



Section 4: Concrete works

Sutherland Shire Public Domain Technical Manual
Part D: Specification

SUTHERLANDSHIRE

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Section 4: Concrete works

Contents

4.1	Scope	4-1
4.1.1	Standards and guidelines	4-1
4.2	Materials	4-2
4.2.1	General	4-2
4.2.2	Concrete properties.....	4-2
4.2.3	Sustainable materials in concrete	4-2
4.2.4	Admixtures	4-3
4.2.5	Sampling and testing	4-3
4.2.6	Formwork	4-4
4.2.7	Reinforcement, tie bars and dowels.....	4-4
4.2.8	Shotcrete (sprayed concrete)	4-5
4.2.9	Epoxy grout.....	4-5
4.2.10	Vapour barrier	4-5
4.3	Construction	4-6
4.3.1	General	4-6
4.3.2	Foundations.....	4-6
4.3.3	Erection of formwork.....	4-6
4.3.4	Placing and fixing reinforcement	4-6
4.3.5	Core holes and embedments	4-7
4.3.6	Placing of concrete	4-8
4.3.7	Compaction of concrete.....	4-9
4.3.8	Joints	4-9
4.3.9	Surface finishes.....	4-11
4.3.10	Concrete curing and protection.....	4-11
4.3.11	Stripping of formwork	4-12
4.3.12	Backfill	4-12
4.4	Quality.....	4-12
4.4.1	Tolerances	4-12
4.4.2	Schedule of hold points and check points – Concrete Works.....	4-13

4 Concrete works

4.1 Scope

This work section provides for the forming, reinforcing, supply and placing of concrete used in the construction of pavements, drainage structures, kerb and gutter, footings, retaining walls and other civil structures.

4.1.1 Standards and guidelines

The following table indicates the Australian Standards and/or RMS Standards applicable to this section. This table is not exhaustive and may not include all standards that may apply to the work to be undertaken. It is the responsibility of the *contractor* to ensure that all relevant standards are met.

AS 1012	<i>Methods of testing concrete</i>
AS 1141	<i>Methods for sampling and testing aggregates</i>
AS 1289	<i>Methods of testing soils for engineering purposes</i>
AS 1379	<i>Specification and supply of concrete</i>
AS 1478	<i>Chemical admixtures for use in concrete</i>
AS 1554	<i>Structural steel welding;</i>
AS/NZS 2350	<i>Methods of testing portland and blended cements</i>
AS/NZS 2425	<i>Bar Chairs in Reinforced concrete</i>
AS 2758	<i>Aggregates and rock for engineering purposes</i>
AS 2870	<i>Residential slabs and footings – Construction</i>
AS 2876	<i>Concrete kerbs and channels (gutters) – Manually or machine placed</i>
AS3582.1	<i>Supplementary cementitious materials for use with portland cement Part 1: Fly ash</i>
AS3582.2	<i>Supplementary cementitious materials for use with portland cement Part 2: Slag – ground granulated Iron blast-furnace;</i>
AS3582.3	<i>Supplementary cementitious materials for use with portland cement Part 3: Amorphous silica;</i>
AS 3600	<i>Concrete structures;</i>
AS 3610	<i>Formwork for concrete;</i>
AS3700	<i>Masonry structures</i>
AS 3735	<i>Concrete structures for retaining liquids</i>
AS 3972	<i>Portland and blended cements;</i>
AS3972	<i>General purpose and blended cements</i>
AS 4347	<i>Damp Proof Courses and Flashings</i>
AS/NZS 4671	<i>Steel reinforcing materials</i>
BS EN 14889	<i>British Standard: Fibres for concrete steel fibres. Definitions, specifications and conformity</i>

ACI 544-3 R08 American Standard: Guide for specifying, proportioning, and production of FRC.

4.2 Materials

4.2.1 General

Concrete shall be ready-mixed concrete unless approved otherwise.

Ready-mixed concrete shall be obtained from member of Cement Concrete & Aggregates Australia and shall comply with AS 3600 and AS 1379.

Concrete mixed on site may be used for concrete pours less than 0.3m³ and shall comply with the current edition of the relevant Australian Standard. The methods of batching, mixing and transportation shall be to the satisfaction of the *PDC*.

4.2.2 Concrete properties

Concrete for the *works* shall have a characteristic compressive strength as specified in the *approved design drawings*.

The maximum size of aggregate to be used shall be 20mm.

Concrete shall be of a consistency such that it can be readily placed and compacted in the forms without segregation of the materials and without excess free water collecting on the surface. Concrete slump shall be 75mm maximum for manually placed concrete and shall be tested in accordance with AS 1012 Part 3.

Concrete for use in kerb extrusion machines shall have zero slump.

4.2.3 Sustainable materials in concrete

Council prefers and encourages the use of sustainable recycled component materials in concrete, provided that the characteristic of the finished concrete meet or exceed the specification.

Replacement materials shall be in accordance with AS 3582 - *Supplementary cementitious materials for use with portland cement*. *Council* expects *contractors* to ensure adequate conditions for this replacement are met (i.e. that construction methods are varied where needed as a result of material replacement).

The final product must comply to AS 3972-2010 - *General purpose and blended cements*.

Council approval must be obtained if the *contractor* proposes to depart from the above specifications.

4.2.4 Admixtures

The use of admixtures shall be subject to the approval of the *PDC*.

Admixtures shall conform to the requirements of *AS 1478* and shall not reduce the strength of the concrete. Admixtures shall not contain chlorides, chlorine, sulphur, sulphides or sulphites or any other substance detrimental to concrete or steel.

The *contractor* shall submit to the *PDC* details of the proposed source and nature of any admixtures and the proposed amount to be added.

4.2.5 Sampling and testing

Where more than 20 cubic metres of concrete is placed in one day, sampling and testing shall be carried out by a NATA Accredited Laboratory (or SSC laboratory) using the relevant procedures set out in *AS 1012*, *AS 1379* and *AS 3600*.

Where less than 20 cubic metres of concrete is placed on any day, *Council's representative* may require one batch of concrete to be sampled and tested for every 50 cubic metres of concrete to be placed over the course of the project.

Not less than three specimens shall be made and tested for any sample of the day's concrete pour.

Where more than 25 cubic metres of concrete is placed in one day, three test cylinders shall be made for each 25 cubic metres or part thereof. Until despatched to the laboratory, the cylinders shall be stored undisturbed at the site in a moist condition, sheltered from the sun and wind and protected from extremes of temperature. The *contractor* shall be responsible for providing the necessary curing facilities and for curing the test cylinders on the site.

One test cylinder of each of the three specimens shall be tested at 7 days, one at 28 days and the third when required by the *PDC*. Should any two test cylinders of a set fail to fulfil the compressive strength specified, the *PDC* shall reject the whole or part of the concrete represented by these specimens in which case it shall be removed and replaced.

A copy of the concrete batch and test certificate shall be provided to the *PCA* for inclusion in the documentary evidence to be submitted in support of certification of the *works*.

4.2.6 Formwork

Formwork shall be constructed in accordance with AS3610.

All exposed edges of the finished concrete shall be chamfered not less than 20 mm x 20 mm unless otherwise specified in the *approved design drawings*. Joints between formwork members shall be sealed to prevent mortar runs and to preserve smooth, straight lines. Internal angles shall be filleted where shown in the *approved design drawings*.

Timber formwork shall be in long lengths free from loose knots and surface defects and shall be of uniform thickness. Before reuse, form materials shall have all protruding nails withdrawn and surfaces to be in contact with concrete shall be thoroughly cleaned.

Formwork shall be so designed and constructed that it may be removed without damaging the concrete and shall be built true to line and braced in a non-yielding manner. The formwork shall be clean, mortar tight and, if necessary, shall be thoroughly soaked with water to close shrinkage cracks.

The formwork shall not be removed sooner than twelve (12) hours after concrete has been placed and in no case shall the formwork or shoring be removed until the concrete has acquired sufficient strength to support its own weight.

4.2.7 Reinforcement, tie bars and dowels

Reinforcing steel for concrete pavements shall comply with the requirements of AS 4671.

All reinforcing bars and mesh shall be supplied by an Australian Certification Authority for Reinforcing Steels (ACRS) accredited supplier and shall be appropriately marked with the supplier's unique identity mark. Any reinforcing steel or mesh not marked and/or not supplied by an ACRS accredited supplier shall be immediately removed from the site.

All steel shall be clean and free from mill scale, loose rust or oil.

Tie bars shall be Grade 500N and dowels shall be Grade 250S steel, both complying with AS 4671.

Dowels shall be straight, one-piece and cut accurately to length. Ends of dowels shall be square and free from burrs.

All reinforcement shall be supported on plastic bar chairs conforming to AS3600 and AS2425.

4.2.8 Shotcrete (sprayed concrete)

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process.

At least ten (10) working days prior to applying any sprayed concrete, the *contractor* shall submit to the *PDC* details of the proposed procedures, plant, materials and mix proportions. Materials shall comply with AS 3600.

A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

Sprayed concrete lining in open drains or “mock rock” retaining walls shall be coloured to match the adjoining rock colour. Sprayed concrete shall have a minimum cement content of 380 kg/m³ as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete.

Core testing of finished shotcrete or on-site test panel (900x900x150mm) as determined by the *PDC* shall comply with the *Recommended Practice for Shotcreting in Australia*. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012. The *contractor* shall provide equipment and facilities for the taking of cores from the work. The *contractor* shall arrange for a NATA accredited laboratory (or SSC laboratory) for the curing and testing of the cores. A copy of this test certificate shall be provided to the *PCA* for inclusion in the documentary evidence to be submitted in support of certification of the *works*.

4.2.9 Epoxy grout

Epoxy grout shall be as specified in the *approved design drawings* and comprise of a commercial epoxy formulation of high compressive strength, greater than 100MPa. Where the *contractor* nominates to use an alternative product, full details of proposed materials and methods shall be submitted to the *PDC* prior to using the epoxy grout.

4.2.10 Vapour barrier

Vapour barrier shall be as specified in the *approved design drawings* and be extra heavy duty polyethylene film 200 microns in accordance with AS 4347.

4.3 Construction

4.3.1 General

Concrete work shall be constructed accurately to the dimensions and details shown in the *approved design drawings* or as directed by the *PDC*.

The preparation of surfaces onto which concrete is to be poured shall be in accordance with the requirements of Section 2 Earthworks.

4.3.2 Foundations

The subgrade shall be formed at the required depth below the finished surface of the concrete, in accordance with the dimensions and design shown in the *approved design drawings*, and the *SSC standard drawings*.

4.3.3 Erection of formwork

Erection and strutting of formwork and falsework shall be in accordance with the requirements of *AS 3610*.

Formwork shall conform to the shape, lines and dimensions required in the finished concrete. Formwork shall be rigid, watertight and braced and fixed so that it will remain in position and shape during the casting of the concrete. Formwork shall be constructed so that it can be removed without damage to the concrete.

All dirt, sawdust, shavings or other debris shall be removed from the inside of forms before placing concrete.

4.3.4 Placing and fixing reinforcement

Reinforcement shall be carefully formed to the dimensions and shapes shown in the *approved design drawings*. For mild steel reinforcing bars, cold bends shall be made around a pin having a diameter of four or more times the nominal diameter of the bars.

Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown in the plans shall not be used. Heating of reinforcement bars will not be permitted.

Where practicable, all reinforcement shall be supplied in the full lengths shown in the *approved design drawings*. Where not practicable, the *contractor* shall splice the

reinforcement by lapping where directed. The lap shall not be less than 40 times the nominal diameter of the bars.

All reinforcement shall be accurately placed in the positions shown in the *approved design drawings*, and shall be securely held during the placing and compacting of the concrete by wiring together with annealed iron wire of not less than 1.2mm diameter and by blocking and supporting the reinforcement on plastic or metal chairs, or by other approved methods. Unless otherwise shown in the *approved design drawings*, the minimum clear cover to reinforcement shall be as specified in *AS 3600 – Concrete structures*.

Reinforcement supports shall be made of durable materials strong enough to withstand the loads that will be applied during construction without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size as to maintain the specified cover. Bars shall be tied at all intersections except where spacing is less than 300 mm in any direction when alternate intersections shall be tied.

Wooden supports shall not be used, nor shall metal supports or tie wires which extend to the surface of the concrete. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete shall not be permitted.

All reinforcement when placed shall present a clean surface free from grease, tar, paint, oil, mud, loose mill scale, loose or thick rust.

The *PDC* shall check the size and location of reinforcing bars for compliance with the approved location and levels relative to the formwork. The *PDC* shall certify the size, location and levels of reinforcing before authorising the placing of concrete.

4.3.5 Core holes and embedments

Prior to pouring concrete all core and embedment requirements for all trades shall be installed. In the case of core holes or embedments not shown in the *approved design drawings*, or where temporary openings are required for construction purposes, appropriate details shall be submitted to the *PDC* at least 7 days prior to the placing of concrete.

Reinforcing bars may generally be slightly moved to clear core holes and embedments, but they shall not be cut, nor shall any cores be cut in hardened concrete without the approval of the *PDC*.

Where reinforcing mesh must be cut, additional reinforcing bars of at least equal strength and length to the cut reinforcement shall be placed at each side of the penetration or embedment.

4.3.6 Placing of concrete

Concrete shall be transported and placed in accordance with the requirements of *AS 3600*. Movement of concrete to the pour face may be by pumping or by means of suitable conveyors, clean chutes, troughs or pipes which shall be made of metal, or have metal linings. Water shall not be used to facilitate the movement.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2 metres, or be deposited in large quantities at any point and moved or worked along the forms. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed.

Concrete shall be deposited in horizontal layers not exceeding 600mm in thickness and compacted such that each succeeding layer is blended into the preceding one by the compaction process. The concrete shall be placed in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face. The concrete shall be forced under and around the reinforcement without the reinforcement being displaced.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

The *contractor* shall keep on site and make available for inspection a log book recording each placement of concrete including.

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

A copy of this log book shall be provided to the *PCA* for inclusion in the documentary evidence to be submitted in support of certification of the *works*.

Unless adequate protection is provided, concrete shall not be placed during rain or when rain appears imminent. Prior to placing concrete, the area shall be clean and moist but free from any ponding of water.

No concrete shall be mixed or placed, without the approval of the *PDC*, while the air temperature in the shade is below 5°C or above 38°C unless special precautions, approved by the *PDC*, are taken.

Concrete affected by environmental factors before it has set, including during mixing, transport or placing, shall be liable to rejection.

Concrete shall not be placed under water unless specified otherwise in the *approved design drawings*.

4.3.7 Compaction of concrete

Concrete shall be compacted immediately after placing by immersion and/or screed vibrators accompanied by hand methods as appropriate to remove entrapped air and compact the mix. Form vibrators shall be used where use of immersed vibrators is impracticable. Concrete shall be fully compacted and entrapped air removed, but the concrete shall not be over vibrated such that segregation is caused. Vibrators shall not come into contact with partially hardened concrete, or reinforcement embedded in it. Vibrators shall not be allowed to rest on reinforcement or be used to move concrete along the forms. Vibrators must be held plumb at all times whilst inserted into the concrete.

Exposed surfaces of the concrete shall be struck off and finished. Where shown in the drawings, corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted or neatly rounded. Exposed surfaces shall be screeded and finished with a float to the design levels and grades in accordance with the *SSC standard drawings*.

4.3.8 Joints

Construction joints (cold joint)

The location of construction joints shall be as shown in the plans. Construction joints not shown in the *approved design drawings* shall be avoided where possible. Where unavoidable, construction joints not shown in the *approved design drawings* shall be completed under the supervision of the *PDC*.

Section 4: Concrete works

Before placing new concrete against concrete which has set, the forms shall be re-tightened and the face of the set concrete shall be roughened, cleaned of foreign matter, latent and loose or porous material and saturated with water.

The face shall then be covered uniformly with a thin coat of neat cement and water to ensure bond and concreting shall then proceed immediately.

Pre-fabricated key joints are also acceptable to be used as construction joints. All key joints shall be approved by the *PDC* prior to use.

Contraction joints/ dummy joint / crack control joint

Contraction joints shall be located and constructed as shown in the *approved design drawings*.

Contraction joints shall be perpendicular to the principal line of stress and be one continuous line without deviation.

When concrete is reinforced, the reinforcing shall stop short of the contraction joint and shall not be carried through the joint in order to avoid the direct access to steel by free water and oxygen.

Sawing for the installation of contraction joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without excessive ravelling, regardless of time or weather conditions. Sawn joints shall be one third of the concrete depth.

Expansion joints

Expansion joints shall be provided as shown in the *approved design drawings* or where directed by the *PDC*. Expansion joints shall be 10mm wide foam filler unless approved otherwise by *Council's representative*. The expansion joint material shall be non-extruding in hot weather and shall not become brittle in cold weather.

An expansion joint shall always be provided where a concrete slab adjoins or abutts an existing structure of any type including the back of road kerbs and pits.

Trip Stop Joints

Refer to Section 6.7.3.

4.3.9 Surface finishes

Kerb and gutter shall be finished with a steel trowel. Edges shall be finished round as shown in the *SSC standard drawings*.

In-situ concrete footways, vehicular crossings, and kerb ramps shall have no visible tool edge and be finished in accordance with Section 6.7.5.

Faulty and honey-combed portions shall be removed and rebuilt.

The *contractor* shall immediately after removal of the forms, backfill the spaces adjacent to the concrete with sound material, thoroughly compacted, leaving the hole in a neat and good state. Where kerb moulding machines are used, the *contractor* shall backfill 48 hours after placing concrete. Backfilling and/or the placement of pavement material shall only be undertaken with the prior approval of the *PDC*.

4.3.10 Concrete curing and protection

The curing and protection of finished concrete shall be in accordance with AS 3600.

For all types of curing regimes, the concrete surface shall be maintained at a temperature not less than 5°C throughout the curing period.

All concrete pours shall be timed such that the concrete has hardened sufficiently, by the time the last person leaves the site, in order to prevent vandalism or graffiti to exposed faces of concrete. Where any exposed concrete is affected by graffiti it shall be removed and replaced between the nearest joints.

Where appropriate or where directed by the *PDC*, all exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand, hessian cloth or commercial curing compounds, in accordance with AS 3799, for a minimum period of 72 hours. For a period of at least fourteen (14) days after placement, the work shall be adequately protected from damage and under no circumstances shall work be loaded until the design strength has been obtained.

4.3.11 Stripping of formwork

Formwork shall be stripped in accordance with AS 3600, where those requirements are more stringent than the relevant requirements of AS 3610.

4.3.12 Backfill

After removal of the forms, but no sooner than three (3) days after pouring, the space between the concrete and the surrounding surface shall be refilled with sound material which shall be thoroughly compacted in even layers, no greater than 150 mm thick, the whole being left in a clean and tidy condition.

4.4 Quality

Any work, which does not meet all the requirements of this specification, shall be rejected.

All non-conforming materials and work shall be repaired or replaced so that the *works* meet all the requirements of this *specification*.

4.4.1 Tolerances

Tolerances shall be in accordance with AS 3600 and AS 3610 .

4.4.2 Schedule of hold points and check points – Concrete Works

1. Work Process:	Fix formwork
<i>Hold point or Check point:</i>	<i>Hold point - PDC</i>
<i>Required Notice:</i>	By arrangement with <i>PDC</i>
<i>Required Action:</i>	The <i>PDC</i> shall check the formwork for location and levels using fixed marks or set-out marks. If there are insufficient marks available, a land survey is to be completed. The <i>PDC</i> shall certify the formwork before reinforcing steel is fixed.
2. Work Process:	Fix reinforcing steel
<i>Hold point or Check point:</i>	<i>Hold point - PDC</i>
<i>Required Notice:</i>	By arrangement with <i>PDC</i>
<i>Required Action:</i>	The <i>PDC</i> shall check the size, location and level of reinforcing bars for compliance with the approved location and levels relative to the formwork. The <i>PDC</i> shall certify the size, location and levels of reinforcing before authorising the placing of concrete.
3. Work Process:	Placing of concrete
<i>Hold point or Check point:</i>	<i>Check point</i>
<i>Required Notice:</i>	By arrangement with <i>PDC</i>
<i>Required Action:</i>	The <i>contractor</i> shall keep on site and make available for inspection a log book recording each placement of concrete. Log book to be provided to the <i>PCA</i> for incorporation into the documents to be presented to <i>Council</i> in support of certification

Section 4: Concrete works

4. Work Process:	Sampling and testing of concrete
<i>Hold point or Check point:</i>	<i>Check point</i>
<i>Required Notice:</i>	NA
<i>Required Action:</i>	The compressive strength of concrete shall be tested by a NATA registered (or SSC laboratory) for compliance with the specification and the test results are to be provided to the <i>PCA</i> for incorporation into the documents to be presented to <i>Council</i> in support of certification