the bundle.

Provision for concrete placement

Notice: If spacing or cover of reinforcement does not comply give notice.

Reinforcement supports

General: Use approved plastic bar chairs. The shape of the chairs shall be such that minimum obstruction is offered to the formation of a homogenous concrete both within and around the chairs. Tubular or cylindrical chair types are not acceptable. Precast concrete or metal chairs shall not be used. Layers of reinforcement shall be separated by the use of approved bar spacers.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. Place a metal or plastic plate under each support to prevent puncturing.

Support spacing: Bars ≤60 diameters, fabric ≤750 mm.

### Fibre reinforcement

General

Fibres to be added may be formed from, but not limited to, steel, synthetic polymer or cellulose polymer material.

Material chosen is to be relevant for application purpose. Note: steel fibre reinforcement is not to be used for pedestrian and bicycle paths.

Application/dosage rate

Reinforcement fibres to be applied/dosed to manufacturer/supplier requirements. Fibre reinforcement suitable for use in concrete pedestrian and bicycle paths to control shrinkage cracking. Dosage rates for other applications to be as per the design.

### Polymeric Film Underlay

General

Under internal slabs on ground including integral ground beams and footings, provide a vapour barrier or, in areas prone to rising damp or salt attack, a damp proofing membrane.

Standard

Vapour barriers and damp-proofing membranes: To *AS 2870*.

Base preparation

Graded stone base: Blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

Concrete working base: Remove projections above the plane surface, and loose material.

Installation

Lay over the base, lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces as far as the damp proof course where applicable, and fix at the top by tape sealing. Locate vertical laps only on vertical or inclined surfaces. Patch or seal punctures or tears before pouring concrete.

## EMBEDMENTS, CORES AND FIXINGS

### Fixings and Embedded Items

Adjoining elements

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. Where applicable provide for temporary support of the adjoining elements during construction of the concrete.

Structural integrity

Fix cores and embedded items to prevent movement during concrete placing. In locating embedded items, do not cut or displace reinforcement, or cut hardened concrete.

Tolerances on placement

Embedded items generally: Within ±10 mm deviation from the correct positions.

Fasteners, including anchor bolts: Within ±3 mm deviation from the correct positions.

Anchor bolt groups for structural steel: To *AS 4100*.

Inserted fixings

Methods: Do not insert fixings using drilling (including masonry anchors), or using explosive tools.

Protection of fixings

Requirement: For all embedded and inserted ferrous fixings (other than stainless steel), provide galvanised surface coating passivated by dipping in 0.2% sodium dichromate solution.

Threaded fastenings: To *AS 1214*.

Structural sections: To *AS 4680*.

## PLACING AND CURING

### Concrete Working Base

Material: N20 concrete. Lay over the base or subgrade and screed to the required level.

Thickness: Minimum 50 mm.

Finish: Membrane support. Wood float finish or equivalent.

Surface tolerance: ±5 mm from the correct plane, ±5 mm from a 2 m straightedge.

### Placing and Compaction

Placing

General: Use placing methods that minimise plastic settlement and shrinkage cracking. Place concrete without segregation.

Layers: Place concrete in layers such that each succeeding layer is blended into the preceding one by the compaction process.

Placing slabs and pavements: Place concrete uniformly over the width of the slab so that the face is generally vertical and normal to the direction of placing.

Horizontal movement

Use suitable conveyors, clean chutes, troughs or pipes.

Vertical movement

In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed chutes or access hatches in forms. As far as practicable, keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete.

Rain

Do not expose concrete to rain before it has set, including during mixing, transport or placing.

Sequence of pours

Minimise shrinkage effect by pouring the sections of the work between construction joints in a sequence such that there will be suitable time delays between adjacent pours. *Refer annexure*.

Compaction

General: Remove air bubbles and fully compact the mix.

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate. Vibrate all structural concrete.

Vibrators: Do not allow vibrators to come into contact with partially hardened concrete, or reinforcement embedded in it. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Screeding: Bring concrete to the required level by means of an approved screeding method. Fully compact concrete before screeding. During screeding, maintain a slight excess of concrete ahead of the screed. The number of passes of the screed must be kept to a minimum. Where a vibration screed is used, the number of passes must not exceed one initial cutting pass plus two finishing passes.

Finishing operations: Use methods to provide a dense surface free from visible surface cracking. Rework concrete surface as necessary to eliminate plastic cracking after the initial set has taken place and before the commencement of curing.

Placing records

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

* Date.
* The portion of work.
* Specified grade and source of concrete.
* Slump measurements.
* Volume placed.

### Placement Conditions

Do not place concrete when the shade temperature is less than 10°C or more than 35°C.

### Hot Weather Placing

Requirement

The provisions of this clause apply to concreting when the surrounding shade outdoor temperature is greater than 32°C.

Mixing

Do not mix concrete when the surrounding outdoor shade temperature exceeds 35ºC.

Handling

Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

Placing

Before and during placing, maintain the formwork and reinforcement at ≤32°C using protection, cold water spraying, or other effective means. When placed in the forms, the temperature of the concrete must not exceed the criteria specified in Table 6.1.

Table 6.1 – Concrete temperature limits

| Concrete element | Concrete temperature limit |
| --- | --- |
| Normal concrete in footings, beams, columns, walls and slabs | 35°C |
| Concrete in large mass concrete sections; or concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness | 27°C |

Temperature control methods

Select one or more of the following methods of maintaining the specified temperature of the placed concrete:

* Use chilled mixing water.
* Spray the coarse aggregate using cold water.
* Cover the container in which the concrete is transported to the forms.
* Cool the concrete using liquid nitrogen injection before placing.

### Placing Under Water

Condition: Do not place under water if placing in the dry is practicable by pumping or other means of dewatering. Do not place concrete under running water.

Minimum cement content for the mix: Increase by 25%.

Method: Place concrete under water by tremie. Do not withdraw the tremie pipe from the concrete during the concrete discharge. Continue placing concrete until all laitance and contaminated concrete is above the finished level. Do not vibrate tremie concrete.

### Evaporation Control

Apply immediately after final screeding where the temperature exceeds 20ºC or where not protected against drying winds to protect concrete from moisture loss. Re-apply each time the concrete is reworked. This requirement may be relaxed where it is demonstrated that the evaporation rate is less than 0.75 kg/m2 per hour.

Acceptable evaporation control methods are:

* Cover the concrete with an impervious membrane, or hessian kept wet.
* Fog spray application of aliphatic alcohol evaporation retardant.

### Curing

General

Protection: Protect fresh concrete, during the curing period, from premature drying and from excessively hot or cold temperatures. *Refer annexure*.

Curing period: Cure continuously until the total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10ºC, is at least the following:

* 3 days for fully enclosed internal surfaces.
* 7 days for other surfaces.

Visually important surfaces

Produce uniform colour on adjacent surfaces.

Curing compounds

Substrates: Do not use wax based or chlorinated rubber based curing compounds on surfaces forming substrates to concrete toppings and cement based render.

Application: Provide a continuous flexible coating without visible breaks or pinholes, which remains unbroken at least seven days after application.

Hot weather curing: Do not use curing compounds.

Polythene sheet

Must be of sufficient strength to withstand wind and foot traffic. Do not use torn or punctured sheets. Provide laps not less than 300 mm. Seal or hold down edges and laps. Daily spray water under sheeting edges and laps. Use clear sheeting if coloured sheeting causes desiccation of the concrete.

Steam curing

Method: Provide a low pressure steam curing enclosure. Arrange formwork, enclosure and steam lines to ensure the temperature variation between any two locations does exceed 5°C. Do not discharge steam directly onto the concrete or formwork.

Curing period: Until the required strength as indicated by cylinder tests is attained.

Application: Any change in temperature must not exceed 24°C per hour. The relative humidity must be 100 percent. The maximum temperature must not exceed 75ºC. The application of steam must be delayed by the period (T) calculated as follows:

T = k/t hours

t = initial temperature in °C

k = 40 for precise temperature control, otherwise 60. Precise temperature control is where the temperature increases at a uniform rate and is within 50°C of the predicted temperature at any time.

When retarding admixtures are used, determine the delay period from measurements of the initial setting time.

Instruments: Provide accurate instruments for recording and controlling the temperature. Spacing of recording points must not exceed 10 m. Record the temperature for the whole steaming operation.

Test cylinders: Place cylinders in the lowest temperature region.

Prestress: Allow temperature to reduce to 600°C before transfer of prestress.

Multiple units: Maintain uniform curing conditions. If cracking occurs, extend the delay time for future units.

### Protection

Loading

Notice: Give notice before loading the concrete structure.

Protection: Protect the concrete from damage due to load overstresses, heavy shocks and excessive vibrations, particularly during the curing period. Do not place construction loads on self-supporting structures that will overstress them.

Surface protection

Protect finished concrete surfaces from damage.

### Cement Contamination

Protection: Water contaminated with cement must not enter the drainage system of the drip zone of any tree.

Clean up: Remove any material contaminated with cement from site.

## PRESTRESSING

### Tendons

General: Provide post-tensioning tendons, anchorages, ducts, supports, grout and anchorage protection. *Refer annexure*.

### Grout

Properties

Maximum shrinkage: 1% by volume after 24 hours.

Maximum water cement ratio: 0.45 (by weight).

Minimum compressive strength (75 mm cube): 30 MPa at 28 days.

Materials

Fine aggregate: Do not use sand in the grout for ducts.

Admixtures: Do not use admixtures containing chlorides, nitrates, sulphides or sulphites. Include an anti-bleed additive.

Cement type: GP to *AS 3972*, free from calcium chloride and less than one month old from date of manufacture.

Fly ash: Maximum 10% by weight of cement.

Epoxy grout

Commercial epoxy formulation of high compressive strength.

### Tensioning Equipment

Gauges

Standard: To *AS 1349*.

Maximum error in pressure indication: 1% of the maximum scale value.

Calibration of gauges and dynamometers

Calibrate at intervals not exceeding 6 months.

Jacks

Calibrate and measure friction losses at least once a year, or after re-sealing.

### Post-Tensioning

Sheathing

General: If ducts are formed with sheaths, provide sheathing material strong enough to transfer the tendon stresses into the body of the concrete.

Stiffening: If tendons are to be installed after concreting, provide temporary stiffening within the sheath such that the duct shape and profile are maintained during concreting. After concreting, remove the temporary stiffening and prove the duct using a suitable gauge before installing the tendon.

Unbonded tendons

Provide galvanised or lead coated steel sheathing for lengths of tendon required to be unbonded. Fasten sheathing to the tendon in such a manner that the efficiency of the bond-break is not impaired by the entry of cement mortar. Measurement of the transfer draw-in to check the efficiency of the bond breaking mechanism may be required.

Stressing

Do not commence stressing until the concrete has attained the required transfer strength. Transfer prestress in a gradual, uniform and preferably simultaneously manner. Large differences of tension between the tendons are not permitted.

Cutting tendons

Do not cut tendons until 7 days after grouting.

Protection of tendons and anchorages

On completion of stressing and grouting, permanently protect anchorage parts and parts of tendons anchored to them. Provide at least 40 mm of cover over the cut tendons when the recesses are concreted.

Grouting ducts

Method: Do not use manually powered grouting machines. Pressure test the ducts at the grout pressure using water before grouting, and rectify leaks. Remove water from ducts using oil free compressed air. Prevent damage to grout vents and fittings during grouting.

Grout openings: Provide grout openings, vents and drains as necessary. Completely fill the duct during grouting. Remove protruding vents and drains after the grout has set and make good to match the adjacent surfaces.

Grout pressure: Seal the duct on completion of grouting at a pressure ≥210 kPa. Fit pressure tap connections to each duct for this purpose.

### Pre-Tensioning

Method: The transfer of stress must be carried out by jacks, de-tensioning screws or by other approved mechanical means. Flame releasing must not be used. Stressing from both ends is permitted if friction losses are such that the specified tendon force cannot be attained by stressing from one end.

Protection of tendons: After release, the tendons must be cut off flush with the ends of the units and protected by two coats of epoxy paint. Flame cutting is not permitted within 40 mm of the concrete face.

Completion: Remove devices for deflecting tendons to a depth of 20 mm. Fill with a dense waterproof patch. Patch colour to match that of parent concrete.

## PRECAST UNITS

### Precast Units

Marking

Identify units by marks which:

* Remain legible until after the unit has been fixed in place.
* Are not visible in the completed structure.
* Show the date of casting.
* Show the correct orientation of the unit.
* On other than units manufactured as a standard product, indicate the locations within the structure in accordance with the marking plan.

Tolerances

Fixings and embedded items in precast units: To *AS 3610* and *AS 3850.1* as applicable.

Lifting devices

Design each lifting device for a working load at least 1.65 times the maximum calculated static load at that point and an ultimate load ≥4 times the maximum static load.

Attachments

Do not place lifting attachments, holes and other temporary fixings for handling purposes on visible faces of units. Recess lifting attachments such as ferrules, or other types of cast-in fixings, and provide plugs for sealing.

### Veneered Construction

General: Do not use veneered construction.

### Handling Precast Units

General

Fix the units securely and accurately in their final positions. Provide components and materials, including fasteners, braces, shims, jointing strips, sealant, flashings, grout and mortar.

Precautions

Do not lift or support units at other than designated points. Use handling methods that do not overstress, warp or damage the units.

Attachments

Remove temporary attachments after erection. Seal or otherwise make good residual recesses.

Protection

Protect the units against staining, discolouration and damage.

## JOINTS

### Construction Joints

Location

Do not relocate or eliminate construction joints, or make construction joints not shown on the drawings. This includes unplanned construction joints. Make suitable contingency plans for equipment or plant failure.

Joint preparation

Roughen and clean the hardened concrete joint surface, remove loose or soft material, free water, foreign matter and laitance. Dampen the surface just before placing the fresh concrete.

Finish at construction joints

Butt join the surfaces of adjoining pours. In visually important surfaces, make the joint straight and true, and free from impermissible blemishes relevant to its surface finish class.

### Expansion Joints

Jointing materials

General: Use jointing materials compatible when used together and non-staining to concrete in visible locations.  *Refer annexure*.

Foamed materials (in compressible fillers): Closed-cell or impregnated types, which do not absorb water.

Bond breaking: Use back-up materials for sealants, including backing rods, which do not adhere to the sealant. They may be faced with a non-adhering material.

Joint filling

Preparation: Before filling, dry and clean the joint surfaces, and prime.

Joint filling: Fill with jointing materials. Finish visible jointing material neatly flush with adjoining surfaces.

Watertightness: Apply the jointing material such that joints subject to ingress of water are made watertight.

### Contraction Joints

The following section only applies to the construction of shared and bicycle paths.

Contraction joints are to be spaced as shown in *Standard Drawing BSD-5208* and formed by one of two methods:

* 4 - 6 mm saw cut to one-third the depth of finished slab (minimum 35 mm for 100 mm thick path). Saw cutting to be undertaken between four (4) and twelve (12) hours of concrete pour;
* Installation of proprietary cracking forming material/device (crack inducer). Crack inducers to be installed to manufacturer/suppliers’ requirements.

### Dowels

Embed dowels normal to the plane of the joint, so that half the dowel lies on each side of the joint. Embed the uncoated half of the dowels in the concrete placed first.

### Proprietary joint systemS

A proprietary joint and/system that is designed to fulfil one or many of these joint types:

* Expansion joint;
* Construction joint;
* Contraction joint;
* Control joint;
* Isolation joint;

Joint system must be accepted by Council prior to installation.

### Articulated Path Joints

The following section only applies to the construction pedestrian/shared/bicycle paths.

These joints are designed to create an articulated joint (hinge) between adjoining concrete, reducing or eliminating differential displacement between adjoining concrete slabs.

Material

A rigid uPVC, or approved non-compressible material, profile having a semi-gloss surface and a light grey colour designed to blend with concrete.

The top surfaces of the joint material are to be grooved or patterned to maintain a skid and slip resistant surface.

Material tolerances:

* Cross-section; ±0.5 mm laterally and ±1 mm vertically (depending on size).
* Straightness; ±25 mm/m horizontally (bow) and ±2 mm/m vertically (crown). Bow within the above tolerance can be straightened on site by pinning the joint into a straight line. Crowned profiles should be installed with the crown upwards.
* Twist; ±1.0 mm/m from vertical.
* Length +0, -10 mm relative to that specified by the customer.

Product outside these tolerances should not be installed.

Material height: The material is to be supplied in heights to match standard Council path thicknesses, namely 100 mm and 125 mm.

Material weight: Material to have typical weight of 1.7 kg/m (100 mm high) and 2.3 kg/m (125 mm high) respectively.

Loading criteria: The articulated joint system is to conform to the following load criteria:

* Enable the slabs to rotate about the joints between them by up to 3.8° in either direction (i.e. to a subtended angle of 176.2°);
* Sustain an imposed loading of 5.0 kPa (Medium Vehicle Traffic as per *AS/NZS 1170.1*) on the slabs adjoining such joints;
* Allow a maximum step between slabs that does not exceed 5 mm in height.

Paths of 100 mm and 125 mm thickness with articulated joints to match are to be able to carry uniformly distributed loads of 300 kg and 400 kg respectively, to allow a maximum vertical uplift at a joint sufficient to cause a rotation between the slabs adjacent to the joint of 3.8° (i.e. an uplift of 50 mm at one end of a slab 1500 mm long), without causing a vertical step in excess of 6 mm at this joint.

Placing

Install articulated joint profiles as per manufacturer/supplier directions. In general, the articulated joint profiles are to be installed as follows:

* Articulated joint profiles shall be installed to within 5 mm of vertical.
* In the horizontal direction they should be installed to ±30 mm per metre of width from a right angle to the length of the pavement.
* In curved sections of pavement, where they may be installed radially, they should be installed to ±30 mm per metre of width from a radial line.
* Where the footpath is to be constructed in two stages, to allow half of the footpath to remain open for pedestrian use, a contraction joint is to be installed to coincide with the centre longitudinal sawcut of the footpath.
* Top of the joint profile shall be installed flush with the concrete path surface;
* Bottom of the joint profile should be flush with the base course;
* Surface of the path should not be tooled or edged at the joint profiles;
* Gap between the ends of the joint profiles and formwork should not be more than 5 mm;
* Concrete should be well compacted around the joint profiles;
* Concrete should be properly cured and have the specified strength.

Joining to new and existing paths

General: Joint locations and set-out are to comply with the requirements shown in *Standard Drawing BSD-5208 and BSD-5204*.

Joining to existing paths: A 150 mm wide sacrificial connecting strip should be used to connect a new path utilising the articulated joint system to an existing path. Refer *Standard Drawing BSD-5204* for details.

Installation at new driveways: For an all new construction, an articulated joint profile member should be cast into the edge of the driveway and a transition slab constructed between the driveway width and the path width. An articulated joint profile member can then be cast into the path end of the transition slab to match the new path.

Installation at existing driveways

In the case of an existing driveway and a new footpath, a 125 mm transition stub should be constructed, connected to the driveway by full thread Ø10 bolt and nut combination as per *Standard Drawing BSD-5204*, and to the new footpath by an articulated joint. These details are not recommended for driveways less than 100 mm thick.

Path terminations

At any permanent termination of a path, longitudinal resistance should be provided to prevent ‘walking’ of the upstream terminal slabs. It is recommended that consideration be given to providing this resistance via a buttress slab.

### Waterstops

*Refer annexure*. Provide waterstops surrounded by fully compacted concrete, and located so that:

* Their correct positions in the finished work are ensured.
* The proper placing and compaction of the concrete is not inhibited.
* Reinforcement is not displaced from its correct position.

## IN SITU CONCRETE SURFACES

### Concrete Surface Finish

General

Colours and textures: Incorporate colours and textures into the surface following placing and compaction, but prior to curing and hardening.

Slip resistance: Comply with the requirements of *Reference Specification* *for Engineering Works* *S155 Road Pavement Marking Clause 4.2*.

Skid resistance: Comply with the requirements of *Reference Specification* *S155 Road Pavement Marking Clause 4.3*.

Level tolerance: Finish slab surfaces to finished levels, to tolerance class B.

Tyning

Execution: Drag a steel comb over the surface of wet concrete in the direction transverse to the axis of the concrete element.

Tyne pattern: 2 - 3 mm wide and square in section, 2 - 3 mm deep, and regular or randomised spacing such that the average spacing is between 10 mm and 30 mm. A random pattern of 10, 14, 16, 11, 10, 13, 15, 16, 11, 10, 13, 10 mm to produce an average tyned space of 13 mm is recommended.

Hessian drag

Drag a wet hessian cloth along the whole width of the paved area immediately after the concrete is at its final surface elevation. In some cases the hessian is given some horizontal movement to create a longitudinal waveform on the surface.

Tyning and hessian drag

Drag a wet hessian cloth longitudinally over the formed surface followed by transverse tyning.

Broomed

After floating, use a broom to produce an even textured surface to meet the specified slip and skid resistance values. In steep slopes or in heavily trafficked areas, use stiff-bristled brooms or tyned rakes to produce coarse textures. Use soft-bristled brooms to produce medium to fine textures.

Machine float

Finish the screeded surface to a uniform smooth texture using a machine float. Hand float in locations inaccessible to the machine float.

Steel trowel

Use steel hand trowels to produce the final finish free of trowel marks and uniform in texture and appearance.

Wood float

Use a wood float to produce the final finish.

Sponge

After machine floating, obtain an even textured sand finish by wiping the surface using a damp sponge.

Smooth rubbed

Remove the forms while the concrete is green, patch immediately, and complete the rubbing not later than the following day. Wet the surface and rub using a Carborundum or similar abrasive brick until a uniform colour and texture are produced. Do not use cement grout other than the paste drawn from the green concrete by the rubbing process.

Sand floated

Remove the forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.

Grout floated

Remove the forms while the concrete is green. Dampen the surface and spread, using Hessian pads or sponge rubber floats, a slurry consisting of one part cement (including an appropriate percentage of white cement) and one and a half parts sand passing a 1 mm sieve. Remove surplus until a uniform colour and texture are produced. Cure.

Coloured pavement treatment

Add organic and/or metallic oxide pigments as required to alter the colour of the cement paste. Distribute colour evenly through the whole product. Use an approved proprietary treatment to produce the integral coloured and patterned surface for in situ paving and ground slabs. Refer *Reference Specification for Engineering Works* *S150 Roadworks, Clause 7.4*.

Exposed aggregate

Remove the forms while the concrete is green. Wet the surface and scrub using stiff fibre or wire brushes, using water freely, until the surface film of mortar is mechanically removed without the use of acid etching, and the aggregate uniformly exposed. Rinse the surface with clean water.  *Refer annexure*.

Bush hammered

Remove the minimum matrix using bush hammering to expose the coarse aggregate without recessing the matrix deeper than the aggregate, to give a uniform texture with insignificant random tool marks. *Refer annexure*.

Sand blasted

Abrasive: Blast the cured surface using hard, sharp graded abrasive aggregate particles until the coarse aggregate is in uniform relief. *Refer annexure*.

Light abrasive: Blast the cured surface using hard, sharp graded abrasive fine aggregate particles to provide a uniform matt finish without exposing the coarse aggregate. *Refer annexure*.

Honed finished

Refer *Reference Specification* *for Engineering Works* *S205 Centres Honed Concrete Paths* for requirements.

### Tolerances

Class A tolerance: Maximum deviation 3 mm using a 3 m straightedge.

Class B tolerance: Maximum deviation 6 mm using a 3 m straightedge.

Class C tolerance: Maximum deviation 6 mm using a 600 mm straightedge.

### Surface Modifiers

Seal stripper

Thoroughly clean the surface before the application of finishes to masonry and cementitious floors. Remove wax (buffable, self-polishing and acrylic paste types), heavy duty polymer finishes, and clear resin sealer using a seal stripper.

Clear resin sealers

Type: Transparent acrylic resin sealer, resistant to ultraviolet light, suitable for exterior or interior applications, rendering the surface impervious to stains of oils, grease, water and acids, non-yellowing, non-discolouring to the base surfaces, cut with a combination of hydrocarbon solvents to give good penetration into the surface.

Total solids: At least 14%.

Surface hardeners

Suitable for cementitious toppings or as laid surfaces. Apply to clean surfaces. Do not apply to non-slip topping.