

B3

Concrete Works

Construction



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3.1 SCOPE

This Technical Specification provides for the supply, forming, reinforcing, and placing of concrete used in the construction of pavements, drainage structures, kerb and gutter, miscellaneous or special structures.

3.2 STANDARDS AND GUIDELINES

Unless stated otherwise in the Technical Specification, the approved drawings or elsewhere in the construction documents, the Works shall comply with the current and relevant Australian Standards and/or TfNSW Standards.

Any variations or ambiguity between the Technical Specification, other construction documents and Australian Standards shall be referred to the City's Representative for direction before proceeding with the Works.

The following list indicates the Australian Standards and/or TfNSW Standards applicable to this Technical Specification. This list is not exhaustive and may not include all standards that apply to the Works to be undertaken. It is the responsibility of the Service Provider to ensure that all relevant standards are met.

AS 1012.1–2001 Methods of testing concrete – Determining of the modulus of rupture AS 1141 Methods for sampling and testing aggregates

AS 1289 Methods of testing soils for engineering purposes AS 1302 Steel reinforcing bars for concrete

AS 1303 Hard drawn steel reinforcing wire for concrete AS 1304 Welded wire reinforcing fabric for concrete AS 1379 Specification and supply of concrete

AS 1478 Chemical admixtures for use in concrete AS 1554 Structural steel welding

AS 2349 Methods of sampling Portland and blended cements AS 2350 Methods of testing Portland and blended cements AS 2758 Aggregates and rock for engineering purposes

AS 2870 Residential slabs and footings – construction

AS 2876 Concrete kerbs and channels (gutters) – manually or machine placed AS 3582.1 Supplementary cementitious materials – fly ash

AS 3582.2 Supplementary cementitious materials for use with Portland cement, Part 2: Slag – ground granulated iron blast-furnace

AS 3582.3 Supplementary cementitious materials for use with Portland cement, Part 3: Amorphous silica AS 3600 Concrete structures

AS 3610 Formwork for concrete

AS 3735 Concrete structures for retaining liquids AS 3972 General purpose and blended cements

BS EN 14889 British Standard: Fibres for concrete. Steel fibres. Definitions, specifications and conformity ACI 544-3 R08 American Standard: Guide for Specifying, Proportioning, and Production of FRC

ASTM C1116-03 Standard Specification for Fibre-Reinforced Concrete and Shotcrete

3.3 MATERIALS

3.3.1 CONCRETE

All concrete used shall generally be ready-mixed concrete unless approved otherwise.

Ready-mixed concrete shall be obtained from an approved ready-mix supplier and shall comply with *AS 1379 - Specification and supply of concrete*

Onsite-mixed concrete may be used where approved by the City's Representative 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 City's Representative.

3.3.2 CONCRETE PROPERTIES

Concrete for the Works shall have a characteristic strength ranging between 25MPa and 40MPa unless noted otherwise on the drawings. The strength will be dependent on the type of Works and will be stated in the relevant section or on the drawings.

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

Concrete shall be of a consistency 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 - Methods of testing concrete – Determining of the modulus of rupture*

Concrete for use in kerb extrusion machines shall contain the maximum amount of water which will produce such consistency that, after extrusion, the shape of the kerb will be maintained.

3.3.3 SUSTAINABLE MATERIALS IN CONCRETE

The City has adopted the use of the Green Building Council of Australia (GBCA)'s Green Star MAT-4 as a standard with the following composition:

- 40 per cent cement replacement
- 50 per cent reclaimed water replacement
- 40 per cent coarse aggregate replacement
- 25 per cent fine aggregate replacement.

The City will consider the following alternatives to replace standard materials:

- Portland cement replacements
 - Ground Granulated Blast-Furnace Slag (GGBS)
 - Fly ash
 - Amorphous silica (silica fume)
 - Mineral additions (limestone)
 - Geopolymer techniques and products (which are generally more suited to pre-cast applications). Note the City of Sydney Wyndham Street trial in April 2019. Once outcomes are agreed upon, geopolymer may be used.
 - Virgin aggregate replacements
 - Recycled pavement (sourced in situ or from external projects) – recycled refers to both re-used sections as well as crushed and re-cast
 - Reclaimed/avoided waste aggregates
 - Blast furnace slag
 - Manufactured sands (waste processed as fine aggregate)
 - Recycled crushed glass (RCG)
 - Any other appropriate aggregate shown to reduce embodied emissions, which performs to

all appropriate standards, and with the approval of the City.

- Steel reinforcement replacements
 - Fibre reinforced concrete (in accordance with Australian guidance and international standards).

Service Providers should design this replacement in accordance with *AS 3582 – Supplementary cementitious materials for use*, and should note that the City expects Service Providers to ensure adequate conditions for this replacement are met (i.e. that installation is varied where needed as a result of material replacement). For example, changes to installation may include extending curing time or varying compaction rates. The final material must comply to the performance specifications below, as well as *AS 3972-2010 – General purpose and blended cements*.

The City prefers and encourages replacement of these materials at GBCA's Green Star MAT-4 proportions provided. Should the Service Provider be able to exceed or not be able to achieve these proportions discussions and approval with the City must be sought.

3.3.3.1 FIBRE REINFORCED CONCRETE (FRC)

Fibre reinforced concrete (FRC) may be used in the construction of footpaths. The material shall be in accordance with appropriate standards and design loads and traffic shall comply with the City's Technical Specifications.

FRC shall have the minimum characteristics:

- Compression strength of the 28-days sample shall be minimum 32 MPa.
- Tensile cracking stress of the FRC shall be minimum 6 MPa.
- Modulus of the rupture shall be minimum 6 MPa.

The mixing process of the FRC in the batching shall be in accordance with the manufacturer's recommendation.

For Macro Poly Fibre concrete, the material's specification shall be in accordance with the following:

- Macro Poly Fibre Reinforcement shall be added to the concrete (with f'_c of 32 MPa) at the rate of 4.6 Kg/m³
- Fibre shall meet all the requirements of *ASTM C1116, Type 3 Standard Specification for Fibre-Reinforced Concrete and Shotcrete*
- The dosage consists of 4kg/m³ of Macro Plastic Monofilament Poly Fibres from 40mm to 65mm long combined with 0.6kg/m³ of a Micro Poly Fibre 10mm to 20mm long
- The fibres shall be made from Virgin Polypropylene with a tensile strength of minimum 550Mpa and have sufficient ductility to permit 180 degree bends without rupture
- Macro Fibres shall be continuously deformed.

3.3.4 ADMIXTURES

The use of admixtures shall be subject to the approval of the City's Representative.

The Service Provider shall submit to the City's Representative details of the proposed source and nature of any admixtures and the proposed amount to be added.

Admixtures shall conform to the requirements of *AS 1478 Chemical admixtures for use in concrete* 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 use of chemical admixtures that result in Portland Cement reductions should be considered in relation to above sustainable materials in concrete aim, though the performance of the material must still meet or exceed all relevant design and construction requirements.

3.3.5 SAMPLING AND TESTING

The Service Provider may be required to carry out sampling and testing of concrete in accordance with the following requirements. Testing shall be carried out by an independent NATA Registered Laboratory using the relevant procedures set out in *AS 1012 Methods of testing concrete – Determining of the modulus of rupture*, *AS 1379 Specification and supply of concrete* and *AS 3600. Concrete structures*

Not less than three (3) specimens shall be made and tested for any sample representative of the day's concrete.

Where more than 15 cubic metres of concrete is placed in one (1) day, three (3) test cylinders shall be made for each 15 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 Service Provider shall be responsible for providing the necessary curing facilities and for curing the test cylinders on the site.

One (1) test cylinder of each of the three (3) specimens shall be tested at 7 days, one (1) at 28 days and the third when required by the City's Representative. Should any two (2) test cylinders of a set fail to fulfil the compressive strength specified, the City's Representative may reject the whole or part of the concrete represented by these specimens in which case it shall be removed and replaced.

3.3.6 FORMWORK

Formwork shall be constructed of one of the following:

- Seasoned or kiln-dried timber
- Metal shutters with joints flush fitting and adequately sealed
- Pressed wood or plywood supported with timber of size and spacing approved by the City's Representative.

All exposed edges shall be chamfered not less than 20mm x 20mm to prevent mortar runs and to preserve smooth, straight lines. Internal angles shall be filleted where shown on the drawings.

Timber formwork shall be in long lengths free from loose knots and surface defects and uniform in thickness. Before re-use, form materials shall have all protruding nails withdrawn and surfaces to be in contact with concrete shall be thoroughly cleaned. Forms shall not be re-used if bulged or warped. All inside surfaces of formwork shall be coated with non-staining mineral oil, grease or other approved agent to ensure non-adhesion of the mortar.

3.3.7 REINFORCEMENT, TIE BARS AND DOWELS

Reinforcing steel for concrete pavements shall comply with the requirements of AS 1302, Steel reinforcing bars for concrete, AS 1303 Hard drawn steel reinforcing wire for concrete, AS 1304 Welded wire reinforcing fabric for concrete, as appropriate.

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

Tie bars shall be Grade 230S and dowels shall be Grade 230R steel, both complying with AS 1302 Steel reinforcing bars for concrete.

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

Plastic bar chairs or plastic-tipped wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at $23 \pm 5^{\circ}\text{C}$ without malfunction. The Service Provider shall demonstrate that the proposed chairs conform to these requirements.

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 identify mark. Any reinforcing steel or mesh not marked and/or supplied from an ACRS accredited supplier shall be immediately removed from the site.

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

The minimum depth of sprayed concrete to be applied shall be 100mm for raingardens and 75mm elsewhere.

Sprayed concrete lining in open drains or natural 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 an onsite test panel (900mm x 900mm x 150mm) as determined by the City Representative shall comply with the Concrete Institute of Australia's *Recommended Practice for Shotcreting in Australia*. Cores shall be secured, accepted, cured, capped and tested in accordance with *AS 1012 Methods of testing concrete – Determining of the modulus of rupture*. The Service Provider shall provide equipment and facilities for the taking of cores from the work. The Service Provider shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the City's Representative.

At least 10 working days prior to applying any sprayed concrete, the Service Provider shall submit to the City's Representative details of the proposed procedures, plant, materials and mix proportions. Materials shall comply with *AS 3600- Concrete structures*

3.3.9 EPOXY GROUT

Epoxy grout shall be as specified on the construction drawings and be a commercial epoxy formulation of high compressive strength, greater than 100MPa. Where the Service Provider nominates to use an alternative product, full details of proposed materials and methods shall be submitted to the City's Representative prior to using the epoxy grout.

3.4 CONSTRUCTION

3.4.1 GENERAL

Concrete work shall be constructed accurately to the dimensions and details shown on the approved plans or as directed by the City's Representative.

The preparation of formation surfaces onto which concrete is to be poured shall be in accordance with the requirements of Section B2 Earthworks.

3.4.2 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, 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.

3.4.3 PLACING AND FIXING REINFORCEMENT

Reinforcement shall be carefully formed to the dimensions and shapes shown on the approved drawings. For mild steel reinforcing bars, cold bends shall be made around a pin having a diameter of four (4) 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 on 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 drawings. Where not practicable, the Service Provider 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 on the plans, 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 forms with plastic or metal chairs, or by other approved methods. Unless otherwise shown on the drawings, the minimum clear cover to reinforcement shall be 50mm or as specified in *AS 3600 – Concrete Structures*.

Reinforcement supports shall be made of durable materials strong enough to withstand the imposed loads 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 300mm 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 will not be permitted.

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

3.4.4 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 on the drawings, or where temporary openings are required for construction purposes, appropriate details shall be submitted to the City's Representative at least seven (7) days prior to their construction.

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 City's Representative.

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

3.4.5 PLACING OF CONCRETE

Concrete shall be transported and placed in accordance with the requirements of *AS 3600 Concrete structures*.

Movement of concrete to the pour face may be by means of suitable conveyors, clean chutes, pumping, or 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.

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

The Service Provider may be requested to 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
- Volume placed.

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 City's Representative, when the air temperature in the shade is below 5°C or above 38°C unless special precautions are taken as approved by the City's Representative.

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.

The Service Provider shall minimise shrinkage effects by pouring the sections of the work between construction joints in a sequence such that there will be suitable time delays between adjacent pours.

3.4.5.1 PLACING OF FRC

Placement of Fibre Reinforced Concrete (FRC) is not significantly different from placing plain concrete. The same factors must be adhered to; good careful vibration, constant level checking and flat screeding will produce the first stage of a quality slab.

Like plain concrete, FRC can be placed either manually or mechanically.

All surfaces shall be finished to a smooth finish prior to applying the final finish. The constructor shall ensure that the fibres and aggregates are not exposed in the smooth finish.

Once the smooth surface is achieved, the final finish (wood float, textures or burnished) may be applied.

3.4.6 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.

Exposed surfaces of the concrete shall be struck off and finished. Where shown on the drawings, corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted or neatly rounded.

3.4.6.1 KERB EXTRUSION MACHINES

Concrete used in kerb extrusion machines shall have a density not less than 96 per cent of the density achieved in a specimen cylinder prepared in accordance with *AS 1012.8, clause 1.7.5. Methods of testing concrete – Determining of the modulus of rupture.*

The Service Provider shall carry out concrete core tests in accordance with AS 1012.14–1991. *Methods of testing concrete – Determining of the modulus of rupture.*

Intervals of such tests shall be one test per lot if requested by the City's Representative. A lot shall be the kerb and channel cast in one day's production. The location for testing shall be the kerb and gutter tray or where there is not a gutter, the top of the kerb on the steepest downhill grade on which the kerb machine is travelling.

On incidental or isolated works or on works where the total length of kerb cast in one day's production is less than 150 linear metres, three core tests shall be conducted. The Service Provider shall request the City's Representative to nominate the position of each test.

The Service Provider shall fill holes due to core sampling with a suitable concrete mix coloured to match the kerb and channel within 48 hours of testing.

3.4.7 APPLICATION OF SHOTCRETE (SPRAYED CONCRETE)

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as close to perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed from the surface after the initial set by air jet or other suitable means as work proceeds and disposed of.

Spraying shall be discontinued if wind causes the separation of the nozzle stream. Concrete shall not be sprayed in air temperatures less than 5°C.

Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

Curing shall commence within one hour of the application of sprayed concrete, except for raingarden applications, and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with manufacturer's specifications.

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven (7) days. Curing is not required for sprayed concrete within raingardens unless directed by the City's Representative.

3.5 JOINTS

3.5.1 CONSTRUCTION JOINTS (COLD JOINT)

Construction joints shall be formed whenever it is necessary to cease concreting for 20 minutes or longer, except at expansion joints. The location of construction joints shall be as shown on the plans or as required and approved by the City's Representative.

These joints shall be perpendicular to the principal line of stress, and in general shall be located at points of minimum shear.

Before placing new concrete against concrete which has set, the forms shall be retightened 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 City's Representative prior to use.

3.5.2 CONTRACTION JOINT (DUMMY JOINT)

Contraction joints shall be located as shown on the standard drawings. They can either be formed using an appropriate jointing tool or sawing once the concrete has partially cured.

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

When concrete is reinforced, the reinforcement should be placed as shown in the standard drawing. This establishes the plane of weakness at the joint area.

The Service Provider shall use a jointing tool for the installation of a contraction joint after the concrete has been edged, and prior to finishing of the surface.

Sawing for the installation of contraction joints shall commence within 6-18 hours of placement to permit cutting the concrete without excessive raveling, depending on weather conditions.

3.5.3 EXPANSION JOINTS

Expansion joints shall be provided as shown on the standard drawings or where directed by the City's Representative. Expansion joints shall be pre-moulded and made of either fibre, sponge rubber, plastic or bituminous impregnated cork. The expansion joint material shall be non-extruding in hot weather, or brittle in cold weather. All joints shall be neatly finished with an edging tool.

An expansion joint shall always be used where a concrete member will join or abut an existing structure of any type.

3.5.4 ISOLATION JOINTS

Isolation joints shall be provided where a pavement abuts a building, kerb, or any other rigid structures such as drainage pits or access holes.

3.6 SURFACE FINISHES

Kerb and gutter shall be finished with a steel trowel. Edges shall be finished with round chamfers as shown on the standard drawing.

In situ concrete footways, vehicular crossings and kerb ramps shall be finished with a medium wood float finish, generally perpendicular to the line of travel. Edges, joints and grooves shall be finished to approval with a rounded chamfer by using a steel edge or grooving tool. The smooth margin adjoining the rounded edge shall not be wider than 25mm and grooves shall not be less than 10mm deep.

All other exposed surfaces, unless otherwise shown on the drawings or directed, shall be struck off and finished with a wooden float, and joints and edges so shown shall be left neatly tooled. Concrete shall not be disturbed after it has been in the forms for 10 minutes.

Faulty and honey-combed portions shall be taken down and rebuilt if directed by the City's Representative.

The Service Provider 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 manner. Where kerb moulding machines are used, the Service Provider 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 City's Representative.

3.7 CONCRETE CURING AND PROTECTION

The requirements for curing and protection shall be in accordance with *AS 3600 Clause 19.1.5-Concrete structures* and this Technical Specification.

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 as such that the concrete has hardened sufficiently, by the time the last person leaves the site, to not allow any vandalism or graffiti to occur on the 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 directed by the City's Representative, 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 Liquid membrane-forming curing compounds for concrete.*, for a minimum period of 72 hours. During this time, the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete.

3.8 STRIPPING OF FORMWORK

Formwork shall be stripped in accordance with *AS 3600 Clause 19.6.2 - Concrete structures*, where those requirements are more stringent than the relevant requirements of *AS 3610 Formwork for concrete*.

3.9 QUALITY

Any lot that does not meet all the requirements of this Technical 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 Technical Specification.

3.9.1 INSPECTIONS

At least two (2) working days' notice shall be given for all inspections.

3.9.2 HOLD AND WITNESS POINTS

Construct Concrete	
1. Process Held:	Installation of Formwork (Section 3.4.2)
Submission Details:	At least two (2) working days before the installation of the formwork.
Release of Hold Point:	The City's Representative will inspect the installed formwork, prior to authorising the release of the Hold Point.
2. Process Held:	Installation of Reinforcement (Section 3.4.3)
Submission Details:	At least two (2) working days before the installation of the reinforcement.
Release of Hold Point:	The City's Representative will inspect the installed reinforcing, prior to authorising the release of the Hold Point.
3. Process Held:	Finish of Concrete (Section 3.6)
Submission Details:	At least two (2) working days prior to finishing the concrete
Release of Witness Point:	The City's Representative will inspect the finished concrete, prior to authorising the release of the Witness Point unless advised otherwise.

3.9.3 TOLERANCES

Item	Activity	Tolerances
1.	Subgrade	
	a) Relative Compaction	≥92% (modified compactive effort)
2	Barriers, Footpathsetc.	
	a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 15mm under a 3m straight edge
	b) Relative Compaction of Subbase	≥95% (modified compactive effort) ≥98% (standard compactive effort)
3	Formwork	
	a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work
4	Fine Aggregate	
	a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate

3.8.3 TOLERANCES, CON'T

Item	Activity	Tolerances
5	Coarse Aggregate	
	a) Percentage of wear	Loss of weight shall not exceed 30%
	b) Crushing Value	Crushing value shall not exceed
	c) Soundness	25%
	d) Particle Shape	The loss of mass when tested with sodium sulphate shall not exceed 12%
	e) Grading	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%
		To be evenly graded within the absolute limits and shall not deviate from the grading of the sample aggregate
6	Aggregate Moisture Content	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed
7	Consistency	In accordance with <i>AS 1012.3, Method 1 Methods of testing concrete</i> – <i>Determining of the modulus of rupture</i> , the slump shall not exceed the nominated slump $\pm 15\text{mm}$ In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm
8	Ready Mixed Concrete	
	a) Mixing and Delivery	The time taken from the introduction of water until the concrete is completely discharged shall not be more than 1.5 hours Where non-agitating equipment is used, the concrete shall be completely discharged not more than 30 minutes after the addition of water
9	Placing and Compacting of Concrete	Concrete shall not be placed without the approval of the City's Representative if the air temperature within 24 hours is likely to be below 5°C of the shade temperature and is likely to exceed 38°C.
10	Finishing of Unformed/Formed Concrete Surfaces	
	a) Wearing Surface	To be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3m length
	b) Finished Surfaces	
	i) Not Adjacent to Roads	$\leq 25\text{mm}$ Plan Position $\leq 25\text{mm}$ Level
	ii) Adjacent to Roads	$\leq 10\text{mm}$ Alignment $\leq 10\text{mm}$ Level
	iii) Culvert Inverts	$\leq 25\text{mm}$ Alignment $\leq 10\text{mm}$ Level

3.10 REVISION REGISTER

Revision	Clause	Description of Revision	Authorised By	Date
Rev. 6	3.5.2	Reference to the timing for the installation of contraction joints updated – “Sawing for the installation of contraction joints shall commence within 6-18 hours of placement”	SA	Aug-23

