CONSTRUCTION SPECIFICATION

C271

MINOR CONCRETE WORKS

SPECIFICATION C271 – MINOR CONCRETE WORKS

CLAUSE CONTENTS PAGE

CITATION

This document is named “Kempsey Shire Council, Construction Specification C271 - Minor Concrete Works”.

ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on PMHC AUS-SPEC. Parts of the AUS-SPEC document that remain are still subject to the original copyright.

VERSIONS, C271 – Minor Concrete Works

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Infrastructure
1.0	Version 1 – First Draft Version		March 2025	

CONSTRUCTION SPECIFICATION C271
MINOR CONCRETE WORKS

GENERAL

C271.01 SCOPE

Brief

1. This Specification is for the supply and placement of concrete, including sprayed concrete, and ancillary requirements like excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the Drawings but not having individual Specifications. These works include road barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

2. The work also includes supply and placement of sprayed concrete and miscellaneous minor concrete work for water and sewerage construction such as valve chambers, thrust and anchor blocks, bulkheads, pumping stations, bedding, encasement and cast-in-situ access chambers.

3. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the Construction Specification for Quality Requirements.

C271.02 REFERENCE AND SOURCE DOCUMENTS

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated:

(a) Council Specifications

(b) Australian Standards

AS 1012.1	-	Methods of testing concrete - Sampling of concrete
AS 1012.3.1	-	Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test
AS 1012.8.1	-	Methods of testing concrete - Method for making and curing concrete - Compression and indirect tensile test specimens.
AS 1012.9	-	Methods of testing concrete - Compressive strength tests - Concrete, mortar and grout specimens.
AS 1012.14	-	Methods of testing concrete - Method for securing and testing cores from hardened concrete for compressive strength.
AS 1141.14	-	Methods for sampling and testing aggregates Particle shape, by proportional caliper.
AS 1141.21	-	Methods for sampling and testing aggregates - Aggregate crushing value.
AS 1141.23	-	Methods for sampling and testing aggregates - Los Angeles value.
AS 1141.24	-	Methods for sampling and testing aggregates - Aggregate soundness - Evaluation by exposure to sodium sulphate solution.

AS 1289.3.3.1	-	Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil.
AS 1289.5.1.1	-	Methods of testing soils for engineering purposes - Soil compaction and density tests – Determination of the dry density/moisture content relation of a soil using standard compactive effort.
AS 1289.5.2.1	-	Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort.
AS 1289.5.4.1	-	Methods of testing soils for engineering purposes - Soil compaction and density tests – Compaction Control Test - Dry density ratio, moisture variation and moisture ratio.
AS 1379	-	Specification and supply of concrete.
AS 1478	-	Chemical admixtures for concrete.
AS 1478.1	-	Chemical admixtures for concrete, mortar and grout - Admixtures for concrete
AS 1478.2	-	Chemical admixtures for concrete, mortar and grout - Methods of sampling and testing admixtures for concrete, mortar and grout
AS/NZS 1554.3	-	Structural steel welding - Welding of reinforcing steel
AS/NZS 1859.1	-	Reconstituted wood-based panels - Specifications - Particleboard.
AS 2082	-	Timber - Hardwood - Visually stress-graded for structural purposes.
AS 2271	-	Plywood and blockboard for exterior use.
AS 2758.1	-	Aggregates and rock for engineering purposes - Concrete aggregates
AS 3600	-	Concrete structures
AS 3610	-	Formwork for concrete.
AS 3799	-	Liquid membrane-forming curing compounds for concrete.
AS 3972	-	General purpose and blended cements.
AS 4671	-	Steel reinforcing materials.

(c) State Authorities

(d) Other

(e) Standard Drawings

C271.03 DEFINITIONS AND ABBREVIATIONS

General

Terms used to define this specification have the same meanings as defined overall in AUS-SPEC Construction and Design Specification, supplemented by additional terms specified in this document below.

EXCAVATION AND FOUNDATIONS

C271.04 GENERAL

Foundations

1. The subgrade, or subbase where specified, shall be formed at the required depth below the finished surface levels shown on the Drawings. Rock foundations shall be neatly excavated to form a bed for the concrete and shall be thoroughly scraped and cleaned. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified).

Unsuitable Material

2. All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Principal Certifier and the subgrade shall be compacted to provide a minimum relative compaction of 100 per cent as determined by AS 1289.5.1.1 for standard compactive effort.

Shoring

3. The Principal Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with statutory requirements. The excavation shall be kept free of water.

C271.05 ROAD BARRIERS, DRIVEWAYS AND FOOTPATHS

Subbase

1. For road barriers and heavy-duty driveways, a subbase of minimum 150mm compacted thickness shall be placed over the subgrade.

2. Standard duty driveways and footpaths shall have a subbase consisting of clean washed sand or crusher dust, of minimum compacted thickness of 50mm, placed over the compacted subgrade. The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

Compaction

3. The subbase material shall be compacted to provide a minimum relative compaction as determined by AS 1289.5.2.1 of 98 per cent for modified compactive effort as appropriate.

Subgrade and Subbase Tolerances

4. The finished subbase shall not deviate more than 12mm under a straight edge 3 metres long, subject to any necessary allowance on vertical curves.

C271.06 RETAINING WALLS, HEADWALLS AND WING WALLS

Rock Foundations

1. In the case of rock foundations for retaining walls, headwalls and wing walls, the excavation shall be carried into the rock for a minimum depth of 150mm. Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be reduced to 100mm.

Earth Foundations

2. Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete blinding layer at least 50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the blinding layer within a period of 48 hours after the concrete has been placed.

Precast Concrete

3. Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete blinding layer while it is still in plastic state. In the case of soil foundations, the concrete shall be not less than 50mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50mm above the highest points of rock.

FORMWORK

C271.07 GENERAL

1. Formwork shall be provided in accordance with AS 3610 to produce hardened concrete to the lines, levels and shapes shown on the Drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Formwork Requirements

2. Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the in-situ earth.

Side Forms

3. Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2 metres or to move concrete along the formwork after deposition.

Concrete Placement

4. Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Fit for Purpose

5. Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the Drawings.

Formwork Fittings

6. Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the Drawings.

Edge Treatment

7. Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

Cleaning and Inspection

C271.08 APPROVAL OF FORMWORK DESIGN

1. Certification from a qualified (structural) engineer shall be provided for box culverts and reinforced concrete retaining walls.

Approval to Design

2. For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted to the Principal Certifier for concurrence before manufacture of the formwork is commenced.

C271.09 PROVISION FOR DRAINAGE

1. Where shown on the Drawings, or where directed by the Principal Consultant, weepholes of 50mm diameter shall be provided in retaining walls and wing walls.

Weep Holes

C271.10 CONSTRUCTION

1. The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified

Formwork Material

shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

2. Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots. *Timber Requirements*

3. Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with AS 2271, the hardwood shall comply with AS 2082 and the particle board with AS/NZS 1859.1. *Timber Standards*

4. Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1m and uniform lengths of not less than 2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than 15mm thick. Form panels less than 15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern. *Formwork Panels for Exposed Surfaces*

5. Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board. *Hidden Surfaces*

6. Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces. *Mild Steel Surfaces*

C271.11 ERECTION

(a) General

1. Dimensions and position of forms, shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown 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. *Formwork Position Tolerances*

2. Joints as erected shall be mortar tight. *Mortar Tight*

3. The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints. For tolerances in plan position and levels, refer to Clauses C271.32. *Coating of Internal Surfaces*

4. Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering. *Release Agent*

b) Approval by the Principal Certifier

1. The formwork and reinforcement placement shall be installed by the Principal Contractor and inspected by the Principal Certifier.

Reinforcement Placement

2. When specified, placing of concrete shall not commence until the reinforcement, has been inspected by the Principal Certifier, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

Concrete Placement

3. Notice of inspection shall be given in accordance with Kempsey Shire Council Asset Delivery Specification (ADS). Notice shall not be less than 24 hours, excluding Saturdays, Sundays and Public Holidays.

Notice of Inspection

MATERIALS FOR CONCRETE

C271.12 MATERIALS

All concrete materials and testing methods to comply with the following Australian Standards:

AS 1012.1	-	Methods of testing concrete - Sampling of concrete
AS 1012.3.1	-	Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test
AS 1012.8.1	-	Methods of testing concrete - Method for making and curing concrete - Compression and indirect tensile test specimens.
AS 1012.9	-	Methods of testing concrete - Compressive strength tests - Concrete, mortar and grout specimens.
AS 1012.14	-	Methods of testing concrete - Method for securing and testing cores from hardened concrete for compressive strength.
AS 1141.14	-	Methods for sampling and testing aggregates Particle shape, by proportional caliper.
AS 1141.21	-	Methods for sampling and testing aggregates - Aggregate crushing value.
AS 1141.23	-	Methods for sampling and testing aggregates - Los Angeles value.
AS 1141.24	-	Methods for sampling and testing aggregates - Aggregate soundness - Evaluation by exposure to sodium sulphate solution.
AS 1379	-	Specification and supply of concrete.
AS 1478	-	Chemical admixtures for concrete.
AS 2758.1	-	Aggregates and rock for engineering purposes - Concrete aggregates
AS 3799	-	Liquid membrane-forming curing compounds for concrete.
AS 3972	-	General purpose and blended cements.
AS 1478.1	-	Chemical admixtures for concrete, mortar and grout - Admixtures for concrete
AS 1478.2	-	Chemical admixtures for concrete, mortar and grout - Methods of sampling and testing admixtures for concrete, mortar and grout

HANDLING AND TREATMENT OF CONCRETE

C271.13 PLACING AND COMPACTING CONCRETE

1. No concrete shall be mixed or placed, without the approval of the Principal Consultant, while the air temperature is, or is likely to be within 24 hours, below 5°C or while the shade temperature exceeds 38°C. All concrete shall be placed in dry weather conditions. Concrete placement is not to commence in the rain or when rain is likely. Prior to placing concrete, the area shall be clean and moist but free from any ponding of water.

Air Temperature Requirements

2. The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

Placement within Time Limit

3. 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. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. 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. The concrete shall be placed in horizontal layers 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 freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units. Vibrators shall not be left in one position for more than 30 seconds and shall not be permitted to rest on reinforcement.

Placement in Forms, Vibrating

4. Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the Drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Exposed Surfaces

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

Initial Set

6. In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

Slurry for Extruded Concrete

C271.14 FINISHING OF UNFORMED SURFACES

(a) Surfaces other than Wearing Surfaces

1. Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water which comes to the surface. A capping of mortar will not be permitted

Finish for Unformed Surfaces

2. All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

Future Contact Surfaces

(b) Wearing Surfaces

Finish for Wearing Surfaces

1. Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than 2 metres. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template, float or broom. The departure from grade shall not exceed 5mm in any 3-metre length.

Surface to receive Asphalt

2. Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.

(c) Finished Levels

Surface Tolerance

1. The finished levels of concrete as follows:

   a. Concrete structures not adjacent to road pavements - the finished levels shall be within 25mm from the specified levels.

   b. Concrete barriers, drainage pits and other structures adjacent to road pavements - the finished concrete shall be within 10mm from the specified levels.

2. Barriers, footpaths and similar shall not deviate from level by more than 5mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical curves

C271.15 CURING AND PROTECTION

Curing Requirements

1. All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds, in accordance with AS 3799, for a minimum period of 3 days. During this time the work must be adequately protected from traffic and any other causes likely to damage the concrete.

2. Curing of extruded concrete shall be to the discretion of the Principal Certifier.

Exposure Classification

3. Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in AS 3600.

C271.16 REMOVAL OF FORMS

Walls, Sumps etc.

1. All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Principal Certifier if the air shade temperature falls below 10°C during the periods specified.

   a. Mass retaining walls, headwalls, wing walls, gully pits, sumps, and similar drainage structures — 48 hours

   b. Footpaths, driveways and similar — 48 hours

   c. Sides of reinforced concrete walls when height of each day pour is:

      i. under 0.6 metres — 1 day

ii.	0.6m to 3m	2 days
iii.	3m to 6m	3 days
iv.	6m to 9m	5 days
v.	Supporting forms under deck slabs of culverts	10 days

Barriers

2. To permit the satisfactory finishing of barriers, forms shall be removed in not less than 12 hours or more than 48 hours after placing concrete, depending upon weather conditions.

Protection of Concrete

3. Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

Superimposed Load

4. No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70 per cent of the design strength.

Removal of Hole Formers

5. Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

C271.17 TREATMENT OF FORMED SURFACES

Quality of Surfaces

1. All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result.

Finish Class

Formed concrete surfaces shall have finishes in accordance with the classes of surface finish in AS 3610 as follows:

a.	Non-visible surface	Class 4
b.	Visible surfaces-	Class 2

Repair of Defects

2. As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

Removal of the Wires

3. Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

Coating with Bonding Agent

4. The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to comply with the manufacturer's requirements.

C271.18 JOINTS

Horizontal Construction Joint

1. Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Principal C. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly

cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

2. Retaining walls shall be provided with vertical expansion joints as shown on the Drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

Vertical Expansion Joints

3. Where barriers are extruded or cast in place, narrow transverse vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints, shall be at intervals of 3 metres.

Barrier Contraction

4. In barriers, unless shown otherwise on the Drawings, expansion joints, 15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding 15m and where the barrier abuts against gully pits. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Barrier Expansion

5. In footpaths, median toppings and driveways, unless otherwise shown on the Drawings, expansion joints, 15mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Footpaths

C271.19 STRENGTH OF CONCRETE

1. When tested in accordance with AS 1012.9, the concrete shall have a compressive strength not less than that shown on the Drawings or if not shown shall have a compressive strength not less than that specified in Table C271.1 for the particular class of work.

Strength Requirement

2. The strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

Determination of Strength

3. In general, two pairs of test specimens shall be moulded for each 15 cubic metres of concrete, or part thereof, one pair being intended for the 7-day test if required and the other pair for a 28-day test.

Moulding of Cylinders

Use	MPa	Coarse Aggregate Nominal Size	Cylinder Strength Required	
			7 days	28 days
		mm	MPa	MPa
Foundations, mass retaining walls	20	40	15	20
Mass concrete footings, pitching, linings etc.	20	20	15	20
Drainage structures, driveways footpaths, road barrier, miscellaneous minor concrete work	20	20	15	20
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining walls	32	20	24	32
Extruded concrete	20	14-10	15	20

Table C271.1 - Concrete Strength Requirements

4. The strengths specified at 28 days shall be increased by multiplying by factors as shown in Table C271.2 for tests at ages in excess of 28 days.

Strength Age Factor

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25
*For intermediate ages the factor shall be determined on a pro-rata basis	

Table C271.2 - Concrete Age Conversion Factors

5. If the test specimens fail to achieve the specified strength, the Principal Contractor may, with the approval of the Principal Certifier, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements nominated in Table C271.1, the concrete will be accepted.

Cores and Test Acceptance

6. If cores taken fail to satisfy the strength requirements, the concrete shall be removed.

Failure of Cores

C271.20 SAMPLING CONCRETE

1. Equipment and facilities shall be provided by the Principal Contractor for the taking and storage of samples of any materials or concrete being used or intended to be used in the work.

Contractor's Responsibility

2. Concrete test specimens shall be cylinders 300mm long and 150mm diameter, moulded concurrently in the presence of the Principal Consultant or Principal Certifier's representative, in accordance with AS 1012.8.1, from samples taken in accordance with AS 1012.1.

Moulding of Test Cylinders

STEEL REINFORCEMENT FOR CONCRETE

C271.21 MATERIAL

1. Steel reinforcement shall comply with the requirements of AS/NZS 4671 Steel reinforcing materials.

Standards

2. The type and size of bars shall be as shown on the Drawings.

Type and Size

3. Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, mill scale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Quality

4. The Principal Contractor shall supply evidence satisfactory to the Principal Certifier that steel reinforcement complies with AS/NZS 4671. Test certificates shall show the results of mechanical tests and chemical analysis.

Documentary Evidence

5. Where the material cannot be identified with a test certificate, samples shall be taken, and testing arranged by the Principal Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length.

Further Sampling

6. Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding required loads without malfunction. The Principal Contractor shall supply evidence to the Principal Consultant certifying that the proposed chairs will conform to load requirements.

Bar Chairs

7. Reinforcing steel must be sourced from mills with Australasian Certification Authority for Reinforcing and Structural Steel (ACRS) third party certification. The Principal Contractor shall supply evidence to the Principal Consultant that the source mill of all reinforcing steel used has ACRS certification.

ACRS Certification

C271.22 BENDING

1. Reinforcement shall be formed to the dimensions and shapes shown on construction plans. Reinforcement shall not be bent or straightened in a manner that will injure the material.

Cutting and Bending

2. Bars with kinks or bends not on the construction drawings shall not be accepted by the Principal Consultant.

3. Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450^{o}C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

C271.23 SPLICING

1. Laps in reinforcing bars, wire or fabric shall be as shown on the Drawings. Laps not shown on the Drawings shall be as follows for unhooked bars:

Lap Dimensions

a.	Plain bars, Grade 250	40 bar diameters
b.	Deformed bars, Grade 500	35 bar diameters
c.	Hard-drawn wire	50 bar diameters

2. Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25mm.

Splice Dimensions

C271.24 STORAGE

1. Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

Protection of Reinforcement

C271.25 PLACING

1. Reinforcement shall be accurately placed as shown on the Drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at

Reinforcement Position

0.5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25mm.

2. Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on Construction Plans.

3. Tack Welding shall not be permitted. *Tack Welding*

4. The reinforcement in each section of the work shall be approved by the Principal Certifier before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours. *Inspection Required*

5. Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Principal Consultant. *Splices*

6. Bars forming a lapped splice shall be securely wired together in at least two places, unless welded. *Lapped Splice*

7. The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on Construction Plans. Where not so indicated it shall be as stated below: *Bar Cover*

a. Concrete normally in contact only with air
   i. Slabs: 40mm
   ii. Other than slabs: 45mm
b. Concrete in contact with earth or fresh water
   i. Slabs of box culverts: 50mm
   ii. Other than culverts: 50mm

In no cases shall the cover be less than 1.5 times the diameter of the bar.

BACKFILLING

C271.26 GENERAL

1. Backfilling, other than for protection of the works, at barriers, paving, etc., and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

2. Compaction of the backfill shall not occur during these 3 days

3. No filling shall be placed against retaining walls, headwalls or wing walls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Principal Consultant and the Principal Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved. *Adjacent to Walls*

4. Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. *Selected Backfill*

Plastic Index

5. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 1289.3.3.1

Compaction

6. The material shall be placed in layers not exceeding 150mm and shall be compacted to provide a relative compaction of not less than 92 per cent as determined by AS 1289.5.2.1 for modified compactive effort.

C271.27 TREATMENT AT WEEPHOLES

Backfill Material Size & Type

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

   a. The maximum particle dimension shall not exceed 50mm

   b. No more than 5 per cent by mass shall pass the 9.5mm sieve.

Extent of Material

2. The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.

Synthetic Membrane

3. Alternatively, the Principal Contractor may provide a synthetic membrane of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's requirements. The use of a synthetic membrane shall be subject to the Principal Consultant’s approval.

SPRAYED CONCRETE

1. 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. *Definition*

2. The minimum depth of sprayed concrete to be applied shall be 75mm. *Depth*

3. Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour. *Colour*

4. Sprayed concrete shall have a minimum cement content of 380 kg/m^3 as discharged from the nozzle and shall have a minimum compressive strength of 32 MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete. *Strength*

5. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.14. Equipment and facilities shall be provided by the Principal Contractor for the taking of cores from the work. The Principal Contractor 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 Principal Certifier. *Test Cores*

6. At least 14 days prior to applying any sprayed concrete the Principal Contractor shall submit to the Principal Certifier details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS 3600. *Contractor's Responsibility*

C271.29 SURFACE PREPARATION

1. Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Principal Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied. *Earth Surfaces*

2. Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete. *Rock Surfaces*

3. Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter. *Steel Pipes*

4. The Principal Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete. *Water Flow*

C271.30 APPLICATION OF SPRAYED CONCRETE

1. 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 nearly as possible 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 *Application Procedure*

coating with minimum rebound of the material and no sagging. Rebound material shall be removed and disposed after the initial set by air jet or other suitable means from the surface as work proceed.

2. Spraying shall be discontinued if wind causes separation of the nozzle stream. *Wind Problem*

3. Concrete shall not be sprayed in air temperatures less than 5°C. *Air Temperature*

4. 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°C and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying. *Construction Joints*

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

6. 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. *Protection of Adjoining Surfaces*

C271.31 CURING

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

2. In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days. *Water Curing*

LIMITS AND TOLERANCES

C271.32 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C271.3 below:

Table C271.3 - Summary of Limits and Tolerances

Item	Activity	Limits / Tolerances	Spec Clause
1.	**Subgrade**		
	(a) Relative Compaction	≥100% (standard compactive effort)	C271.04
2.	**Barriers, Footpaths etc.**		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 12mm under a straight-edge 3 metres long.	C271.05
	(b) Relative Compaction of Subbase	≥98% (modified compactive effort)	C271.05
3.	**Formwork**		C271.11
	(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.	**Placing & Compacting of Concrete**	Concrete shall not be placed without the approval of the Certifying Engineer if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	C271.13
5.	**Finishing of Unformed Concrete Surfaces**		
	(a) Wearing Surface	To be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3-metre length.	C271.14
	(b) Finished Level	The finished levels of concrete structures not adjacent to road pavements shall not vary more than 25mm from the specified levels.	C271.14
		In the case of drainage pits and other structures adjacent to road pavements	C271.14

the finished concrete level shall not vary more than 10mm from the specified level and alignment.