



AUS-SPEC

Infrastructure Specifications

0391 Auxiliary concrete works

0319 AUXILIARY CONCRETE WORKS

IMPORTANT: This document has been adapted from the NATSPEC suite of specification templates for use in the Cessnock City Council area by both Council and industry. NATSPEC regularly updates the base templates (currently in April and October each year), and Council may incorporate changes into its version of AUS-SPEC from time to time. To assist in highlighting any changes made by Council to the NATSPEC templates, the following conventions are used.

- See ANNEXURE M at the end of this document which contains (where practical) Cessnock City Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown **in brown text like this**.
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Where there is a conflict between main body text and Cessnock City Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide cast in-situ, pre-cast units and sprayed concrete, as documented.

1.2 CROSS REFERENCES

General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- 0136 *General requirements (Construction)*.
- 0152 *Schedule of rates (Construction)*.
- 0161 *Quality management (Construction)*.
- 1101 *Traffic management*.

1.3 STANDARDS

General

Specification and supply of concrete: To AS 1379 (2007).

Concrete materials, design and construction: To AS 3600 (2018).

Formwork design and construction: To AS 3610.1 (2018) and Austroads ATS 5305 (2023).

Plywood formwork: To AS 6669 (2016).

Formed surfaces: To AS 3610.1 (2018).

Concrete structures for retaining liquids: To AS 3735 (2001).

Design, installation and testing of post-installed and cast-in fastenings: To AS 5216 (2021).

Concrete structures for retaining earth: To AS 4678 (2002).

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions given in AS 1379 (2007), AS 3600 (2018) and the following apply:

- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Early age strength: A mean compressive strength at 7 days exceeding the values shown in AS 1379 (2007) Table 1.2.
- Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.

- Geopolymer concrete: Geopolymer binder aggregates, water and additives.
- Sprayed concrete: Concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process, to produce a sound homogeneous product with a surface finish reasonably uniform in texture and free from blemishes. Sprayed concrete is also called Shotcrete.
- Weather – cold: Ambient shade temperature less than 10°C.
- Weather – hot: Ambient shade temperature greater than 30°C.

1.5 TOLERANCES

Formwork

Plumb of elements > 8 m high: 1:1000.

Plumb of elements ≤ 8 m high: To AS 3610.1 (2018).

Position: Construct formwork so that finished concrete conforms to AS 3600 (2018) clause 17.5, AS 3610.1 (2018) clause 3.3 and as documented.

Reinforcement

Fabrication: To AS 3600 (2018) clause 17.2.

Formed surfaces

Form face deflections: To AS 3610.1 (2018) Table 3.3.4.1.

Straight elements: To AS 3610.1 (2018) Table 3.3.5.1.

Precast units

Manufacturing, installation, fixings and embedded items tolerance for precast elements: To AS 3610.1 (2018) Table 3.3.6.2, AS 3850.2 (2015) clause 2.11 and AS 3850.3 (2021).

1.6 SUBMISSIONS

Certification

Formwork design certification: For other than permanent composite form systems, submit certification by a professional engineer experienced in formwork design verifying conformance of the design.

Formwork execution certification: Submit certification by a professional engineer experienced in formwork design and construction, verifying conformance of the completed formwork, including the suitability of the formwork for the documented surface finish class.

Precast units: Provide independent certification by a professional engineer of conformance of the design to project criteria.

Execution details

Modifications: Submit details of any proposed on-site modifications to the documented reinforcement.

Formwork removal: Submit formwork removal procedures.

Reshoring: Submit details of any proposed reshoring.

Reinforcement: Submit the following:

- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 (2006) Section 8.
- Mechanical bar splices: Details and test certificates for each size and type of bar to be spliced.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600 (2018).
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Details of any proposed welding of reinforcement to AS/NZS 1554.3 (2014).

Measurement of materials: Submit proposal to measure materials by volume for on-site mixing for minor concrete works.

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

- Changes to the concrete mix.
- Changes to documented joint locations.
- Curing and protection methods.
- Curing period for low-pressure steam curing.
- Cutting or displacing reinforcement, or cutting or coring hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.

- Placing under water.
- Sequence and times for concrete placement, and construction joint locations and relocations. Include any proposed sequential placement of slab segments.
- Site storage, mixing and transport methods and equipment, if applicable.
- Temperature control methods to suit hot or cold atmospheric conditions during concrete placement.
- Sawn joints: Submit details of proposed methods, timing and sequence of sawing joints.

Construction joints: Submit details of any emergency construction joints included in the works.

Repair of defects: Submit details of the proposed method of defect repair.

Surface repairs: Submit details of the proposed method of surface repair.

Precast units: Submit the following:

- Manufacturer's details: Submit name, contact details and credentials of proposed manufacturer of precast elements.
- Safe work method statement: Prepare a safe work method statement specific to the project for the precast erection and submit on request.
- Lifting and handling equipment: Submit details and specification of proposed equipment along with qualifications and training of the operating personnel in the form of a qualification register.

Method statement: Submit method statement for all sprayed concrete works.

Products and materials

Void formers: Submit type-test results as evidence of conformity to requirements of MATERIALS, **FORMWORK, Void formers**.

Reinforcement strength and ductility: Submit type-test reports as evidence of conformity to AS 3600 (2018) Table 3.2.1 for each reinforcement type.

Steel fibre reinforcement: Submit a declaration of performance certificate as evidence of conformity to the **Steel fibre reinforcement properties schedule**.

Machine mixing: Submit details of proposed concrete mix when on-site machine mixing is proposed.

Product conformity: Submit evidence of conformity, as appropriate, as follows:

- Certification by a JASANZ accredited third party.
- Report by an Accredited Testing Laboratory describing tests and giving results which demonstrate that the product conforms.

Concrete mixes: Submit details, for each grade and type of concrete including any proposed use of special-purpose cement types.

Curing compounds: Submit details of any proposed curing compounds, including the following:

- Dosage rates.
- Certified type-test results by an Accredited Testing Laboratory for water retention to AS 3799 (1998) Appendix B for liquid membrane-forming compounds.
- Evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.
- For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

Admixtures: Submit details of any proposed admixtures, including the following:

- Brand name.
- Place of manufacture.
- Basic chemical composition.

Admixtures must not be corrosive to steel and must not encourage other detrimental effects such as cracking and spalling.

Precast units: Submit the following:

- Protective coating details: Submit proposals for protective coatings to exposed metallic components to AS 2312.1 (2014) or AS/NZS 2312.2 (2014) with regard to site-specific corrosivity zoning.
- Proprietary inserts: Submit proprietary documentation for any lifting, bracing or fixing inserts. Include make, type and working load limit.
- Non-proprietary inserts: Submit certificate from a professional engineer certifying the working load limit.

Samples

Coloured concrete: Submit sample blocks of coloured concrete before casting final concrete.

Sprayed concrete sample panels: Submit 3 sample panels for each mix proposed.

Shop drawings

Submit shop drawings to a scale that best describes the detail, showing the following:

- Location: The location of any cores, anchors, fixings or embedded items, including any requirement to displace reinforcement.
- Formwork: Submit shop drawings including details of proposed forms, falsework, form liners, bolt positions, release agents and, where applicable, re-use of formwork.
- Precast concrete drawings: Submit shop drawings of structural precast concrete elements showing the proposed details for their design, manufacture, assembly, transport and installation.

Subcontractors

Pre-mixed supply: Submit names and contact details of proposed pre-mixed concrete suppliers and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.

Tests

Requirement: Submit test results to **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES** and of the following.

- Concrete compressive strength test results to AS 1012.9 (2014).
- Slip resistance test of completed installations.
- Drying shrinkage test results.
- Location of test cores.
- Lifting inserts and attachments for precast elements.
- If applying superimposed loads to a future load bearing concrete structure, within 21 days of placing concrete, complete tests to demonstrate that 95% of the concrete design strength has been achieved.

1.7 INSPECTIONS**Notice**

General: Give notice so that inspection may be made of the following:

- Base preparation: Completed and prepared base before laying underlay or placing concrete.
- Completed formwork: Completed formwork following certification by professional engineer with the following in place before placing concrete:
 - All reinforcement.
 - Fixings and embedded items fixed in place.
 - Dust and debris removed from forms.
- Steel reinforcement placement: Completed steel reinforcement placement before placing concrete.
- Concealed surfaces or elements before covering.
- Commencement of concrete placement and compaction.
- Finishing and curing of concrete.
- Galvanizing repair: Any repaired galvanizing of steel reinforcement before placing concrete.
- Emergency hand mixing: Emergency hand mixing of concrete due to mechanical failure.
- Sprayed concrete sample panels: Concrete spraying of sample panels.
- Evaluation of the off-form finishes.
- Evaluation of surface finish.

2 MATERIALS**2.1 CONCRETE****Properties**

Concrete mix and supply: Conform to the following:

- Normal-class: To AS 1379 (2007) clause 1.5.3.
 - . Properties: As documented in the **Normal-class concrete properties schedule**.

- Special-class: To AS 1379 (2007) clause 1.5.4 and Austroads ATS 5315 (2023).
- . Properties: As documented in the **Special-class concrete properties schedule**.

Sprayed concrete mix:

Sprayed concrete wet-mix design table

Constituent materials	Quantity per m³
Cement (kg)	335
Fly ash (kg)	85
10 mm aggregate (kg)	610
Coarse sand (kg)	585
Fine sand (kg)	530
Water reducer (litres)	1.6
Superplasticiser (litres)	1.0
Air entraining agent (litres)	0.1
Water (litres)	200
Slump (mm)	60

Consistency

Stockpile: If uniform, consistent colour is documented, stockpile sand, cement and aggregates at the beginning of the project to minimise colour variations.

Aggregates

Standard: To AS 2758.1 (2014).

Sprayed concrete individual aggregates in mix: Consistent grading within allowable variation to AS 2758.1 (2014) Section 8.

Cement

Standard: To AS 3972 (2010).

Age: Less than 6 months old.

Storage: Store cement bags under cover and above ground.

Geopolymer concrete

Geopolymer concrete: To SA TS 199 (2023) and supply of geopolymer concrete to Austroads ATS 5330 (2020).

Supplementary cementitious materials

Fly ash: To AS/NZS 3582.1 (2016).

Slag: To AS 3582.2 (2016).

Amorphous silica: To AS/NZS 3582.3 (2016).

Water

Standard: To AS 1379 (2007) clause 2.4.

Requirement: Clean, free from oil, acid, alkali, organic or vegetable matter and including not more than 500 mg/L of chloride ions.

Coloured concrete

Standard: To AS 3610.1 (2018).

Manufacture: Produce 4 sample blocks of each coloured concrete using the proposed mix and method before casting final concrete.

Sample block size (nominal): 300 x 300 x 50 mm.

Chemical admixtures

Standard: To AS 1478.1 (2000), used to the manufacturer's recommendations and free from chlorides, or other substance detrimental to concrete or reinforcing steel.

2.2 FORMWORK

General

Form linings, facings and release agents: Compatible with documented concrete surface finish and any proposed applied finishes to concrete.

Lost formwork: Free of timber or chlorides, and not to impair the structural performance of the concrete members.

Void formers

Requirement: Material capable of maintaining rigidity and shape until the concrete has set, capable of withstanding construction loads and non-collapsible on absorption of moisture.

Laboratory testing: Use void formers tested under laboratory conditions for conformance with the following:

- Deflection during placing and compaction of the concrete does not exceed beam or slab span/1000.
- Additional deflection between initial set and 7 days does not exceed span/400.

Test method: Place formers on damp sand and load with a mass of wet concrete at least equal to the mass of the beams or slabs to be supported.

Profiled steel sheeting composite forms

Material: Hot-dipped zinc-coated sheet steel to AS 1397 (2021).

Minimum steel grade: G550.

Accessories: Use materials and corrosion protection compatible with the profiled steel sheeting.

Plywood formwork

Material: To AS 6669 (2016).

Grade: Use appropriate grade for the documented design dimensions, loading and surface quality.

Joints: Seal the joints consistent with the surface finish class.

Tolerances: To AS 3610.1 (2018) Section 3.

2.3 REINFORCEMENT

Fibre reinforcement

Steel fibres: To AS 3600 (2018) clause 16.7.1.

Synthetic fibres: To EN 14889-2 (2006).

Properties: To the **Steel fibre reinforcement properties schedule**.

Steel reinforcement

Standard: To AS/NZS 4671 (2019).

Properties: To the **Steel reinforcement properties schedule**.

Fabrication tolerances: To AS 3600 (2018) clause 17.2.2.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Storage: Store reinforcement above the surface of the ground and protect from damage and from deterioration by exposure.

Protective coating

Standard: To AS 3600 (2018) clause 17.2.1.2.

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

Epoxy coating: High build, high solids chemically resistant coating to AS/NZS 3750.14 (1997).

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680 (2006):

- Sequence: If fabricating after galvanizing, repair damaged galvanizing and coat cut ends.
- Zinc-coating (minimum): 600 g/m².

Accessories

Reinforcement supports: To AS/NZS 2425 (2015).

Tie wire:

- General: Annealed steel 1.25 mm diameter (minimum).
- External and corrosive applications: Galvanized.

2.4 PRECAST UNITS

General

Requirement: Provide proprietary precast units as documented.

Materials, components and equipment for manufacture: To AS 3850.1 (2015).

Planning, design, construction, transportation, erection and installation: To AS 3850.2 (2015) and AS 3850.3 (2021) for civil construction works.

Marking

Identification: Identify all units with easily visible markings that will be hidden once the unit is installed, including the following:

- Date of manufacture.
- Manufacturer's name or registered mark and location of manufacture.
- Maximum mass of unit in kg.
- Batch number.
- Correct orientation of unit.

2.5 MISCELLANEOUS

Surface hardeners, sealants and protectors

Supply: If documented, provide proprietary products to the manufacturer's recommendations.

Polymeric film underlay

Vapour barriers and damp-proofing membranes: To AS 2870 (2011) clause 5.3.3.

Curing compounds

Liquid membrane-forming compounds: To AS 3799 (1998).

Liquid membrane-forming curing compound: Compatible with the following:

- The water retention requirements of AS 3799.
- The concrete, and any applied finishes, including toppings and render.
- The surface colour required for visually important surfaces.

2.6 TESTING

Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

3 EXECUTION

3.1 GROUND PREPARATION

Rock foundations

Minimum depth: Excavate a minimum depth of 150 mm, or as documented, into the rock.

Mass concrete blinding

In situ walls: Place a mass concrete blinding slab on the prepared subgrade before constructing wall footings.

Blinding thickness:

- Earth foundation: Minimum 50 mm.
- Rock foundation: Minimum 50 mm above the highest point of rock.

Restriction: Do not place forms or other materials on the blinding within 48 hours of the blinding being placed.

Base preparation

Requirement: Prepare base, as follows:

- Graded prepared subgrade: Blind with sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay, where documented.
- Concrete blinding: Remove projections above the plane surface, and any loose material.

Polymeric film underlay installation

Standard: To AS 2870 (2011) clause 5.3.3.

Requirement: Where documented, lay underlay over the base, as follows:

- Lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape.
- Face the laps away from the direction of concrete pour.
- Patch or seal punctures or tears before placing concrete.
- Cut back as required after concrete has gained strength and formwork has been removed.

3.2 FORMWORK**General**

Robustness: Provide formwork of adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape.

Stripping: Provide forms that can be removed without causing damage to the completed structure.

Side forms: In earth excavations, provide side forms to prevent contact between concrete and the in situ earth.

Corners above ground: Provide 25 mm bevelled fillet at re-entrant angles, and chamfer at corners.

Steel linings: Clean off any rust and apply rust inhibiting agent before use.

Design

General: The design of formwork is the contractor's responsibility.

Certification: For in situ box culverts and retaining walls, obtain certification by a professional structural engineer, experienced in formwork design, verifying conformance of the design.

Fittings and embedments

Requirement: Make provision for the accurate location and firm support of fittings, bolts, anchorages and formers of holes and recesses, as documented.

Temporary fittings for the support of the formwork: Arrange to allow removal without damage to the concrete.

Embedments: Fix through formwork to prevent movement, or loss of slurry or concrete, during concrete placement.

Bolt holes

Formwork tie bolts left in the concrete: Position to achieve minimum 50 mm concrete cover to bolt.

Openings

Application: In vertical forms, provide form openings or removable panels for inspection and cleaning at the base of columns, walls and deep beams.

Access: For thin walls provide access hatches for placing concrete so that concrete does not fall a distance greater than 2 m.

Release agents

Application: Before placing reinforcement, apply a release agent to form face and linings. Spread the coating uniformly in a thin film and remove any surplus before placing concrete.

Staining: If commercial quality form oil or grease is used, make sure that surfaces to be exposed will not become stained or discoloured.

Unlined timber forms: Wet the timber thoroughly before oiling.

Profiled steel sheeting composite formwork

Installation: To the manufacturer's recommendations and structural documentation.

Visually important surfaces

Surface finish classes 2 or 3 (AS 3610.1): Set out the formwork to give a regular and symmetrical arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface.

Formwork panels: Provide formwork for exposed surfaces from panels having uniform widths of not less than 1 m and uniform lengths of not less than 2 m, except where the dimensions of the member formed are less than these dimensions.

Plywood panels: Conform to the following:

- Orientation: Grain of the outer plies perpendicular to the studding or joists.
- Thickness: Not less than 15 mm thick, where attached directly to the studding or joists.

- Variations: If plywood less than 15 mm thick is used, provide a continuous backing of dressed material of 20 mm minimum thickness.

Mild steel form surfaces: Counter-sink all bolt and rivet heads and grind back all welds to an even and smooth surface.

Void formers

Protection: Keep void formers dry until use, install on a firm level surface and place reinforcement and concrete with minimum delay.

Completed formwork

Certification: Obtain certification by a professional engineer, experienced in formwork design and construction, verifying conformance of the completed formwork, including the suitability of the formwork for the documented surface finish class.

3.3 REINFORCEMENT

General

Fixing: To AS 3600 (2018) clause 17.2.5 and as documented.

Modifications

Requirement: Record any on-site modifications to the documented reinforcement, including position, splice location, spacing or cover, to accommodate concrete placement or the requirements of AS 3600.

Dowels

Fixing: If a dowel has an unpainted half, embed that half in the concrete placed first.

Tolerances:

- Alignment: 1:100.
- Location: \pm half the diameter of the dowel.

Grade: 250N.

Cover

Concrete cover generally: To AS 3600 (2018) clause 4.10.

Concrete cover for structures retaining liquids: To AS 3735 (2001) clause 4.4.

Supports

Concrete, metal or plastic supports: Provide as follows:

- Able to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal, located within the concrete cover zone, or are used with galvanized or zinc-coated reinforcement.

Spacing:

- Bars: \leq 60 bar diameters.
- Mesh: \leq 600 mm.

Supports over underlay: Prevent damage to polymeric film underlays. If appropriate, place a metal or plastic plate under each support.

Projecting reinforcement

Protection: If starter or other bars extend beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is cast into later work.

Tying

Requirement: Secure the reinforcement against displacement at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of formwork or unformed faces to prevent the ties projecting into the concrete cover.

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

Bundled bars: If required, tie bundled bars in closest possible contact. Provide tie wire at least 2.5 mm diameter and spaced not more than 24 times the diameter of the smallest bar in the bundle.

Columns: Secure longitudinal column reinforcement to all fitments (or helical reinforcement) at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Welding

General: If welding of reinforcement is proposed, conform to AS/NZS 1554.3.

Bending

Restriction: Use only bars with bends as documented. If required to bend or straighten bars do not use heat and use only methods that will not damage the steel and its structural properties, to AS 3600 (2018) clause 17.2.3.2.

Splicing

Lapped splices: Provide laps in reinforcing bars as documented and securely tie together in a minimum of two places.

Lapping of reinforcing mesh: Overlap each sheet of reinforcing mesh a minimum length of the spacing of the wires running perpendicular to the edge of the sheet, plus 25 mm.

Staggering: Stagger splices as documented.

Galvanizing repair

Damaged galvanizing: If galvanizing is damaged, propose repairs to AS/NZS 4680 (2006) Section 8.

Fibre-reinforced concrete

Steel fibres: To AS 3600 (2018) Section 16.

Synthetic fibres: To EN 14889-2 (2006).

3.4 CORES, FIXINGS AND EMBEDDED ITEMS**General**

Requirement: Install fasteners to manufacturers' recommendations and the assumptions in AS 5216 (2021) Appendix G.

Location

Requirement: Produce shop drawings showing the proposed locations, clearances and cover of any cores, fixings or embedded items, indicating any proposed repositioning or displacement of reinforcement.

Coring

Requirement: If cutting or coring of hardened concrete is proposed, prepare details to Austroads ATS 5317 (2023).

Adjoining elements

Fixings: Provide fixings for adjoining elements. If required, provide for temporary support to the adjoining elements during concreting, to prevent movement.

Protection

General: Protect embedded and projecting items against damage.

Compatibility: Provide inserts, fixings and embedded items that are compatible with each other, with the reinforcement and with the documented concrete mix and the documented surface finish.

Corrosion protection: In external or exposed locations, galvanize anchor bolts and embedded fixings.

Grease: Grease threads that will project from the concrete.

Structural integrity

Position: Fix cores and embedded items to prevent movement during concrete placement. In locating cores, fixings and embedded items, displace but do not cut reinforcement, and maintain documented cover to reinforcement.

Isolation: Isolate embedded items to prevent water tracking to concrete providing minimum cover to reinforcement.

Tolerances

Requirement: Maximum deviation from correct positions:

- Anchor bolt groups for structural steel: To AS/NZS 5131 (2016) Appendix F.
- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

3.5 PRE-MIXED CONCRETE SUPPLY**General**

Addition of water: To AS 1379 (2007) clause 4.2.3.

Transport and production equipment: Use equipment which:

- Prevents segregation or loss of materials.
- Supplies a homogenous product suitable for placing and compaction.

Delivery information: For each batch, obtain a delivery docket and keep a record of the information required by AS 1379 (2007), and the following:

- Special class performance concrete: Documented performance and type of cement binder.
- Special class prescription concrete: Details of mix, additives, and type of cement binder.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.
- Project assessment carried out each day.
- The concrete element or part of the works for which the concrete was ordered, and where it was placed.
- The total amount of water added at the plant and the maximum amount permitted to be added at the site.

Pre-mixed concrete subcontractors

Requirement: Compile a list of names and contact details of proposed pre-mixed concrete suppliers, and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.

Elapsed delivery time

General: Make sure that the e-lapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the **Elapsed delivery time table**. Do not discharge at ambient temperature below 10°C or above 30°C unless approved heating or cooling measures are taken to deliver concrete within the range 5°C to 35°C.

Elapsed delivery time table

Concrete temperature at time of discharge (°C)	Maximum elapsed time (minutes)
5 – 24	120
24 – 27	90
27 – 30	60
30 – 35	45

3.6 ON-SITE MIXING

Machine mixing

Requirement: Mix all materials by machine, conforming to the following:

- Mixer requirements: Use a mixer which will uniformly distribute the materials throughout the batch.
- Mixer capacity: Use a mixer with capacity for one or more whole bags of cement to be used per batch of concrete. Do not exceed the manufacturer's rated capacity of the mixer with the volume of the mixed material.
- Mixing time: Allow a mixing time for each batch of not less than 1.5 minutes after all ingredients are assembled in the mixer, and before any portion of the batch is removed.
- Total mix discharge: Discharge the entire contents of a batch from the mixer before placing any new materials in the mixer for the next batch.

Emergency hand mixing

Restrictions: Hand mixing is only permitted if there is a breakdown of mechanical mixing equipment. Provide notice if hand mixing is required and conform to the following:

- Hand mix in small quantities no greater than 0.25 m³ per batch, to complete a section of the work or reach a suitable construction joint. Do not start a new section of work.
- Hand mix on a water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. Use an amount of cement 10% more than required for machine mixed concrete.

Procedure: Conform to the following:

- First mix the fine aggregate and cement until a uniform colour is obtained, and then spread on the mixing platform in a thin layer.
- Spread the coarse aggregate, previously drenched with water, over the fine aggregate and cement in a uniform layer, and turn the whole mass over as further water is added with a rose sprinkler.

- After the water is added, turn the mass at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance.

Measurement of materials

General: Measure all materials by weight, except if necessary:

- Water: Measure by volume with an approved adjustable water-measuring and discharging device.
- Cement: Measure by bags as packed by the manufacturer. Proportion batches on the basis of one or more unbroken bags of cement, assumed to weigh 20 kg per bag.

Bulk cement: Weigh in an individual hopper and keep separate from the aggregates until the components of the batch are discharged from the batching hopper.

Measurement by volume for minor works: Not permitted, without approval.

Measuring by volume: Minor concrete works only

Mixing by volume on site: If measurement by volume is approved, proportion the materials to produce a mix free of voids and having the documented strength at 28 days.

Volume batching: Use the nominal proportions documented in the **Volume batching table**.

Volume batch table

Approximate Concrete Compressive Strength MPa	Parts by volume: Cement	Parts by volume: Fine aggregate	Parts by volume: Coarse aggregate
20	1	2	3

Maximum water to cement ratio: 0.75 (by weight).

Fine aggregate bulking: If the fine aggregate contains sufficient moisture to produce 'bulking' in excess of 10%, increase the volume of fine aggregate by a corresponding amount.

Mix workability: Do not use water to improve mix workability if the addition of water will exceed the maximum water to cement ratio.

Batch measurement: Measure the volumes of fine and coarse aggregates for each batch in boxes or bins, as follows:

- Measure the aggregates loose (i.e. without compaction) in the boxes and strike off level.
- Do not undertake measurements by shovels or like methods.
- Arrange batch proportions for each batch to contain 1 bag of cement. Assume one 20 kg bag of cement to have a volume of 13.9 litres.

3.7 PLACING AND COMPACTION

Preparation

Cleaning: Before placing concrete, remove free water, dust, debris and stains from the area, the forms and the formed space.

Water: Moisten the area before placing concrete: Remove any ponding water.

Placing

Horizontal transport:

- Use suitable conveyors, clean chutes, troughs, hoppers or pipes.
- Minimise jolting and vibration of concrete whilst transporting around site.

Discharge vertically in a controlled manner into forms or further distribution equipment.

Method: Avoid segregation and loss of concrete, and minimise plastic settlement. Maintain a nominally vertical and plastic concrete edge during placement.

Horizontal elements: Place concrete in layers not more than 300 mm thick. Compact the following layer into previous layer before previous layer has taken initial set.

Vertical elements: Limit the free fall of concrete to a maximum of 2 m.

Fibre-reinforced concrete: For pumped concrete use a screen (100-150 mm mesh) on the pump hopper to catch fibre balls.

Placement of special class concrete: Austroads ATS 5320 (2023).

Compaction

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate to remove entrapped air and to fully compact the mix.

Vibrators: Do not allow vibrators to contact set concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the formwork. Avoid causing segregation by over-vibration.

Placing records

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

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

Rain

Protection: During placement and before setting, protect the surface from damage.

Time between adjacent placements

General: As documented in the **Minimum time delay schedule**.

Placing in cold weather

Cement: Do not use high alumina cement.

Temperature limits: Maintain the following temperature limits:

- Freshly mixed concrete: $\geq 5^{\circ}\text{C}$.
- Formwork and reinforcement before and during placing: $\geq 5^{\circ}\text{C}$.
- Water: Maximum 60°C when placed in the mixer.

High early strength cement: If deteriorating weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary so that the temperature of the placed concrete is $\geq 5^{\circ}\text{C}$.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any formwork, materials, and equipment coming in contact with the concrete.

Freezing: Prevent concrete from freezing.

Placing in hot weather

Requirement: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses.

Evaporation rate limit: $\leq 0.50 \text{ kg/m}^2/\text{h}$.

Evaporation control barriers: Erect barriers to protect freshly placed concrete from drying winds.

Temperature control: Select one or more of the following methods to make sure the temperature of the concrete mix does not exceed 35°C :

- Cool the concrete using liquid nitrogen injection before placing.
- Cover horizontal transport containers.
- Forms and reinforcement before and during placing: $\leq 35^{\circ}\text{C}$.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water or ice.

Placing under water

General: Do not place under water unless conditions prevent dewatering.

Method: Prepare a detailed method statement if proposing to place concrete under water.

Extruded concrete

Surface slurry: Where the extrusion machine is equipped with a slurry receptacle place small quantities of cement-sand slurry, comprising two parts plasterer's sand and one part cement (by

volume), together with sufficient water to bring it to a semi-fluid condition, and feed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

3.8 CURING

General

Requirements: Taking into account the average ambient temperature at site over the relevant period affecting the curing, adopt procedures to make sure of the following:

- Curing: Cure continuously from completion of finishing when the concrete has set sufficiently not to be damaged by the curing process, until the total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10°C, conforms to AS 3600 (2018) clause 17.1.5 and the following, unless accelerated curing is adopted:
 - . High early strength concrete: 3 days.
 - . Other concrete: 7 days.
- End of curing period: Prevent rapid drying out at the end of the curing period.
- Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

Curing method:

Curing compounds

Liquid membrane-forming compounds: Provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken at least for the required curing period after application.

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

Self-levelling toppings: If used also as curing compounds, conform to AS 3799 (1998).

Visually important surfaces: Apply curing compounds to produce uniform colour on adjacent surfaces.

Water curing

Method: Select a method of ponding or continuously sprinkling to prevent damage to the concrete surface during the required curing period.

Wet hessian curing

Method: Place wet hessian sheets/bags over concrete surface. Keep hessian wet during the required curing period by regularly sprinkling with water. Protect from wind and traffic.

Impermeable sheet curing

Method: Place impermeable sheets, to ASTM C171 (2020), over concrete surface. Anchor down and tape joints in material to retain concrete moisture. Keep the concrete surface covered for the required curing period.

Cold weather curing

Temperature: Maintain concrete surface temperatures above 5°C for the duration of the curing period.

Hot weather curing

Requirement: If the concrete temperature exceeds 25°C, or the ambient shade temperature exceeds 30°C, protect from drying winds and sun by using an evaporative retarder until curing is commenced.

3.9 JOINTS

Construction joints

Location: Do not relocate or eliminate construction joints, or form undocumented construction joints. If emergency construction joints are made necessary by unforeseen interruptions to the concrete pour, provide details of the action taken.

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

Joint preparation: Scabble hardened concrete joint surface to a minimum 3 mm amplitude. Remove loose or soft material, foreign matter and laitance. Dampen the surface just before placing the fresh concrete and coat with a neat cement slurry.

Expansion and isolation joints

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

Expansion joint dowels: Install dowels along the joint, as documented.

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

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

Jointing materials: Provide jointing materials compatible with each other, and non-staining to concrete in visible locations.

Bond breaking: Provide back-up materials for sealants, including backing rods, which do not adhere to the sealant.

Foamed materials (in compressible fillers): Closed-cell or impregnated, not water absorbing.

Slab-on-grade control joints

General: Provide control joints, as documented.

Tooled and sawn joints: Form joints within the concrete surface with either a grooving tool or a mechanical circular saw.

Timing: Form joints as early as possible after placement of concrete. Make sure the concrete has hardened sufficiently to prevent dislodging aggregate.

Joint width: 3 to 5 mm wide.

Joint depth: A minimum of $(0.25 - 0.33) \times$ depth of the concrete.

3.10 FORMED SURFACES

General

Surface finish: To AS 3610.1 (2018) Table 3.3.3.1 and as documented in the **Formed surface finishes schedule**.

Removable bolts: Remove tie bolts without damaging the concrete.

Bolt hole filling: Provide material with durability and colour matching the concrete.

Recessed filling: Fill or plug the hole to 6 mm below the finished surface.

Finishing methods

Requirement: If horizontal concrete elements or faces of vertical concrete elements are to have a finish other than an off-form finish, provide finishes as documented.

~~Types of finishing methods:~~

Curing

Requirement: If formwork is stripped before the minimum curing period continue curing the exposed faces until the curing period elapses.

Repair of defects

Physical quality evaluation: To AS 3610.1 (2018) clause 3.3.

Repair method: If defect repair is required, obtain approval of the proposed method before commencing repairs.

3.11 UNFORMED SURFACES

General

Requirement: As documented in the **Unformed surface finishes schedule**.

Surface finish: To be compatible with any documented applied finish.

Finished levels: Strike off, screed and level slab surfaces to the documented finished levels and tolerances.

Finishing methods – surfaces other than wearing surfaces

General: Compact and tamp, screed off and finally dress with a wooden float to an even surface, also:

- Use a vibrating screed if the distance between forms perpendicular to the direction of screed is greater than 2 m.
- Drain or otherwise promptly remove any water which comes to the surface.
- After initial screeding use a bullfloat to compact and level the surface and to close minor cracks.
- Roughen all future contact surfaces, so that the coarse aggregate at the surface is firmly embedded but not forced below the surface.

Finishing methods – wearing surfaces

General: Compact then screed off the surface with a vibrating screed, or hand screed if the distance between forms perpendicular to the direction of screed is no greater than 2 m.

Correction: Immediately following compaction and screeding test and correct for high or low spots.

Bullfloat: After initial screeding use a bullfloat to compact and level the surface and to close minor cracks.

Final finish: Finish the surface true and uniform and free of any glazed or trowelling finish and finally dress with a wooden template or float.

Surface to receive asphalt: After compacting, screeding and correcting, dress with a wooden float and finally broom to produce a rough surface.

Broom finish: Use a broom or hessian belt drawn across the surface to produce a coarse even-textured transverse-scored surface.

Textured patterned surface: Finish coloured, textured or patterned surfaces, as documented.

Edging: Finish all edges with an edging tool and such a bullnose edger.

Grooving: Install tooled joints as documented.

Sawn joints: Install sawcut joints as documented

Tolerances

Finished surface: Conform to the following maximum deviations from documented values:

- Concrete structures not adjacent to road pavements:
 - . Absolute level: ± 25 mm.
 - . Alignment: 25 mm.
- Concrete structures adjacent to road pavements (e.g. drainage pits):
 - . Absolute level: ± 10 mm.
 - . Alignment: 10 mm.
- Longitudinal surfaces greater than 10 m in length: 5 mm from a 3 m straightedge, subject to any necessary allowances for vertical and horizontal curves.

Surface repairs

Method: If surface repairs are required, obtain approval of the proposed method before commencing repairs.

3.12 PRECAST UNITS

Lifting and handling

General: Conform to the handling and installation requirements of AS 3850.2 (2015) and AS 3850.3 (2021).

Requirement: Lift and support units only at designated points. Use handling methods which do not overstress, warp or damage the units.

Site conditions: Only lift units when the wind and temperature conditions allow handling and fixing consistent with the structural capability and geometry of the unit.

Cranes: To AS 2550.1 (2011).

Temporary bracing and propping: To AS 3850.2 (2015) Section 5 for building construction and AS 3850.3 (2021) Section 5 for civil construction.

Attachments

Requirement: Remove temporary attachments after erection. Seal and rectify residual recesses.

Installation

Fixing: Fix the units securely and accurately in their final positions to AS 3850.2 (2015) Section 6.

Ancillaries: Provide components and materials, including fasteners, braces, shims, jointing strips, sealant, flashings, grout and mortar, necessary for the installation of the units as documented by the unit manufacturer.

Storage

Support points: When storing elements support units only at designated support points.

Protection: Adequately store and protect units to prevent warping, twisting, crushing, cracking, discolouration, staining and any other damage, until they are installed in their final location. Refer to manufacturers recommendations.

3.13 SPRAYED CONCRETE

Detail

Minimum thickness: 75 mm.

Colour: Spray coloured concrete lining in open drains to match the adjoining rock colour.

Strength

Minimum cement content: 380 kg/m³ as discharged from the nozzle.

Minimum compressive strength: 25 MPa at 28 days when tested by means of 75 mm diameter cores taken from in-place sprayed concrete.

Method statement

Requirement: Prepare **and submit** a method statement for all sprayed concrete works to include details of the proposed procedure, plant, materials and mix proportions. **This is a WITNESS POINT.**

Sprayed concrete sample panels

Requirement: Prepare sample sprayed concrete test panels on 750 mm square hardboard panels as follows:

- Quantity: 3 panels for each mix proposed.
- Thickness: 75 mm.
- Conditions: Similar to those where works will take place.
- Method: Apply concrete in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the works.

Sample test cores

Securing, accepting and preparing test specimens: To AS 1012.9 (2014).

Testing: To AS 1012.14 (2018).

Cores: Cut four 75 mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed and test as follows:

- As for cores from in situ sprayed concrete. One core compression test at 3 days, one core at 7 days and the remaining two cores at 28 days.

Defective core: If any of the cores reveals defects such as lack of compaction, dry patches, voids or sand pockets or exhibits an unacceptable surface finish, modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Surface preparation

Earth: Grade, trim, compact and dampen earth surfaces before applying the sprayed concrete. Take any necessary precautions to prevent erosion when the sprayed concrete is applied.

Rock: Clean off loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. Dampen the rock surfaces before applying the sprayed concrete.

Corrugated steel pipes: **Not used in Cessnock LGA.** ~~Clean off loose material, mud and any other foreign matter that might prevent bonding of the sprayed concrete to the steel.~~

Water flow: Remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

Application for sprayed concrete

Equipment: Use clean delivery hoses and provide back-up equipment to allow continuous application of sprayed concrete to all surfaces in the event of equipment breakdown.

Procedure: Begin application at the bottom of the area being sprayed and build up making several passes of the nozzle over the working area.

Technique: Hold the nozzle so that the stream of material is as near as possible to perpendicular to the surface being coated.

Spraying around reinforcement: If spraying around reinforcement, spray concrete behind the reinforcement before concrete can accumulate on the face of the reinforcement.

Protection of adjoining surfaces: Protect adjoining surfaces not requiring sprayed concrete from splash and spray rebound.

Regulation: Regulate the velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix so as to produce a dense coating with minimum rebound of the material and no sagging.

Rebound: After the initial set, as work proceeds, remove and dispose of splash and rebound material from the surface by air-water jet or other suitable means.

Wind problems: If wind causes separation of the nozzle stream, discontinue spraying.

Air temperature: If air temperature is less than 5°C, do not spray.

Construction joints

General: Keep construction joints to a minimum.

Requirement: Provide construction or control joints as required, or as documented, to the details shown in CIA Z5 (2020) clause 12.5.4.

Forming: Form joint by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface.

Preparation: Clean and wet by air-water jet the joint edge before recommencing concrete spraying.

Finishing

Surface finish: As documented in the **Unformed sprayed concrete surface finishes schedule**.

Finished surface: Unless an off-nozzle finish has been documented, strike off, screed and level surfaces to the documented position or level and the flatness tolerance class documented.

Finishing methods:

- Off-nozzle finish: No additional finishing required to the natural textured surface left by spraying.
- Screed finish: Trim, slice or screed surface to a true line and grade to produce a surface which may exhibit defects such as drag marks from aggregate.
- Steel trowel finish: After screeding finish, as follows:
 - . Use power or hand steel trowels to produce a smooth surface relatively free from defects.
 - . When the surface has hardened sufficiently, re-trowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.
- Wood float finish: After screeding, use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.
- Broom finish: After screeding and steel trowelling use a broom or hessian belt drawn across the surface to produce a coarse even-textured transverse-scored surface.
- Scored or scratch finish: After screeding, use a stiff brush or rake drawn across the surface before final set, to produce a coarse scored texture.
- Sponge finish: After screeding and steel trowelling, use a damp sponge to wipe the surface to produce an even textured sand finish.

Curing

General: Refer to EXECUTION, **CURING** for relevant curing requirements which also apply to sprayed concrete.

Commencement: Commence curing within one hour of the application of sprayed concrete with water or colourless wax emulsion curing compound conforming to AS 3799 (1998) and applied to conform to manufacturer's specifications.

Water curing: If water curing, keep the surface of the sprayed concrete continuously wet for at least seven days.

3.14 TESTING

General

Test authority: Concrete supplier or an Accredited Testing Laboratory.

Reports and records of test results: To the relevant parts of the AS 1012 series. Keep results on site.

Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Assessment process of test results

Standard: To AS 1379 (2007).

Method of assessment: Project assessment.

Sampling

Method of sampling: To AS 1012.1 (2014).

Sampling locations: To AS 1012.1 (2014) and the following:

- Slump and spread tests: On site, at the point of discharge from the agitator.
- Compressive strength tests: Spread the site sampling evenly throughout the pour.

Frequency of sampling: To AS 1379 (2007) Sections 5 and 6 and the following:

- Slump and spread tests: Take at least one sample from each batch.
- Compressive strength tests: To the **Project assessment strength grade sampling table**.

Project assessment strength grade sampling table

Number of batches for each type and grade of concrete per day	Minimum number of samples per batch: Columns and load bearing wall elements	Minimum number of samples per day: Other elements
1	1	1
2-5	1	2
6-10	1	3
11-20	1	4
each additional 10	1	1 additional

Making and curing of specimens

General: To AS 1012.8.1 (2014) and AS 1012.8.2 (2014).

Specimens for compressive strength tests: Make and cure at least two specimens from the sample of each grade.

Specimen size:

- Aggregate size \leq 20 mm: Nominally 200 x 100 mm diameter.
- Aggregate size $>$ 20 mm: Nominally 300 x 150 mm diameter.

Test methods

General: To the relevant parts of the AS 1012 series.

Acceptance criteria: As documented in the **Normal-class concrete properties schedule – performance** and **Special-class concrete properties schedule**.

Drying shrinkage at 56 days: To AS 1012.8.4 (2015) and AS 1012.13 (2015).

Cores and test acceptance

General: If test specimens fail to achieve the documented 28 day strength, arrange for cores to be taken from the corresponding concrete to AS 3600 (2018) clause B6 and nominate proposed core locations.

Acceptance: For acceptance, demonstrate conformance of the average strength of cores with the documented 28 day strength requirements to AS 3600 (2018) clause B6.

Failure of cores

Deduction: If cores taken fail to satisfy the strength requirements, apply the deduction provisions in **ANNEXURE – DEDUCTIONS**.

Completion tests

Liquid retaining structures: Liquid tightness to AS 3735 (2001).

3.15 COMPLETION

Early loading

Prohibition: Submit proposals for the application of any superimposed load (including backfilling), to any part of what will become a load bearing structure, within 21 days of placing concrete. Do not apply superimposed loads unless it can be demonstrated that 95% of the design strength of the concrete has been achieved.

Formwork removal

Extent: Remove all formwork, including formwork in concealed locations, but excepting lost formwork.

Timing: Do not strip formwork prematurely if damage to the concrete may be caused. Do not disturb forms until concrete is hardened enough to withstand formwork movements and removal without damage. It is recommended to maintain all formwork in place, after placement of concrete, for the following minimum periods, provided that the ambient air temperature does not drop below 10°C during that period:

- Mass concrete retaining walls, headwalls, wingwalls, gully pits, sumps and similar drainage structures: 2 days.
- Reinforced concrete walls when height of pour each day is:
 - . Under 0.6 m: 1 day.
 - . 0.6 m to 3 m: 2 days.
 - . 3 m to 6 m: 3 days.
 - . 6 m to 9 m: 5 days.
- Supporting forms under deck slabs of culverts: 10 days.

Concrete containing special additives: In case of concrete containing special additives, confirm that the recommended stripping times are still appropriate.

Protection of concrete during form removal: Remove forms so that the concrete will not be cracked, chipped or otherwise damaged. Do not use crowbars or other levering devices for exerting pressure on the fresh concrete to loosen the forms.

Removal of hole formers: Remove hole formers such as pipes and bars as soon as the concrete has hardened sufficiently to prevent damage to the concrete.

Precast units

Erected precast units: Submit certification that the erected precast units conform to the documented project requirements and manufacturer recommendations.

Rejection: Reject any precast elements not conforming to the documented tolerances.

Protection

Protection: Protect the concrete from damage due to construction load overstresses, physical and thermal shocks, and excessive vibrations, particularly during the curing period.

Surface protection: Protect finished concrete surfaces and applied finishes from damage.

4 ANNEXURE A

4.1 ANNEXURE - SELECTIONS

Formwork dimensional deviation schedule

Dimension or measurement	Location or element	Deviation (mm)

Steel reinforcement properties schedule

	A	B	C
Shape			
Ductility class			
Strength grade			

Notes to schedule:

A, B, C: These designate each instance or type or location of the item scheduled. Edit to align with the project's codes or tags.

Coordinate codes in the Schedule with those that appear on drawings.

Shape: R (round), D (deformed ribbed), I (deformed indented) or welded wire mesh. Ductility class: To AS/NZS 4671 clause 5.2(c): L (low), N (normal) or E (seismic).

Strength grade: AS/NZS 4671 considers only 3 strength grades 250 MPa, 300 MPa and 500 MPa. See AS 3600 clause 17.2 for materials and construction requirements.

Steel fibre reinforcement properties schedule

	A	B	C
Shape			

	A	B	C
Tensile Strength			
Type/Group			
Diameter (mm)			
Length (mm)			
Aspect ratio			
Coating			
Dosage (kg/m ³)			

Normal-class concrete properties schedule

	Foundations, mass concrete retaining walls	Drainage structures, mass concrete footings, pitching, linings, miscellaneous minor concrete work	Reinforced culverts, headwalls, base slabs, large sign structure footings, reinforced retaining walls	Safety barriers	Extruded concrete
Strength grade/characteristic compressive strength f'_c (MPa)	20	20	32	40	20
Maximum aggregate size (mm)	40	20	20	20	14
Slump (mm)					
Air entrainment - air volume (%)					
Assessment process					

Notes to schedule:

Slump: Nominate a value for slump at the point of acceptance, suitable to the proposed method of placement. For safety barriers refer to the 1195 Rigid concrete safety barrier systems worksection.

Air entrainment: If required, nominate a value up to a maximum of 5.0%. Delete if not required.

Assessment process: Nominate if production assessment or project assessment is required.

If high durability is of significant importance, consider also specifying the minimum cement content in kg/m³.

Special-class concrete properties schedule

	A	B	C
Strength grade/characteristic compressive strength f'_c (MPa)			
Maximum aggregate size (mm)			
Slump (mm)			

	A	B	C
Air entrainment - air volume (%)			
Assessment process			
Drying shrinkage			
Bleeding (mL/mm ²)			
Cement type			
Spread (mm)			
Density of hardened concrete (kg/m ³)			
Density of plastic concrete (kg/m ³)			
Duration of air drying			
Early age strength (MPa)			
Flexural strength (MPa)			
Indirect tensile strength (MPa)			
Mineral oxide content			
Mix type			
Water:cement ratio maximum			

Notes to schedule:

A, B, C: These designate each instance or type or location of the item scheduled. Edit to align with the project's codes or tags.

Coordinate codes in the Schedule with those that appear on drawings.

Drying shrinkage: Generally between 500 to 800 $\mu\epsilon$ and not more than 1000 $\mu\epsilon$. For example, drying shrinkage at 56 days for the following are:

- A water tight structure is normally between 500 to 550 $\mu\epsilon$.
- Concrete up to and including strength grade 32 is 650 $\mu\epsilon$ and for higher strength grades is 700 $\mu\epsilon$.

Specifying unrealistically low drying shrinkage could potentially be difficult to achieve with locally available aggregates and can adversely affect the workability of the concrete, both factors could increase costs.

See CCAA Fact Sheet - Specifying low drying shrinkage \neq crack control.

If the concrete is special class only because of the specification of a drying shrinkage less than 1000 $\mu\epsilon$, only complete the first 6 items (rows) of the above schedule.

Duration of air drying: Standard drying period is 56 days.

Concrete properties schedule – prescription

	A	B	C
Aggregate water absorption, maximum (%)			
Admixtures: Proportions			
Admixtures: Types			
Coarse aggregate: Proportions			

	A	B	C
Coarse aggregate: Size (mm)			
Coarse aggregate: Types			
Coarse aggregate: Colour			
Fine aggregate: Proportions			
Fine aggregate: Types			
Minimum cement content (kg/m ³)			
Mix type			
Water:cement ratio, maximum			

Minimum time delay schedule

Between (pour locations)	Minimum period between adjacent pours (days)
Adjacent pours abutting horizontal construction joints in walls	
Adjacent pours abutting vertical construction joints in walls	
Floor slab construction joints	
Pour strips and adjacent concrete	
Retaining wall construction joints	

Formed surface finishes schedule

	A	B	C
Location			
Surface finish class to AS 3610.1 (2018)			
Form lining type			
Colour control			
Bolt hole filling			
Surface finish type			

Notes to schedule:

A, B, C: These designate each instance or type or location of the item scheduled. Edit to align with the project's codes or tags.

Coordinate codes in the Schedule with those that appear on drawings.

Formed concrete surfaces shall have finishes conforming to the classes of surface finish in AS 3610.1 as follows:

- Non-visible surfaces: Class 4.
- Visible surfaces: Class 2.

Unformed surface finishes schedule

	A	B	C
Location			

	A	B	C
Flatness tolerance class			
Primary finish			
Slip resistance treatment			
Surface modifier			

Unformed sprayed concrete surface finishes schedule

	A	B	C
Location			
Flatness tolerance class			
Finish			

4.2 ANNEXURE - SUMMARY OF HOLD AND WITNESS POINTS

For private developments, certain Hold and Witness Points where specifically noted below require representatives of both the Superintendent and the Principal Certifier (e.g. Council) to authorise release.

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
SUBMISSIONS, Certification Design	H	Certification of formwork design conformance	3 days before erecting formwork	Erection of formwork
SUBMISSIONS, Certification Completed formwork	H	Certification of completed formwork conformance	1 day before placing concrete	Placement of concrete
SUBMISSIONS, Certification Precast units	H	Provide independent certification by a professional engineer of conformance of the design to project criteria.	7 days before installing units	Installation of units
SUBMISSIONS, Execution details Reshoring	H	Details of any proposed reshoring for excavations	7 days before excavation works	Excavation
SUBMISSIONS, Execution details Reinforcement	H	Details of any proposed changes to documented reinforcement.	7 days before on-site placement	Installation of reinforcement
SUBMISSIONS, Execution details Welding Reinforcement	H	Details of any proposed welding of reinforcement to AS/NZS 1554.3 (2014)	7 days before on-site welding	Welding of reinforcement
SUBMISSIONS, Execution details	H	Details of any proposed changes to the concrete mix	7 days before ordering concrete	Placement of concrete

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
Concrete mix		design including additions of any special cement types and admixtures		
SUBMISSIONS, Execution details Sequence and times for concrete placement	H	Details of any proposed changes to the proposed sequential placement of slab segments	7 days before ordering concrete	Placement of concrete
SUBMISSIONS, Execution details Coring	H	Details of any proposed cutting or coring required in hardened concrete	3 days before coring concrete	Concrete coring
SUBMISSIONS, Execution details Measurement of materials	H	Proposal to measure materials by volume for on-site mixing for minor concrete works	7 days before on-site concrete mixing	On-site concrete mixing
SUBMISSIONS, Execution details Repair of defects	H - Superintendent and Principal Certifier	Details of the proposed method of defect repair	3 days before repairing defect	Repair of defect
SUBMISSIONS, Execution details Surface repairs	H	Details of the proposed method of surface repair	3 days before repairing surface	Repair of surface
SUBMISSIONS, Execution details Method statement	H	Detailed method statement for sprayed concrete works	14 days before spraying concrete	Sprayed concrete works
SUBMISSIONS, Execution details Precast units	H	Submit name, contact details and credentials of proposed manufacturer of precast elements.	Before engaging precast manufacturer	Installation of precast units.
SUBMISSIONS, Execution details Precast units	H	Prepare a safe work method statement specific to the project for the precast erection and submit on request.	14 days before installation on site	Installation of precast units.
SUBMISSIONS, Execution details Precast units	H	Submit details and specification of proposed equipment along with qualifications and training of the operating personnel in the form of a qualification register.	14 days before installation on site	Installation of precast units.

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
SUBMISSIONS, Products and materials Reinforcement strength and ductility	H	Submit type-test reports as evidence of conformity to AS 3600 (2018) Table 3.2.1 for each reinforcement type	7 days before placing reinforcement	Placing steel reinforcement
SUBMISSIONS, Products and materials Curing compounds	H	Evidence of compatibility with concrete and with applied finishes	7 days before placing curing compound	Curing of concrete
SUBMISSIONS, Products and materials Machine mixing	H	Details of proposed concrete mix for on-site machine mixing of concrete	7 days before on-site concrete mixing	On-site concrete mixing
SUBMISSIONS, Products and materials Precast units	H	Submit proposals for protective coatings to exposed metallic components to AS 2312.1 (2014) or AS/NZS 2312.2 (2014) with regard to site-specific corrosivity zoning.	14 days before applying protective coatings	Application of protective coating
SUBMISSIONS, Products and materials Precast units	H	Submit proprietary documentation for any lifting, bracing or fixing inserts. Include make, type and working load limit.	14 days before lifting precast units.	Lifting of units
SUBMISSIONS, Products and materials Precast units	H	Submit certificate from a professional engineer certifying the working load limit.	14 days before lifting precast units.	Lifting of units
SUBMISSIONS, Samples Sprayed concrete	H	3 sample panels for each proposed mix	10 days before spraying concrete for works	Sprayed concrete works
SUBMISSIONS, Shop drawings Cast-in locations	H	Submit location of any cores, anchors, fixings or embedded items	7 days before pouring concrete	Placement of concrete
SUBMISSIONS, Shop drawings Precast units	H	Submit shop drawings of structural precast concrete elements showing the proposed details for their design, manufacture,	28 days before manufacture	Manufacture of precast units

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
		assembly, transport and installation		
SUBMISSIONS, Tests Loading	H	Results to show that concrete has achieved 95% of its design strength	1 2 day before applying superimposed load	Application of super-imposed load
COMPLETION Certificate Precast units	H	Submit certification that the erected precast units conform to the documented project requirements and manufacturer recommendations.	Before project practical completion	Project completion
INSPECTIONS, Notice Base preparation	W - Superintendent and Principal Certifier	Completed and prepared base	1 day before laying underlay or placing concrete	-
INSPECTIONS, Notice Completed formwork	W	Completed formwork	1 day before placing concrete	-
INSPECTIONS, Notice Steel reinforcement placement	W – Superintendent and Principal Certifier	Completed installed steel reinforcement, including cores fixings and embedded items fixed in place	1 day before placing concrete	-
INSPECTIONS, Notice Galvanizing repair	W	Repairs to damaged galvanizing of steel reinforcement	1 day before placing concrete	-
INSPECTIONS, Notice Emergency hand mixing	W	Emergency hand mixing of concrete due to mechanical failure	Immediately after mechanical failure	-
INSPECTIONS, Notice Off-form finish	W	Evaluation of the off-form finish	After stripping of all formwork	-
INSPECTIONS, Notice Surface finish	W	Evaluation of the surface finish	After the concrete curing period	-

Clause and description	Type	Submission/Inspection details	Submission/Notice times	Process held
INSPECTIONS, Notice Sprayed concrete sample panels	W	Concrete spraying of sample panels	3 days before spraying sample panels	-
Note: H = Hold Point, W = Witness Point				

4.3 ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method	
Concrete constituent materials	Material quality – Supplier's documentary evidence and certification of:				
	Cement	1 mth's prod'n	1 per week	AS 3972 (2010)	
	Fly ash	1 mth's prod'n	1 per month	AS/NZS 3582.1 (2016)	
	Water	1 contract	1 per contract	AS 3583.13 (1991), AS 1289.4.2.1 (2020)	
	Admixtures	1 mth's prod'n	1 per month	AS 1478.1 (2000)	
	Steel reinforcement	1 delivery	1 per production batch	AS/NZS 4671 (2019)	
	Fine aggregates				
	Grading	1 wk's prod'n	1 per 200 m ³ concrete ^a	AS 1141.11.1 (2020)	
	Moisture content	N/A	1 per day		
	Sulfate soundness	1 contract	1 per contract	AS 1141.24 (2018)	
	Bulk density	1 contract	1 per contract	AS 2758.1 (2014)	
	Unit mass (Particle density)	1 contract	1 per contract	AS 2758.1 (2014)	
	Water absorption	1 contract	1 per contract	AS 2758.1 (2014)	
	Material finer 2 m	1 contract	1 per contract	AS 2758.1 (2014)	
	Deleterious material (impurities/reactive)	1 contract	1 per contract	AS 2758.1 (2014)	
	Coarse aggregates				
	Grading	1 wk's prod'n	1 per 200 m ³ concrete ^a	AS 1141.11.1 (2020)	
	Moisture content	N/A	1 per day		
	Wet strength	1 contract	1 per contract	AS 1141.22 (2019)	
	Wet/dry strength variation	1 contract	1 per contract	AS 1141.22 (2019)	
	Wear	1 contract	1 per contract	AS 1141.23 (2021)	
	Crushing value	1 contract	1 per contract	AS 1141.21 (1997)	

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	Sulfate soundness	1 contract	1 per contract	AS 1141.24 (2018)
	Particle shape	1 contract	1 per contract	AS 1141.14 (2007)
	Fractured faces	1 contract	1 per contract	AS 1141.18 (2022)
	Bulk density	1 contract	1 per contract	AS 2758.1 (2014)
	Unit mass (Particle density)	1 contract	1 per contract	AS 2758.1 (2014)
	Water absorption	1 contract	1 per contract	AS 2758.1 (2014)
	Material finer 75 m	1 contract	1 per contract	AS 2758.1 (2014)
	Weak particles	1 contract	1 per contract	AS 2758.1 (2014)
	Light particles	1 contract	1 per contract	AS 2758.1 (2014)
	Deleterious materials (impurities/reactive)	1 contract	1 per contract	AS 2758.1 (2014)
	Iron unsoundness	1 contract	1 per contract	AS 2758.1 (2014)
	Falling/dusting unsoundness	1 contract	1 per contract	AS 2758.1 (2014)
Mix design	Compressive strength	1 contract mix	1 per mix per contract	AS 1012.9 (2014)
	Aggregate moisture content	1 contract mix	1 per mix per contract	
	Consistency – slump	1 contract mix	1 per mix per contract	AS 1012.3.1 (2014)
	Air content	1 contract mix	1 per mix per contract	AS 1012.4.2 (2014) Method 2
	Shrinkage	1 contract mix	1 per mix per contract	AS 1012.8.4 (2015) AS 1012.13 (2015)
Concrete	Consistency – slump	15 m ³	1 per batch	AS 1012.3.1 (2014)
	Compressive strength (7 and 28 day)	15 m ³	As per the Project assessment strength grade sampling table	AS 1012.1 (2014) AS 1012.8.1 (2014) AS 1012.9 (2014)
Concrete placement	Finished levels	15 m ³	1 per element or 1 per 15 m length	Survey and 3 m straightedge
	Surface dimensions	Single fabrication	As required to confirm design dimensions	Measure
Sprayed concrete	Test panels and cores	1 contract	4 cores from 1 test panel of each mix design	AS 1012.9 (2014) AS 1012.14 (2018)
	Compressive strength cores	15 m ³	2 per 15 m ³	AS 1012.9 (2014) AS 1012.14 (2018)
a. or part thereof, per lot.				

4.4 ANNEXURE - PAY ITEMS

This schedule assumes the contract is tendered on a Schedule of Rates basis. For private development works use of this schedule is optional, at the Superintendent's discretion.

Pay items	Unit of measurement	Schedule rate scope
0319.1 25 MPa Concrete works	m ³ of concrete supplied and placed	Include all operations involved in ground preparation, formwork, concrete supply, placement, compaction, joints, finishing, curing and testing.
0319.2 32 MPa Concrete works	m ³ of concrete supplied and placed	Include all operations involved in ground preparation, formwork, concrete supply, placement, compaction, joints, finishing, curing and testing.
0319.3 40 MPa Concrete works	m ³ of concrete supplied and placed	Include all operations involved in ground preparation, formwork, concrete supply, placement, compaction, joints, finishing, curing and testing.
0319.4 Precast units	'Each' precast unit, as documented	All costs associated with the supply and installation of the precast unit.
0319.5 Sprayed concrete	m ² of sprayed concrete in place	Include all the operations involved in the surface preparation, spraying, jointing, removal of splash and rebound material, curing and testing.
0319.6 Steel Reinforcement	Tonnage of steel used	Include all steel reinforcement total tonnage used on the project for concrete works.

4.5 ANNEXURE - DEDUCTIONS

General

To be addressed in Concrete Supply Agreement.

Deductions: Conform to the following:

- Concrete payment rates: At the scheduled rates provided the concrete meets the documented strength requirements.
- Reduction in payment rates: Where any concrete does not reach the documented strength, at the scheduled rate of payment reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen fails to reach the documented strength, up to a maximum deficiency of 10%.
- Rejection: If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made for the work nor for any remedial work to rectify the deficiency.
- Reinforcement payment rates: Do the tender reinforcement rates compare with the actual tonnage used on-site.

4.6 ANNEXURE - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS 1012		Methods of testing concrete
AS 1012.1	2014	Sampling of concrete
AS 1012.3.1	2014	Determination of properties related to the consistency of concrete - Slump test
AS 1012.4.2	2014	Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1	2014	Method for making and curing concrete – Compression and indirect tensile test specimens
AS 1012.8.2	2014	Method for making and curing concrete - Flexure test specimens
AS 1012.8.4	2015	Method for making and curing concrete - Drying shrinkage specimens prepared in the field or in the laboratory
AS 1012.9	2014	Compressive strength tests - Concrete, mortar and grout specimens
AS 1012.13	2015	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory

AS 1012.14	2018	Method for securing and testing cores from hardened concrete for compressive strength and mass per unit volume
AS 1141		Methods for sampling and testing aggregates
AS 1141.11.1	2020	Particle size distribution - Sieving method
AS 1141.14	2007	Particle shape, by proportional caliper
AS 1141.18	2022	Crushed particles in coarse aggregate derived from gravel
AS 1141.21	1997	Aggregate crushing value
AS 1141.22	2019	Wet/dry strength variation
AS 1141.23	2021	Los Angeles value
AS 1141.24	2018	Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1289		Methods of testing soils for engineering purposes
AS 1289.4.2.1	2020	Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379	2007	Specification and supply of concrete
AS 1397	2021	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS 1478		Chemical admixtures for concrete, mortar and grout
AS 1478.1	2000	Admixtures for concrete
AS/NZS 1554		Structural steel welding
AS/NZS 1554.3	2014	Welding of reinforcing steel
AS/NZS 2312		Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2312.1	2014	Paint coatings
AS/NZS 2312.2	2014	Hot dip galvanizing
AS/NZS 2425	2015	Bar chairs in reinforced concrete - Product requirements and test methods
AS 2550		Cranes, hoists and winches - Safe use
AS 2550.1	2011	General requirements
AS 2758		Aggregates and rock for engineering purposes
AS 2758.1	2014	Concrete aggregates
AS 2870	2011	Residential slabs and footings
AS/NZS 3582		Supplementary cementitious materials
AS/NZS 3582.1	2016	Fly ash
AS 3582.2	2016	Slag - Ground granulated blast-furnace
AS/NZS 3582.3	2016	Amorphous silica
AS 3583		Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13	1991	Determination of chloride ion content
AS 3600	2018	Concrete structures
AS 3610		Formwork for concrete
AS 3610.1	2018	Specifications
AS 3735	2001	Concrete structures for retaining liquids
AS/NZS 3750		Paints for steel structures
AS/NZS 3750.14	1997	High-build epoxy (two-pack)
AS 3799	1998	Liquid membrane-forming curing compounds for concrete
AS 3850		Prefabricated concrete elements
AS 3850.1	2015	General requirements
AS 3850.2	2015	Building construction
AS 3850.3	2021	Civil construction
AS 3972	2010	General purpose and blended cements
AS/NZS 4671	2019	Steel for the reinforcement of concrete
AS 4678	2002	Earth-retaining structures
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 5131	2016	Structural steelwork - Fabrication and erection
AS 5216	2021	Design of post-installed and cast-in fastenings in concrete
AS 6669	2016	Plywood – Formwork
SA TS 199	2023	Design of geopolymer and alkali-activated binder concrete structures
Austrroads ATS		Austrroads technical specifications

Austrroads ATS 5305	2023	Formwork for concrete
Austrroads ATS 5317	2023	Coring of hardened concrete
Austrroads ATS 5320	2023	Placement of concrete
Austrroads ATS 5330	2020	Technical specification for the supply of geopolymer concrete
CIA Z5	2020	Shotcreting in Australia
ASTM C171	2020	Standard specification for sheet materials for curing concrete
EN 14889		Fibres for concrete
EN 14889-2	2006	Polymer fibres - Definitions, specifications and conformity
EN 15804	2012	Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
ISO 14025	2006	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 21930	2017	Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services
CCAA Fact Sheet	2012	Specifying low drying shrinkage ≠ crack control

5 ANNEXURE M – CESSNOCK CITY COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's <i>Development Engineering Handbook</i> . Acceptance is to be obtained in writing from: an authorised representative of Council's Director of Infrastructure and Engineering Services.	Variation procedure
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	DA Conditions
M3.	Refer to the Cessnock City Council <i>Development Engineering Handbook</i> for final inspection, works-as-executed and handover requirements.	Completion

6 AMENDMENT HISTORY

0	15/01/2024	First Published
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