

## SECTION 703 - GENERAL CONCRETE PAVING

### 703.01 GENERAL

This section specifies the requirements for the supply of materials and construction of Portland cement-based and geopolymer binder-based concrete paving for edgings, footpaths and other surfacings and any other concrete work not specified elsewhere in the specification, together with the necessary excavation and backfilling. In the context of general concrete paving, portland cement concrete and geopolymer binder concrete are equivalent products.

Requirements for structural concrete for bridgeworks and other major concrete components and structures are specified in Section 610.

### 703.02 STANDARDS

Australian Standards are referenced in an abbreviated form (e.g. AS 1379).

AS 1012	Methods of testing concrete
AS 1141	Methods of sampling and testing aggregates
AS 1379	The specification and supply of concrete
AS 1478	Chemical admixtures for concrete
AS 2758.1	Aggregate and rock for engineering purposes - Concrete aggregates
AS 3582.1	Part 1: Fly ash
AS 3582.2	Part 2: Slag - Ground granulated iron blast furnace
AS 3582.3	Part 3: Amorphous silica
AS 3610	Formwork for concrete
AS 3799	Liquid membrane - Forming curing compounds for concrete
AS 3972	Portland and blended cements
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

### 703.03 DEFINITIONS

For the purpose of this section, the following definitions apply:

**Alkaline Component:** Combinations of alkali and alkali earth containing salts, minerals and glasses.

**Cement:** Material complying with the requirements of AS 3972 and as specified.

**Cementitious Material:** Portland cement or a mixture of Portland cement with one or more of Fly Ash, Ground Granulated Blast Furnace Slag (GGBF Slag), or Amorphous Silica complying with the requirements of AS 3582.1, AS 3582.2 and AS 3582.3 respectively.

**Edgings:** Kerbs, channels, mowing and other edge strips including those behind kerbs and channels.

**Geopolymer Binder:** Binder containing greater than 80% Fly Ash, Ground Granulated Blast Furnace Slag (GGBF Slag) or Amorphous Silica complying with the requirements of AS 3582.1, AS 3582.2 and AS 3582.3 respectively, metakaolin and up to 20% alkaline components.

**Geopolymer Concrete:** Concrete which comprises geopolymer binder, aggregates, water and admixtures.

**Local Streets:** Collector roads and all other local roads and streets.

**Portland Cement:** General purpose Portland cement Type GP complying with the requirements of AS 3972.

**Surfacings:** Traffic islands, median slabs, bicycle paths, footpaths, shared paths, vehicle and pram crossings and other similar slabs or pathways on prepared bedding.

**Traffic Routes:** M, A, B, C roads, freeways and arterial roads.

#### **703.04 SUPPLY OF PREMIXED CONCRETE**

(a) Portland Cement-based Concrete

Portland cement-based concrete shall be N20, N25 or N32 standard strength grade, as specified for the application and complying with the requirements of AS 1379.

(b) Kerb and Channel

Concrete used in kerb extrusion machines will not be subject to compressive strength requirements but shall have a minimum cementitious material content in the finished concrete as follows:

- Traffic Routes – a minimum of, or equivalent to, 320 kg of cementitious material or geopolymer binder per cubic metre of concrete
- Local Streets – a minimum of, or equivalent to, 280 kg of cementitious material or geopolymer binder per cubic metre of concrete.

Where kerb and channel is placed and compacted with internal vibration between previously placed formwork, concrete shall be:

- Traffic Routes – N32 portland cement-based concrete or 32 MPa geopolymer concrete standard strength grade; and
- Local Streets – N25 portland cement-based concrete or 25 MPa geopolymer concrete standard strength grade as specified.

(c) Geopolymer Concrete

(i) General

Geopolymer concrete shall be manufactured to comply with the minimum 28 day compressive strength requirements for each strength grade ranging from 20 MPa to 32 MPa. The mix design for each geopolymer concrete strength grade shall have a unique identification number.

Geopolymer concrete shall not be mixed when the air temperature is lower than 5°C or greater than 35°C.

Water may be added to the freshly mixed geopolymer concrete prior to commencement of discharge subject to the manufacturer's approval and provided a means of accurately measuring the volume of water is available.

No water shall be added after commencement of discharge of geopolymer concrete unless expressly approved by the manufacturer.

Geopolymer concrete which has begun to stiffen shall not be used in the works.

Prior to the discharge of geopolymer concrete at the site, the mixer or agitator shall be operated at mixing speed for not less than two minutes, until the geopolymer concrete achieves the required uniformity.

(ii) Water

The quality of water used in the manufacture of geopolymer concrete shall comply with the requirements of Clause 610.09, except that no recycled water shall be allowed.

## (iii) Moisture Content of Aggregates

The determination of moisture content of the fine and coarse aggregates shall comply with the requirements of Clause 610.13(b).

## (iv) Delivery Docket

All information recorded on the delivery docket shall comply with the requirements of Clause 610.13(c).

## (v) Period for Completion of Discharge

The period for completion of discharge shall comply with the requirements of Clause 610.13(d) except that this time may be extended beyond 60 minutes provided the geopolymer concrete complies with the specified requirements.

## (vi) Water Left in the Mixer or Agitator

Water left in the mixer or agitator from the previous load shall comply with the requirements of Clause 610.13(e).

## (vii) Manufacturer Competency

Manufacturers and/or licensed technology providers utilised in the supply of geopolymer concrete shall have a minimum of three years continuous experience in commercial supply and a demonstrated competency in the technology of the geopolymer concrete to be applied.

Documented evidence shall be available to demonstrate supply experience and competency of manufacturers in the technology.

**703.05 AGGREGATES**

Concrete aggregates shall comply with the requirements as set out in Table 703.051.

**Table 703.051**

Property	Relevant Standard and Clauses	Test Limits for Product Acceptance
<b>General Requirements</b>		
1. Particle density	AS 2758.1-7.1	Greater than 2100 kg/m <sup>3</sup>
2. Bulk density	AS 2758.1-7.2	Greater than 1200 kg/m <sup>3</sup>
3. Water absorption	AS 2758.1-7.3	Less than 2.5% for Coarse Less than 1.5% for Fine
<b>Dimensions</b>		
1. Grading	AS 2758.1-8.1 Table 1,2,3	Single-sized aggregate Coarse and fine
Material finer than 75 microns	AS 2758.1-8.2	Coarse 2% max., Fine 5% max.
2. Particle shape	AS 2758.1-8.3	10% max. at 3:1 ratio for misshapen, flat and elongated
<b>Durability</b>		
1. Los Angeles Value	AS 1141.23	35% maximum
2. Unsound Stone Content	AS 1141.30	Unsound stone content: 5% maximum Total of unsound stone and marginal stone: 10% maximum
<b>Impurities</b>		
1. Organic impurities	AS 2758 1-14.1	Not darker than the Standard Reference Colour No.3
2. Sugar	AS 2758 1-14.2	Less than 1 part in 10,000
3. Alkali- Aggregate Reactivity	Clause 610.11(e)	Limits as per Clause 610.11(e)
4. Soluble salts (% to cementitious material mass)	Clause 610.07(k)	5.0% max. Sulphate salts 0.15% max. Chloride salts

**703.06 CHEMICAL ADMIXTURES**

Chemical admixtures shall comply with the requirements of AS 1478 unless otherwise specified. They shall be used in accordance with the requirements of Clause 2.5 of AS 1379 and the manufacturer's recommended method of use.

**Air entraining admixtures shall not be used unless approved by the Superintendent.**

Chemical admixtures containing calcium chloride, calcium formate or triethanolamine shall not be used.

**703.07 PLACING, COMPACTING AND FINISHING CONCRETE**

Concrete shall be transported, handled and placed to prevent segregation, loss or leakage of materials. Fresh concrete shall not be placed against concrete which has taken its initial set, except at properly formed construction joints. Concrete shall be thoroughly compacted by means of continuous tamping and internal vibration and shall be worked around any embedments and into corners of formwork or excavations to produce a dense concrete free from voids, honeycombing, segregation or surface defects.

Unformed surfaces shall be hand tamped to ensure a smooth surface and screeded to achieve the specified level, dimensions, falls and tolerances.

Geopolymer concrete shall be placed and finished in accordance with this clause and the geopolymer manufacturer's placement guidelines.

**Any concrete repairs shall be carried out using a method and materials accepted by the Superintendent.**

**703.08 AMBIENT WEATHER FOR CONCRETING OPERATIONS**

Concreting operations shall comply with the requirements of Clauses 610.17(a), 610.17(b), 610.17(c) and 610.17(d) for limits, restrictions and treatments to be applied for concreting in hot, cold and wet weather, except that curing shall be in accordance with Clause 703.09.

**703.09 CURING OF CONCRETE****(a) General**

The curing of exposed concrete surfaces shall commence immediately after finishing operations are progressively completed and shall continue uninterrupted for a period of not less than seven days after placing the concrete, with the exception of concrete edgings which shall be cured for a period of not less than three days after placing the concrete.

Concrete shall be cured either by water curing, wet hessian, polyethylene sheeting which is adequately sealed, curing compound or a combination of these. Freshly finished exposed concrete surfaces shall be effectively protected from rain or damage from other sources, until hard set has occurred.

Curing compounds shall comply with AS 3799. The curing compound shall be applied in two coats using a fine spray at the rate stated on the certificate of compliance. The curing membrane shall be maintained intact for not less than the specified period of curing. Any damage to the curing membrane during the period of curing shall be repaired immediately at the original rate of application.

At the end of the curing period, the edgings, footpaths and other surfacing shall provide a dense, hard wearing surface.

**(b) Curing of Geopolymer Concrete**

Geopolymer concrete shall be cured in accordance with the requirements of Clause 703.09(a), including the specified minimum curing periods, and as follows:

**(i) The curing methods acceptable for curing of geopolymer concrete are:**

1. covering with polyethylene sheet
2. maintaining the formwork in place in accordance with the requirements of Clauses 610.23(e) and Clause 610.23(f) respectively
3. covering with wet hessian blankets.

Hessian or burlap mats shall consist of at least two layers of hessian having a combined weight of at least 0.5 kg/m<sup>2</sup> dry and shall have a width after shrinkage of at least 300 mm greater than necessary to cover the entire width and vertical faces of a footpath and other surfacings. The hessian blankets or mats shall be new or have only been used for curing concrete, shall be free from tears and shall be soaked in water for at least one hour prior to concrete placement proceeding.

- (ii) Further to the requirements of this clause curing of geopolymer concrete shall also be carried out in conjunction with the procedures as stated in the manufacturer's placement guidelines.

### 703.10 CONFORMANCE TESTING FOR CONCRETE STRENGTH AND CONSISTENCY

#### (a) General

The minimum compressive strength requirements for each strength grade shall be as shown in Table 703.101.

**Table 703.091**

Portland Cement Concrete Strength Grade	Geopolymer Binder Concrete Strength Grade	Minimum Compressive Strength at 28 days (MPa)
N20	20	20
N25	25	25
N32	32	32

Sampling and testing of the strength of concrete shall be carried out in accordance with Clause 6.2 of AS 1379. The frequency of sampling and testing shall provide at least one sample at the point of discharge to be tested of each 50 m<sup>3</sup> or part thereof of each strength grade placed on any one day. Where less than 50 m<sup>3</sup> is provided for any one day then one sample shall be tested of each strength grade.

The consistency of the concrete shall be determined by a slump test of each concrete strength sample in accordance with AS 1012.3 and Clause 5.2 of AS 1379. The concrete represented by the samples shall be deemed to comply with the nominated concrete slump if the measured slump is within the limits given in Table 6 of Clause 5.2 of AS 1379.

### 703.11 FORMWORK

The materials, design, construction and stripping of formwork shall comply with the relevant requirements of AS 3610. Joints in formwork shall be constructed such that loss of mortar is prevented.

**Prior to placing concrete in an earth excavation, formwork shall be erected so that fresh concrete is not placed directly against the sides of the excavation, unless otherwise shown on the drawings or approved by the Superintendent.**

Formwork shall not be stripped until the minimum times specified in AS 3610 Table 5.4.1 have elapsed from the time of completion of the placing of concrete. The minimum time shall also not be less than:

- (a) 2 days for vertical formwork on external surfaces; and  
 (b) 1 day for vertical forms on permanently hidden surfaces.

### 703.12 STEEL REINFORCEMENT

Steel reinforcement shall comply with the relevant requirements of AS/NZS 4671.

Galvanizing where specified shall be in accordance with the requirements of AS/NZS 4680.

Steel fibre reinforcement where specified shall be of a type and quantity recommended by the manufacturer for the intended use.

The minimum cover of any steel reinforcement to the nearest concrete surface shall be 50 mm unless shown on the drawings.

Reinforcement shall be supported using either concrete or plastic chairs. Wire chairs with or without plastic tips, bricks or pieces of timber or coarse aggregate shall not be used to support steel reinforcement.

**703.13 TOLERANCES ON LINE, LEVEL AND SHAPE**

All surfaces shall be finished in conformity with the lines, grades, thicknesses and cross sections shown on the drawings or as specified, within the following limits:

- (a) Footpaths and other surfacings shall be shaped to match existing fixtures, e.g. pit covers, edgings and vehicle crossings, within 5 mm. Elsewhere the departure of the finished work from line or level shall not exceed 10 mm at any point, and the rate of change of deviation from line or level shall not exceed 10 mm in 10 m. Except on curves or in shaped areas, the deviation of the finished work from a 3 m straightedge shall not exceed 5 mm at any point.
- (b) Section dimensions shall not differ from those shown on the drawings by more than 5 mm except that overall width shall not exceed the specified width by more than 15 mm; and on dimensions less than 25 mm the tolerance shall be  $\pm 3$  mm.
- (c) Footpaths and other surfacings shall generally be 75 mm thick. Median surfacings within 2 m of the edges of medians and bays of footpath adjacent to intersecting kerb and channel shall be 150 mm thick and reinforced with SL72 steel fabric.
- (d) Private entrance vehicle crossings shall be 150 mm thick and commercial vehicle crossings shall be 170 mm thick, both reinforced with SL72 steel fabric.
- (e) Where median surfacings are to be constructed between edge sections of the same level, paving shall be crowned to produce a crossfall towards the edges not exceeding 3% nor less than 1%.

**703.14 SETTING OUT**

The Contractor shall set out the work in accordance with the drawings and as specified.

**HP The Superintendent will review and confirm the set out. The work shall be constructed in accordance with the confirmed set out to the line and level.**

**703.15 PROVISION FOR DRAINAGE DURING CONSTRUCTION**

Before obstructing any waterway, channel or culvert, the Contractor shall make appropriate provision for its temporary diversion, and obtain prior written approval from the relevant waterway authority. The Contractor shall make provision for the safe discharge of drainage and stormwater at all times during construction.

**703.16 HOUSEHOLD DRAINAGE CONNECTIONS**

Existing household drains which are not connected to underground stormwater drains shall be altered as necessary and connected through the kerbing to drain into the channel.

Provision shall be made for connection of future household drains as specified or shown on the drawings.

**703.17 EXCAVATION**

The Contractor shall carry out any necessary excavations and disposal of excavated material.

The Contractor shall box out to a sufficient depth to allow for the required compacted thickness of bedding material under the full width of concrete paving.

Where it is necessary to excavate existing pavement, the excavation shall not extend more than 150 mm from the edge of the adjacent face. Existing asphalt or bituminous surfacing shall be saw cut for a sufficient depth to produce a neat vertical face.

**703.18 BEDDING PREPARATION**

All bedding material used for cast in place concrete paving construction works shall be compacted size 20 mm Class 3 or Class 4 crushed rock or Class 3 or Class 4 crushed concrete, manufactured and supplied in accordance with the requirements of Sections 812 or 820 respectively.

**(a) Edgings**

Where edgings are constructed over pavement layers, bedding shall be provided between the pavement layer and the underside of the edging, or the edging thickened to match the pavement layer.

Where edgings are not constructed over pavement layers, bedding shall be not less than 75 mm compacted thickness.

**(b) Footpaths and other Surfacing**

Bedding shall be not less than 50 mm compacted thickness.

Bedding shall be trimmed to the appropriate levels, moistened as necessary, and firmly compacted.

For footpaths and other surfacings the foundation shall be true to grade and cross section as shown on the drawings by filling and excavating as necessary. All soft wet or unstable material shall be removed to a depth of not less than 75 mm below the design level of the underside of bedding and filled with bedding material moistened and compacted to form a stable foundation.

Immediately before concrete is placed, the bedding shall be moist but shall have no free water on the surface.

**703.19 PROVISION FOR PERMANENT SIGNS**

Sign post sleeves shall be supplied and placed by the Contractor to provide for erection of permanent signs in the areas to be paved.

Sleeves shall be placed at the locations shown on the drawings.

Sign post sleeves shall be 100 mm nominal diameter 500 mm long, plugged at one end. They shall be placed vertically in the ground, with the plugged end at the bottom and with the top 15-20 mm above the finished level of the footpath or surfacing, before concreting is commenced. Any concrete which falls into the sleeve shall be removed.

**703.20 MACHINE EXTRUSION**

Where an extrusion or slip-form machine is used, the datum for grade and alignment of the section to be extruded shall be established by the Contractor.

Concrete shall be fed to the machine at a uniform rate. The machine shall be operated to produce a satisfactorily compacted, dense mass of concrete free of any faulty or honeycombed patches. Surfaces shall be substantially free from surface pitting larger than 5 mm diameter.

Where work using fixed forms is combined with extruded work and similar concrete mixes are used for both, the concrete in the fixed form sections shall be compacted with internal vibration to produce a satisfactory compacted mass of concrete.

**703.21 PROFILE TRANSITIONS AND MATCHING EXISTING SECTIONS**

Where it is necessary to join to an existing section of profile different from that being constructed, the change of profile shall be made at a constant rate between 10 and 20 mm per metre. Transitions between different profiles shall be made in accordance with the drawings.

Matching of new to existing concrete paving shall be such that it appears identical to the existing section. When replacing damaged sections of footpath or other surfacings the damaged section shall be removed completely to the nearest construction joint and replaced with identical material to the existing.

### **703.22 SURFACE FINISH**

Exposed surfaces shall be treated as follows:

(a) Edgings

All edgings shall be rendered and have a steel trowel finish.

Rendering shall be applied within 30 minutes of placing or extruding concrete. The mortar used shall consist of two parts of fine aggregate, one part of cement, and sufficient water to produce a mix of suitable consistency. The thickness of rendering shall not exceed 3 mm. Exposed surfaces shall be given a steel trowel finish.

(b) Footpaths and other Surfacings

Fresh concrete shall be compacted with internal vibration and worked until all the coarse aggregate is below the surface and the mortar comes to the top. It shall then be struck off and finished to grade and cross section with a wooden float to produce a lightly textured non skid surface. All outside edges of slabs and all joints shall be finished with a suitable tool.

After finishing, all work shall present a consistently neat appearance of uniform colour. All edges shall be sharp and clean and bullnoses shall be regular and of uniform radius. All discoloured concrete shall be cleaned or replaced by the Contractor.

Permanently hidden concrete surfaces of edgings, footpaths and other concrete surfacings shall have a Class 4 surface finish in accordance with AS 3610.

All other concrete elements constructed with reference to Section 703 shall have a Class 3 surface finish for external surfaces and a Class 4 surface finish for permanently hidden surfaces in accordance with AS 3610.

### **703.23 JOINTS**

Transverse joints shall be constructed at right angles to the back of edgings and the edge of surfacing. Joints in surfacing shall be opposite joints in adjacent edgings.

(a) Edgings

(i) Transverse Joints

Transverse joints shall be constructed at regular intervals not exceeding 2.5 m. For extruded edgings this shall be done by a method which does not damage or distort the adjacent surfaces. For edging constructed using fixed forms, templates shall be removed as soon as practicable after finishing the work. The guillotine (for extruded work) or template (for fixed work) shall cut between 40% and 70% of the area of the section. In both cases the resultant slot in the edging shall be tooled to a depth of 20 mm to produce a neat groove not less than 5 mm wide on the exposed surfaces, following which a vertical cut shall be made through the base of the groove to a depth not less than 50 mm from the surface.

(ii) Expansion Joints

Expansion joints shall be placed at junctions with bridges, and shall be 15 mm wide and filled with cork or bituminous impregnated particle board strip extending for the full width and full depth of the edging. The filler shall be placed in position before concrete is placed, and shall be held firmly in position during the placing of the concrete.



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(b) Footpaths and other Surfacing

(i) Expansion Joints

Expansion joints shall be placed at intervals not exceeding 12.5 m for conventionally reinforced concrete and at intervals not exceeding 10 m for fibre reinforced concrete, on either side of vehicle crossings, and at junctions with bridges. The expansion joint shall be 15 mm wide and filled with cork or bituminous impregnated particle board strip extending for the full width and full depth of the paving. The filler shall be placed in position before concrete is placed, and shall be held firmly in position during the placing of the concrete.

(ii) Control Joints

Unless otherwise specified, control joints at least 25% of the paving thickness deep and 5 mm wide shall be formed with a cutting tool at 2.5 m intervals along the full width of footpaths and other surfacings, within four hours of placing the concrete where the air temperature measured at the time of placement is between 20°C and 35°C and within 24 hours of placing the concrete where the air temperature measured at the time of placement is less than 20°C.

(c) Between Edgings and Footpaths and other Surfacing

Except on narrow medians (less than 2.0 m wide) surfaced full width, bonding between the surfacing and the edging shall be prevented by painting the back of the edging with bitumen, or by using a strip of bituminous felt material between the edging and the surfacing.

### **703.24 PROTECTION OF CONCRETE**

All concrete shall be protected from damage from early loading by pedestrians, animals, vehicles and from rain or any other cause.

The Contractor shall ensure that no vehicles are permitted to cross over private entrance or commercial vehicle crossings a minimum of four days after completion of casting of the concrete. Vehicles equal to or less than 1.5 tonnes in weight may be permitted to cross after four days, vehicles greater than 1.5 tonnes may be permitted to cross after seven days

### **703.25 MARKING OF CONDUIT POSITIONS**

The positions of any existing conduits passing under edgings shall be marked by a chase in the edging immediately above the conduit together with a suitable identification mark.

### **703.26 BACKFILLING AND PAVEMENT RESTORATION**

As soon as the concrete has cured sufficiently and not earlier than 3 days after placing, topsoil material, free from perishable matter and lumps, shall be placed and firmly compacted in layers not exceeding 150 mm in thickness and to a width not less than 300 mm behind the edging to the top of the edging.

Where edging has been constructed alongside an existing pavement, part of which has been excavated to permit the construction of the edging, the excavated space shall be backfilled to the surface level of the existing pavement. Unless otherwise specified, Size 7 or Size 10 asphalt shall be used for this work and firmly compacted in layers not exceeding 100 mm in thickness.

### **703.27 CRACKING OF CONCRETE**

The concrete shall have no surface cracks at any stage after construction of width greater than 0.20 mm. Where such cracks exist, they shall be identified as a non-conformance.

The repair of concrete cracks shall be carried out in accordance with Section 687 using a method and materials approved by the Superintendent.