Muswellbrook Shire Council

CONSTRUCTION SPECIFICATION

AUS-SPEC (Cot 09)

0310 Concrete - Combined

Version 01

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
0	No amendment has been made	all	Nil		14 June 2012

Contents

0310 CONCRETE – COMBINED

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide cast concrete that:

- Conforms to the design details.
- Satisfies quality and inspection requirements.
- Is compatible with following trades and finishes.

Post–tensioned concrete: Provide post-tensioned concrete that is:

- In conformance with the performance criteria nominated.
- Certified by a professional engineer for the design and the erected framing.

Precast or tilt-up concrete: Provide elements that are:

- Undamaged by handling and installation.
- In conformance with performance criteria nominated.
- Certified by a professional engineer for the design and the erected components.

Selections: As documented.

Design

Formwork: The design of the formwork, other than profiled steel sheeting composite formwork, is the contractor's responsibility.

Post-tensioning: Design and provide post-tensioning in conformance with the Structural design actions schedule in General requirements and the following:

Deflection: Long term incremental deflection shall not exceed span divided by:

1.2 CROSS REFERENCES

General requirements

Requirement: Conform to the following:

- *General requirements*.
- *Concrete finishes*.

1.3 STANDARDS

General

Formwork design and construction, formed surfaces: To AS 3610 and AS 3610.1.

Plywood formwork: To AS 6669.

Profiled steel sheeting including shear connectors: To AS 2327.1.

Specification and supply of concrete: To AS 1379.

Concrete materials and construction: To AS 3600 - 2009.

Post-tensioning: To AS 3600.

Concrete structures for retaining liquids: To AS 3735.

Cement: To AS 3972 and AS 1478.1.

Strand, bar and wire: To AS/NZS 4672.1.

Structural design: To AS 3600.

Precast flooring: To AS 3610 and AS/NZS 1170.

Methods and equipment

Precast elements: Comply with the recommendations of NP:PCH (Precast concrete handbook).

Precast/tilt-up concrete elements, transport, erection and installation: To AS 3850.

1.4 INTERPRETATIONS

Abbreviations

General: For the purposes of this worksection the abbreviations given below apply:

WLL: Working Load limit.

Definitions

General: For the purposes of this worksection the definitions given below apply.

- Ambient temperature: The air temperature at the time of mixing and placing of concrete, and the predicted or likely air temperature at any time during the 48 hours following concrete placement.
- Concrete class:
  - . Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.5.3.
  - . Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in accordance with AS 1379 clause 1.5.4.
- Early age: A mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.
- Green concrete: Concrete which has set but not appreciably hardened.
- National code: National code of practice for precast, tilt-up and concrete elements in building construction.
- Precast concrete: Concrete building elements, cast in moulds and cured away from the final structural position, and then transported, lifted and fixed into position.
- Weather:
  - . Cold: Ambient shade temperature < 10°C.
  - . Hot: Ambient shade temperature > 30°C.

1.5 INSPECTION

Notice

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

- Base or subgrade before covering.
- Membrane or film underlay installed on the base.
- Completed formwork, and reinforcement, tendons, cores, fixings and embedded items fixed in place.
- Surfaces or elements to be concealed in the final work before covering.
- Commencement of concrete placing.
- Commencing initial, incremental or final stressing of tendons.
- Cutting and grouting tendons.
- First precast unit of each type at the earliest possible time prior to and immediately after stripping.
- Site erection including fixings, in situ topping.
- Installed temporary bracing.
- Final structure prior to removal of temporary bracing.
- Evaluation of surface finish.

1.6 TOLERANCES

General

Formed element: To AS 3610.1 clause 5.2.2.

Position: Construct formwork so that finished concrete is in conformance with AS 3600 clause 17.5 and the Formwork dimensional deviation schedule.

Precast: To AS 3610.1 clause 5.3.

Reinforcement and tendon position: To AS 3600 clause 17.5.3.

Formed surfaces: Confirm conformance with the surface finish requirements of AS 3610.1 for the surface class nominated in the Formed surface finishes schedule.

Unformed surfaces: Confirm conformance with the **Flatness tolerance classes table** for the class of finish nominated using a straight edge placed anywhere on the surface in any direction.

Flatness tolerance class table

Class	Measurement	Maximum deviation (mm)
A	3 m straight edge	3
B	3 m straight edge	6
C	600 mm straight edge	6

1.7 SUBMISSIONS

Calculations

Design: Submit structural performance calculations.

Design

Theoretical extensions calculations: Submit calculations of tendon jacking forces, extensions and losses for each stressing stage. Submit amount of draw-in expected in seating anchorages, friction along tendon (wobble) coefficient and friction curvature coefficient for tendons and duct-forming material.

Loading: Submit details of proposed construction systems, loads and procedures, including propping and re-shoring.

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.

Drawings

Cores, fixings and embedded items: If the locations of these items are not shown or are shown diagrammatically, submit shop drawings showing the proposed locations, clearances and cover. Indicate proposed repositioning of reinforcement.

General: Submit shop drawings of architectural and structural precast concrete showing the proposed details for their design, manufacture, assembly, transport and installation, including the following:

- Project title and manufacturer's name.
- Marking plans and elevations referenced to the building grids and floors to locate each precast unit.
- Shape or profile drawings (submit these before fabrication of moulds and tooling).
- Concrete mix and type of cement if special-class concrete.
- Locations, sizes, details, materials, ductility and stress grades of tendons and reinforcement.
- Locations, sizes, details, materials, corrosion protection and grades of cast-in ferrules, locating plates and angles, cut outs and openings, bolts, anchors and lifting devices.
- Cast-in services.
- Site fitments.
- Details of all joints caulking, baffles and waterproofing.
- Surface finish class and surface treatment, if applicable.
- Curing and protection methods.
- Weights of units.
- Calculated maximum loadings on lifting and bracing inserts and attachments.
- Equipment and methods for handling, transport and installation, including lifting inserts and pick-up points.
- Evidence of load capacity of lifting and bracing inserts and attachments in the form of test reports or calculations.
- Specification of plugs for sealing recesses for cast-in fixings.

Post tensioned drawings: Submit shop drawings of post-tensioned work showing details of the proposed system for approval prior to commencing on site, including the following:

- Profiles, sizes and details of tendons, anchorages, ducts, duct formers, splicing, sheathing, end block reinforcement and other associated components.

- Stressing requirements including sequence of stressing, jacking forces and the basis of assumed loss calculations.
- Number, size and position of grout openings, vents and drain holes in the ducts.

Products

Protective coatings: Submit proposals for protective coatings or exposed metallic components to AS/NZS 2312 with regard to site specific corrosivity zoning.

Product conformity: Submit current assessments of conformity, as follows:

- Certificate of conformity by a JAS-ANZ accredited third party.
- Declaration of conformity by an AS/NZS ISO 9001 quality management system certified supplier.
- Mark of conformity of a JAS-ANZ accredited third party applied to the product.
- Report by a NATA accredited laboratory describing tests and giving results which demonstrate that the product conforms.

Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit the following information:

- Certified test results for water retention to AS 3799 Appendix B.
- 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.

Void formers: Submit test certificates to confirm that the formers comply with the following requirements under laboratory conditions, when placed on damp sand and loaded with a mass of wet concrete equal to at least the mass of the beams or slabs they are required to support:

- Deflection during placing and compaction of the concrete is less than the span of the beam or slab divided by 1000.
- Additional deflection between initial set and 7 days does not exceed span/400.
- The load carrying capacity for 48 hours after flooding with water.

Colour: Provide details of achieving the selected colour including details of the type and colour of the cement, sand and aggregates as well as colouring oxide pigments or stain.

Proprietary documentation: Submit proprietary documentation for any lifting, bracing, fixing inserts. Include make, type and WLL.

Non proprietary inserts: Submit certificate by design engineer.

Concrete mix: Submit concrete mix details including the proportions and source of the constituents, compaction equipment, admixtures, release agents, curing compounds.

Grout: Submit proposed grout mix (including grading, proportions, compressive strength and shrinkage) including additives, if any.

Epoxy grout: If required, submit proposed formulation.

Duct-forming material: On request, submit samples of proposed material.

Tendon materials: Submit test certificates for strand, bar or wire proposed.

Typical certified stress-strain curves for each 10 coils of wire or strand, or each parcel of tendon materials.

Anchorages: Submit performance test certificates for each type and size of anchorage and coupler.

Samples

Surface finish: Submit samples for texture and colour.

Execution details

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

- Addition of water at the site.
- Changes to the plastic concrete mix.
- Curing and protection methods.
- Curing period for low-pressure steam curing, if proposed.
- Cutting or displacing reinforcement, or cutting 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.
- Site storage, mixing and transport methods and equipment, if applicable.
- Temperature control methods.

Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details.

Sequence of concrete placement: If sequential placement of slab segments is proposed, provide details.

Sawn joints: Submit proposed methods, timing and sequence of sawing joints.

Props: If props above a floor do not coincide with the props below, submit details.

Reshoring: If reshoring is intended, submit proposals.

Stripping single storey suspended work: If the requirements of AS 3610 cannot be met, give notice.

Surface repair method: If required, submit details of the proposed method before commencing repairs.

Reinforcement: If changes are proposed to reinforcement shown on the drawings, submit details.

Damaged galvanizing: If repair is required, submit proposals to AS/NZS 4680 Section 8.

Provision for concrete placement: If spacing or cover of reinforcement does not comply give notice.

Splicing: If splicing not documented is proposed, submit details.

Welding: Give notice before welding reinforcement.

Pre-mixed supply: For each batch, submit a docket listing the information required by AS 1379 , and the following information:

- For special class performance concrete, specified performance and type of cement binder.
- For 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 amount of water, if any, added at the site.
- 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.

Subcontractors: 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.

Panel casting: Submit panel casting checklist.

Manufactuer's details: Submit name, contact details and credentials of proposed manufacturer of precast concrete units.

Safe work method statement: Prepare a safe work method statement specific to the project for the precast erection and submit on request.

Erection documentation: Submit lifting device locations and specification including marking plans and shop drawings.

Early lifting: If it is proposed to lift the units by their designated lifting points before 28 day strength has been achieved, submit evidence to demonstrate that the unit has adequate strength to carry its own weight without damage or residual cracking or deflection on removal of the lifting device.

Lifting and handling equipment: Submit proposed equipment along with qualifications and training of the operating personnel.

Stressing schedule: Record a stressing schedule, including the following and submit upon request.

- Setting out elongation and jacking forces.
- Identification number of dynamometers, gauges, pumps and jacks.
- Initial stressing force (or pressure) when tendons are marked for measurement of elongation.
- Force applied (dynamometers).
- Pump or jack pressure and area of the piston.
- Elongation before anchoring.

- Elongation remaining after anchoring.

Post-tensioning: Record and submit the following data:

- Concrete mix.
- Details of placing and curing including dates.
- Details of placing of reinforcement and tendons.
- Dates of post-tensioning operations.
- Name of operator.
- Identification of tendons.
- Stressing method (single or double end, monostrand or multistrand).
- Calculated tendon extensions (theoretical extensions) at final stressing and for staged stressing if required, before stressing operations commence.
- Comparison of theoretical and actual extensions.
- If tendons not marked at nil load, initial force or pressure where tendons are marked for measurement of elongations.
- Early age test results for strength from NATA prior to stressing.
- Tendon breakage and non-conformance reports.
- As built shop drawings.

Grouting: For each duct grouted, record and submit a record identifying the following:

- Identification of duct and tendons.
- Grouting date.
- Composition of the grout (water : cement ratio, admixtures).
- Grout tests including air tests of ducts.
- Details of grouting (including pumping or supply interruptions, topping up).

Tests

Lifting inserts and attachments for precast units: Submit test results.

Structural performance: Submit test results of prior testing for static load tests.

Static load tests: If structural performance requirements are nominated for the precast unit, perform static load tests on the prototype to AS 3600 .

Concrete test certificates and records: Submit test certificates, and also retain results on site.

2 PRODUCTS

2.1 MATERIALS

General

Stockpile: Stockpile sand, cement and aggregates proposed to be used if required for uniform, consistent colour.

Cement

Standard: To AS 3972.

Age: Less than 6 months old.

Storage: Store cement bags under cover and above ground.

Aggregates

Standard: To AS 2758.1.

Aggregate properties: Conform to the **Aggregate property schedule**.

Special aggregates: Stockpile special aggregates at the beginning of the project to minimise colour and other variations.

Water

Standard: To AS 1379.

Quality: Use clean water, free from oil, acid, alkali, organic or vegetable matter and not more than 500mg/l of chloride ions.

Polymeric film underlay

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

Other

Chemical admixtures: To AS 1478.1.

Chemical admixture content: Free of chlorides, fluorides and nitrates.

Curing compounds: To AS 3799.

Pigments: Ensure that the pigments are:

- Chemically inert.
- Alkaline resistant.
- Insoluble.
- Light-fast.

2.2 CONCRETE

Properties

Concrete mix and supply: To conform to AS 1379.

Cover

Concrete cover generally: To AS 3600.

Concrete cover for structures for retaining liquids: To AS 3735.

Concrete performance - Shrinkage sensitive structures

Drying shrinkage (maximum including tolerances):

- 650 µm for concrete up to and including strength grade 32.
- 700 µm for higher strength grades.

Duration of air drying: 56 days.

Testing

Sampling, identification and testing of specimens: Sample the concrete on site, at the point of discharge from the agitator to AS 1012.

Type and frequency: Conform to AS 1379. For each property test at least two specimens from each sample. To the **Project assessment strength grade sampling table**.

Post-tensioned concrete additional requirements: For each prestressed element take at least 3 samples for 3 day, 7 day and 28 day testing, at the rate of at least one sample per 2 batches, from well distributed locations including the anchorage area. Cure 3 day and 7 day samples by the same method as the prestressed element.

Slump: Test at least one sample from each batch before placing concrete from that batch in the work.

Strength grade/Characteristic compressive strength: Spread the site sampling evenly throughout the pour.

Project assessment strength grade sampling table

Number of batches for each type and grade of concrete per day	**Minimum number of samples**	
Columns, loadbearing wall and post tensioned slab/beam elements per batch	**Other elements per day**	
1	1	1
2-5	1	2
6-10	1	3
11-20	1	4
each additional 10	1	1 additional

Post tensioned and tilt-up concrete: Determine strength using site cured specimens.

Conformance: Test in conformance with the **Control tests schedule**.

Embedded pressure pipes: If leak tests have not been successfully completed, do not embed pipes.

Testing for liquid tightness to AS 3735:

Test authority: Concrete supplier or NATA registered laboratory.

Testing: All test cylinders for early age testing must be 'site cured'. Cure on the floor where concrete placed ensuring exposure to the same weathers and temperatures. Test cylinders must be left on site until the morning of the test.

Sampling locations: Distribute the sampling locations randomly, include the anchorage area and the last concrete placement area. Make reference to a structural element on the drawings.

2.3 FORMWORK

General

Form linings, facings and release agents: Compatible with applied finishes.

Lost formwork: Must contain no chlorides, and not impair the structural performance of the concrete members.

Void formers: Material must maintain its rigidity and shape until the concrete has set, is capable to withstand construction loads and is non-collapsible on absorption of moisture.

Steel decking

Material: Hot-dipped zinc-coated sheet steel to AS 1397, minimum G500-Z350.

Profiled steel sheeting composite formwork: Minimum steel grade G550.

Accessories: Adopt material and corrosion protection to match the profiled steel sheeting.

Plywood formwork

Material: Plywood sheeting to AS 6669.

Grade: To meet the design dimensions, loading and surface quality specified to AS 3610 and AS 3610.1.

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

2.4 REINFORCEMENT

Fibre reinforcement

Reference: CIA CPN35.

Protective coating

Corrosion: Protect from corrosion in accordance with AS 3600.

Epoxy coating: To be high build, high solids chemically resistant coating.

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680:

- Sequence: If fabrication is to occur after galvanizing, submit proposals for galvanizing repair and coating of cut ends.
- Zinc-coating (minimum): 600 g/m^2.

Steel reinforcement

Standard: To AS/NZS 4671.

- Ductility grade: Class N.

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

Tie wire

General: To be annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

2.5 POST TENSIONING

General

Type: Do not use high alumina cement.

Grout

Standard: To AS 3600 clause 17.1.8.

Grout duct size: Large enough to provide sufficient erection tolerance and clearance for grout flow.

Maximum shrinkage: 1% by volume after 24 hours.

Maximum water: cement ratio: 0.40 (by weight).

Compressive strength: 32 MPa at 7 days.

Aggregates: Do not use aggregates for post tensioning grout.

Blended cements: Type GB To AS 3972.

Admixtures: Do not provide admixtures containing chlorides, nitrates, sulphides or sulphites. Include an anti-bleed additive.

Quality: Use fresh cement/grout.

Fly ash: Maximum 10% of cement by weight.

Epoxy grout type: Commercial epoxy formulation of compressive strength exceeding 40 MPa.

Ducts

Robustness: Provide ducts with sufficient strength to retain their shape, resist damage during construction, and prevent entrance of cement paste and water from the concrete. Material to be left in place must not cause deterioration or electrolytic action.

Wall thickness: To account for abrasion during stressing of the tendon.

Size: To allow feeding of tendons and grouting.

Steel

Stressing bars: Type, grade of strand, wire or bar to AS/NZS 4672.1.

Type: 7 wire, stress relieved, high tensile steel and strand.

Prestressing hardware (including ducts, anchorages): To AS 3600.

Structural welding: To AS/NZS 1554.3.

Tendons: Do not weld prestressing tendons.

Quality: Ensure that there are no nicks, damage or foreign matter such as mud and dirt. Store the stressing bars on supports clear of the ground.

Straightening of tendons: Not permitted. Supply tendons in coils large enough to self straighten.

High tensile steel bars: Inspect individually and reject any surface imperfections greater then 0.40 mm deep.

Anchor plates: Hot dip galvanized to AS/NZS 4680.

Anchorages: To AS/NZS 1314.

Reinforcement: To AS/NZS 4671.

2.6 MISCELLANEOUS

Cast-in items

Structural steel

Protective coating:

Stainless steel:

Bearing pads

Selections and testing: To AS 5100.4.

- Width:
- Thickness:
- Type:

Flashings

Standard: To AS/NZS 2904.

Sealants

Compression-seals: Polyethylene or polyurethane foam strip.

Sealant:

Baffle strip:

Coloured concrete

Standard: To AS 3610.1.

Manufacture: Using the same mix and method used in the works, supply sample blocks of concrete prior to colouring with mineral oxides.

- Number: 4.
- Size (nominal): 300 x 300 x 50 mm.

Surface hardeners, sealants and protectors
Material supply: If required by the project documentation, provide proprietary products in accordance with the manufacturer's written requirements.

2.7 PRECAST AND TILT-UP UNITS

General
Concrete: To AS 3600 and AS 1379.

Testing: To AS 1012.

Durability
Exposure classification:

Concrete cover: To AS 3600.

Strength
Minimum compressive strength: [complete/delete]

Flexural strength required at lifting to AS 3850:

Finishes
Off-form surface finish to AS 3610.1:

Generally class 2 or 3 to AS 3610.1.

3 EXECUTION

3.1 POLYMERIC FILM UNDERLAY

Location
General: Under slabs on ground including integral ground beams and footings, provide a vapour barrier or, in areas prone to rising damp or salt attack, a damp-proofing membrane.

Installation
General: Lay over the base, 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. Take the underlay up vertical faces past the damp proof course where applicable, and tape fix at the top. Patch or seal punctures or tears before placing concrete. Cut back as required after concrete has gained strength and forms have been removed.

Base preparation
General: According to base type, as follows:

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

3.2 FORMWORK

General
General: Conform to the **Formed surface finishes chedule.**

Bolt hole filling
Cover: Position formwork tie bolts left in the concrete so that the tie does not project to within 50 mm of finished surface.

Durability: Provide material with durability and colour matching the concrete.

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

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

Corners
Work above ground: Fillet at re-entrant angles, and chamfer at corners.

- Face of bevel 25 mm.

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

Openings
General: 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 and columns, provide access hatches for placing concrete.

Release agents
Application: Before placing reinforcement, apply a release agent to form linings and facings.

Slip formwork: Provide access below the moving formwork for surface treatment and inspection.

Profiled steel sheeting composite formwork
Fixing: If sheeting cannot be fixed to structural steel supports with puddle welds, or with welded shear studs in composite construction, provide details.

Steel linings
Rust: Clean off any rust and apply rust inhibiting agent prior to reuse.

Visually important surfaces
General: For concrete of surface finish classes 1, 2 or 3, set out the formwork to give a regular arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface.

Void formers
Use: Cast designated suspended ground floor slabs and beams on void formers.

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

3.3 REINFORCEMENT

Tolerances
Fabrication and fixing: To AS 3600 clause 17.2.

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

Tolerances:

- Alignment: 2 mm in 300 mm.
- Location: ± half the diameter of the dowel.

Grade: 250 N.

Supports
General: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:

- To be adequate to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.

Minimum spacing:

- Bars: ≤ 60 diameters.
- Mesh: ≤ 800 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

Projecting reinforcement
General: If ‘starter’ or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.

Tying
General: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms or unformed faces so that the ties do not project 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: Tie bundled bars in closest possible contact. Provide tie wire of at least 2.5 mm and spaced not more than 24 times the diameter of the smallest bar in the bundle.

Columns: Secure longitudinal column reinforcement to all ties at every intersection.

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

Tolerances: To AS 3600 Section 17.

Cleaning

General: Remove all debris from the formed space.

Welding

General: If welding of reinforcement is proposed, provide details.

3.4 POST TENSIONING

Tendons

Cutting tendons: Cut tendons only after approval of theoretical and actual extensions for each incremental stage. Restress or de-stress as instructed prior to cutting.

Care: Do not weld tendons, do not expose them to sparks, ground current or excessive temperatures such as flame or oxyacetylene cutting.

Grout fittings and ducts: For bonded construction, protect from collapse and other damage.

Conformance: Provide tendons in conformance with the Tendon schedule.

Protection: Ensure tendons are not displaced by heavy and prolonged vibration, the pressure of the concrete being placed, workmen or construction traffic.

Ducts

Standard: To AS 3600 clause 17.3.

Placement: Locate and secure to positions, as documented.

Supports: Support and fix at regular intervals. Protect from collapse and other damage.

Tolerances: For placement of ducts and tendons to AS 3600 clause 17.5.3.

Sheathing: If ducts are formed with sheaths, provide sheathing material strong enough to transfer the tendon stresses into the body of the concrete.

Sequence: Assemble post tensioning tendons and install strand, bar or wire within the duct prior to concreting.

Coupling

Standard: To AS/NZS 1314 Section 5.

Cover: Position and fix couplers to provide adequate cover.

Anchorages

Supply and install: Adequate end block and anti-burst to ensure sufficient transfer strength.

Gauges and jacks

Standard: To AS 1349.

Maximum error in pressure indication: 1% of the maximum scale (concentric) value.

Period: Calibrate gauges and jacks as a whole and at intervals not exceeding 6 months, after re-sealing of jack or gauge, or if any inaccuracy in the gauges is suspected at any time.

Gauges: If required provide more frequent calibration.

Sets: Unless approval is given, jacks and gauges must be calibrated and used as a set.

Post-tensioning

Post-tensioning: To AS 3600.

Procedure: Initial stress must be carried out immediately on attaining the initial strength.

Tendon force: Verify tendon force and instructions on re-stressing or de-stressing.

Timing: Grout tendons as soon as practicable after stressing and within 3 weeks or sooner if required due to corrosive environments.

Procedure: Prevent damage to grout vents and fittings during grouting. Do not use manually powered grouting machines. Completely fill the duct during grouting. Inject grout into voids between tendons, ducts and anchorages, until grout flows from vents without air bubbles. Close vents as they fill, progressively in the direction of flow. If there is a blockage or interruption, completely flush grout from the duct using water.

Temperature: Maintain concrete around grouted tendons at ≥ 5°C for at least 3 days after grouting.

Protection

Grout ducts: Do not subject grouted ducts to shock, vibration, construction traffic or similar loads until 24 hours after completion of grouting.

Permanent protection

Tendons and anchorages: On completion of stressing and grouting, permanently protect anchorage and tendons. Provide at least 40 mm of cover over the cut tendons when the recesses are concreted. Keep anchorages free of foreign matter (rust, grease, oil, paint).

3.5 CONCRETE

General

General: Provide concrete in conformance with the **Properties table – performance in the Selections.**

Elapsed delivery time

General: Ensure that the elapsed 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℃ or above 30℃.

Elapsed delivery time table

Concrete temperature at time of discharge (℃)	Maximum elapsed time (minutes)
10 – 24	120
24 – 27	90
27 – 30	60
30 – 32	45

Pre-mixed supply

Addition of water: If water is to be added, comply with AS 1379 Section 4.2.3.

Transport: Mode must prevent segregation, loss of material and contamination of the environment, and must not adversely affect placing or compaction.

Site mixed supply

Emergencies: If mixing by hand is carried out, provide details.

Plant: Mix concrete in a plant located on the construction site.

3.6 CORES, FIXINGS AND EMBEDDED ITEMS

Adjoining elements

Fixings: Provide fixings for adjoining elements including any temporary fixings that are required.

General: Grease threads. Protect embedded items against damage.

Compatibility: Ensure inserts, fixings and embedded items are compatible with each other, with the reinforcement, with the concrete mix used and surface finish requirements.

Corrosion: If in external or exposed locations, galvanize anchor bolts and embedded fixings, or propose alternative materials such as stainless steel.

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

Isolation: Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

3.7 PLACING AND COMPACTION

Placing

Horizontal transport: Use suitable conveyors, clean chutes, troughs or pipes.

General: Use placing methods which avoid segregation and loss of concrete, and which minimise plastic settlement. Maintain a generally vertical and plastic concrete edge during placement.

Layers: Place concrete in layers ≤ 300 mm thick, such that each succeeding layer is compacted before previous layer has taken initial set. Compact into previous layer.

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 come into contact with set concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Placing records

General: 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

General: During placement and prior to setting, protect the surface from damage, to achieve the desired finish.

Time between adjacent placements

General: Conform to the **Minimum time delay schedule.**

Vertical elements

General: In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed vertical chutes or access hatches in forms.

Placing in cold weather

Cement: Do not use high alumina cement.

Placing concrete: Maintain the temperature of the freshly mixed concrete at ≥ 5°C.

Formwork and reinforcement: Before and during placing maintain temperature at ≥ 5°C.

Severe weather: If severe weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

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 forms, materials, and equipment coming in contact with the concrete.

Maximum temperature of water: 60°C when it is placed in the mixer.

Plastic concrete: Prevent plastic concrete from freezing, without using salts or chemicals.

Placing in hot weather

Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete in conformance with the Elapsed delivery time table.

Placing concrete: Maintain the temperature of the freshly mixed concrete in conformance with the Hot weather placing table.

Formwork and reinforcement: Before and during placing maintain temperature at ≤ 35°C.

Severe weather: If ambient shade temperature > 38°C, do not mix concrete.

Temperature control: Select one or more of the following methods of maintaining the specified temperature of the placed concrete:

- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water prior to mixing.
- Use chilled mixing water.

Hot weather placing table

Concrete element	Temperature limit

Concrete element	Temperature limit
Normal concrete in footings, beams, columns, walls and slabs	35°C
Concrete in sections ≥ 1 m in all dimensions except for concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness	27°C

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

Placing under water

Condition: If placing in the dry is practicable by pumping or other means of dewatering, do not place under water.

Minimum cement content for the mix: Increase by 25%.

Method: If required, submit proposals.

3.8 CURING

General

Curing: Cure continuously from completion of finishing 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, is at least the following, unless accelerated curing is adopted:

- Fully enclosed internal surfaces/Early age concrete: 3 days.
- Other concrete surfaces: 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.

Cold weather curing

General: Maintain concrete temperature between 10 – 20°C for curing period.

Curing compounds

Application: 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, confirm compliance with AS 3799.

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

Hot weather curing

Curing compounds: If it is proposed to use curing compounds, provide details.

Protection: Select a protection method as applicable.

- If the concrete temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant.
- If ambient shade temperature is > 35°C, protect from wind and sun using an evaporative retarder until curing is commenced.
- Immediately after finishing, either cover exposed surfaces using an impervious membrane or hessian kept wet until curing begins, or apply a curing compound.

Water curing

General: If water is used, pond or continuously sprinkle in such a way as to not cause damage to the concrete surface, for the required curing period.

3.9 JOINTS

Construction joints

Location: Do not relocate or eliminate construction joints, or make construction joints not shown on the drawings. If emergency construction joints are made necessary by unforeseen interruptions to the concrete pour, submit a report on 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.

Preparation: Roughen and clean the hardened concrete joint surface. Remove loose or soft material, free water, foreign matter and laitance. Dampen the surface just before placing the fresh concrete and coat with a neat cement slurry.

Expansion joints

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

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 when used together, 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. They may be faced with a non-adhering material.

Foamed materials (in compressible fillers): Closed-cell or impregnated types which do not absorb water.

Slip joints

Requirement: If concrete slabs are supported on masonry, provide proprietary slip joints.

3.10 FORMED SURFACES

General

General: Provide formed concrete finishes in conformance with the **Formed surface finishes schedule.**

Damage: Do not damage concrete works through premature removal of formwork.

Curing

General: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

Evaluation of formed surfaces

General: If evaluation of formed surface tolerance or colour is required, complete the evaluation before surface treatment.

Finishing methods

General: If soffits of concrete elements or faces of concrete columns are to have a finish other than off the form, provide details of proposed procedures.

Blasted finishes:

- Abrasive: Blast the cured surface using hard, sharp graded abrasive particles until the coarse aggregate is in uniform relief.
- Light abrasive: Blast the cured surface using hard, sharp graded abrasive particles to provide a uniform matt finish without exposing the coarse aggregate.

Bush hammered finish: Remove the minimum matrix using bush hammering to expose the coarse aggregate, recessing the matrix no deeper than half the aggregate size, to give a uniform texture.

Exposed aggregate finish: Remove the vertical face forms while the concrete is green. Wet the surface and scrub using stiff fibre or wire brushes, using clean water freely, until the surface film of mortar is mechanically removed, and the aggregate uniformly exposed. Do not use acid etching. Rinse the surface with clean water.

Floated finishes:

- Sand floated finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.
- Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread a slurry, using hessian pads or sponge rubber floats. Remove surplus slurry and work until a uniform colour and texture are produced.

Smooth rubbed finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a carborundum or similar abrasive brick until a uniform colour and texture are produced.

Surface repairs
Surface repair method: If surface repairs are required, submit proposals.

3.11 UNFORMED SURFACES

General
General: Strike off, screed and level slab surfaces to finished levels, to the tolerance class noted in the **Unformed surface finishes schedule.**

Surface finishes
General: Provide surface finishes in conformance with the Unformed surface finishes schedule.

Surface repairs
Surface repair method: If surface repairs are required, submit proposals.

Finishing methods – primary finish
Machine float finish:

- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.

Steel trowel finish: After machine floating 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.

Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy appearance, uniform in texture, appearance and free of trowel marks and defects.

Wood float finish: After machine floating 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 machine floating and steel trowelling draw a broom or hessian belt across the surface to produce a coarse even-textured transverse-scored surface.

Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.

Sponge finish: After machine floating and steel trowelling, obtain an even textured sand finish by wiping the surface using a damp sponge.

Finishing methods – supplementary finish
Abrasive blast: After steel trowelling, abrasive blast the cured surface to provide texture or to form patterns without exposing the coarse aggregate using hard, sharp graded abrasive particles.

Coloured applied finish: To a machine float finished surface, apply a proprietary liquid or dry shake material in accordance with the manufacturer's written requirements and trowel to achieve the required appearance.

Stamped and coloured faux paved or cobblestone finish: A complete proprietary finishing system.

Exposed aggregate: After steel trowelling, grind the cured surface of the concrete to expose the coarse aggregate.

3.12 PRECAST AND TILT-UP UNITS

Lifting points
Standard: To AS 3850.

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

Remove: Remove, seal and make good temporary attachments after erection.

General: Provide proprietary lifting devices with published load data designed specifically for lifting concrete elements. Use face and edge lifters as required.

Storage
Support points: Store elements at designated storage points.

Prevent damage: Adequately store units to prevent warping, twisting, crushing, cracking and staining.

Protection: Protect the units against staining, discolouration and other damage until they are installed in their final location.

Lifting and handling

Lifting and handling: Conform to the National code and AS 3850.

Site conditions: Ensure the wind and temperature conditions allow handling and fixing consistent with structural capability and geometry of the element.

Cranes: To AS 2550.

Temporary bracing and propping: To AS 3850 and AS/NZS 1170.2.

Fixing

Fixing: Fix the units securely and accurately in their final positions.

Ancillaries: Provide components and materials, including fasteners, braces, shims, jointing strips, sealant, flashings, grout and mortar, bearing pads or strips, ties and dowels, clips and fixings necessary for the installation of the units.

3.13 COMPLETION

Formwork removal

Extent: Remove formwork, other than profiled steel reinforcement decking, including formwork in concealed locations, but excepting lost formwork.

Timing: Do not disturb forms until concrete is hardened enough to withstand formwork movements and removal without damage.

Stripping:

- General: To AS 3600 where it is more stringent than AS 3610.1.
- Post-tensioned concrete: Remove formwork supporting post-tensioned concrete members only when sufficient stripping has been added to support the loads.

Loading

General: Do not erect masonry walls or other brittle elements on beams and slabs while they are still supported by formwork.

Unencased reinforcement

General: Provide plastic protective caps on the ends of vertical starter bars to protect workers on site.

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 SELECTIONS

4.1 SCHEDULES

Tendon schedule

Structural element	Tendon material	Tendon size (mm)

Test panels schedule

Application	Incorporated features	Panel size

Formwork dimensional deviation schedule

Dimension or measurement	Location or element	Deviation (mm)

Formed surface finishes schedule

Property	Type		
	A	B	C
Location			
Surface finish class to AS 3610.1.			
Form lining type			
Colour control			
Bolt hole filling			
Surface finish type			

Concrete Properties table – performance

	Type		
	A	B	C
Normal and special class			
Air entrainment – air volume (%)			
Maximum aggregate size (mm)			
Assessment process			
Slump (mm)			
Strength grade/characteristic compressive strength (MPa)			
Special class			
Bleeding (mL/mm^2)			
Cement type			
Density of hardened concrete (kg/m^3)			
Density of plastic concrete (kg/m^3)			
Drying shrinkage			
Duration of air drying			
Early age strength (MPa)			
Flexural strength (MPa)			
Indirect tensile strength (MPa)			
Mineral oxide content			
Mix type			
Water:cement ratio maximum			

Control tests schedule

Concrete element	28 day strength	Transfer strength (MPa)	Days after pouring	Early strength (MPa)	Days after pouring

Concrete element	28 day strength	Transfer strength (MPa)	Days after pouring	Early strength (MPa)	Days after pouring

Minimum time delay schedule

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

Unformed surface finishes schedule

Property	Type		
	A	B	C
Location			
Flatness tolerance class			
Primary finish			
Supplementary finish			
Slip resistance class to AS/NZS 4663: - Wet pendulum - Dry floor friction			
Slip resistance treatment			
Slip resistance tests			
Surface modifier			