0310P MAX FRANK IN CONCRETE - COMBINED

Branded worksection

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Worksection abstract

This branded worksection *Template* is applicable to the use of concrete for buildings and associated structures together with the use of specialist products for concreting works, produced by Max Frank, including spacers, formwork, reinforcement, sealing and acoustic products. It combines relevant clauses from the following worksections: *0311 Concrete formwork*, *0312 Concrete reinforcement*, *0313 Concrete post-tensioned*, *0314 Concrete in situ* and *0315 Concrete finishes*.

Background

This worksection *Template* combines relevant clauses from the following worksections: *0311 Concrete formwork*, *0312 Concrete reinforcement*, *0313 Concrete post-tensioned*, *0314 Concrete in situ* and *0315 Concrete finishes*.

***Guidance* text**

All text within these boxes is provided as guidance for developing this worksection and should not form part of the final specification. This *Guidance* text may be hidden or deleted from the document using the NATSPEC Toolbar or the hidden text *Hide* and *Delete* functions of your word processing system. For additional information visit FAQs at www.natspec.com.au.

***Optional* style text**

Text in this font (blue with a grey background) covers items specified less frequently. It is provided for incorporation into *Normal* style text where it is applicable to a project.

Related material located elsewhere in NATSPEC

If a listed worksection is not part of your subscription package and you wish to purchase it, contact NATSPEC.

Related material may be found in other worksections. See for example:

- *0311 Concrete formwork*.
- *0312 Concrete reinforcement*.
- *0313 Concrete post-tensioned*.
- *0314 Concrete in situ*.
- *0315 Concrete finishes*.
- *0318 Shotcrete*.
- *0321 Precast concrete*.
- *0322 Tilt-up concrete*.
- *0612 Cementitious toppings*.
- *0613 Terrazzo in situ*.

Material not provided by MAX FRANK Australia Pty Ltd.

This branded worksection *Template* includes generic material which may not be provided by the Product Partner including:

- Concrete.
- Formwork other than MAX FRANK Systems.
- Reinforcement other than MAX FRANK Systems.
- Post-tensioning.

Documenting this and related work

You may document this and related work as follows:

- Either fully detail the work in the structural drawings or define performance criteria (loading, deflection, exposure, fire-resistance) for any anticipated contractor design. For design by contractor, independent certification by a professional engineer of the design and documentation, and of the erected structure/structural element, is appropriate.
- Show on the drawings any special requirements.
- Show on the drawings the required reinforcement including the location, type, size and spacing of bars, any special requirement for types of supports, and the concrete cover. Show the location and minimum length for lapped splices.
- See AS 2870, SA HB 28 and CCAA T49 for design and construction requirements for residential slabs and footings. BCA 3.2.4 contains a table of site classifications that are the basis for requirements for footing design. Show the details on

the drawings. Slabs on ground may be used as part of a termite management system installation – coordinate with *0184 Termite management*.

See NATSPEC TECHnote DES 006 on specifying concrete.

Refer to CCAA Briefing 18 for information on design of concrete slabs for housing in flood-prone areas.

Refer to www.ptia.org.au for further information on post-tensioning.

The *Normal* style text of this worksection may refer to items as being documented elsewhere in the contract documentation. Make sure they are documented.

For example:

- Formwork procedures and loadings.
- Applied finishes.
- Reinforcement layout, details, splice locations and concrete cover.
- Colour requirements.
- Dimensions and loadings.
- PT duct locations and fixing methods.
- PT anti-burst reinforcement.
- PT stressing stages.
- Joint locations and types.

Search www.environmentdesignguide.com.au, the Australian Institute of Architect's environmental advisory subscription service for notes on the following:

- Thermal mass in building design.
- Embodied energy of building materials.
- Life cycle energy analysis.

Specifying ESD

The following may be specified by retaining default text:

- Profiled steel sheeting composite formwork.
- Pre-consumer supplementary cementitious materials (SCM) as partial replacement for portland cement. e.g. fly ash, slag cement and amorphous silica.

The following may be specified by including additional text:

- Re-useable formwork.
- Engineered wood form panels.
- Timber forms from a sustainable source, e.g. plantation.
- Other permanent formwork, e.g. unfinished or prefinished fibre cement, polymer formwork, aluminium composite panels and insulating formwork.
- Fabric formwork to reduce formwork material weight.
- Reinforcing with recycled steel content.
- Fibre-reinforced bars and grids.
- Recycled plastic in fibre-reinforced concrete.
- High-grade reinforcing to reduce the amount of reinforcement and/or concrete required to achieve the same performance.
- Reinforcement with improved corrosion resistance for enhanced concrete durability.
- Wire and welded mesh to use less reinforcing material.
- Reinforcement manufactured using electric arc furnace instead of basic oxygen steel to reduce required energy input.
- Recycled concrete aggregate.
- Admixtures to reduce CO_2 of the concrete.
- Exposed concrete slab to reduce finish materials required, e.g. polished or honed concrete floor, off-form walls and ceilings.
- Low odour and low VOC emitting sealers and stains, e.g. water-based dyes and sealers.

Refer to the NATSPEC TECHreport TR 01 on specifying ESD and the following for further information:

- Climate-responsive house design using concrete: CCAA T58.
- Sustainable concrete buildings: CCAA Briefing 13.
- Sustainable concrete materials: CCAA Briefing 11.
- Thermal mass benefits for housing: CCAA Briefing 12.

1 GENERAL

For over 50 years, the FRANK Group has been developing, manufacturing and distributing spacers, formwork, reinforcement, sealing and acoustic products. This diversity of products makes Max Frank Australia the partner of choice for planners, architects and construction companies.

Comprehensive technical service and assistance are of paramount importance to us. This includes providing application instructions, expert advice on detailed layouts and workshop drawings, technical documentation and software programmes to provide solutions.

FRANK is ISO 9001 approved.

1.1 RESPONSIBILITIES

General

Requirement: Provide cast in situ reinforced concrete, as documented.

Documented is defined in the *0171 General requirements* worksection as meaning contained in the contract documents.

Max Frank: Provide Max Frank products, as documented.

Performance

Requirements:

- Conforming to the design details and performance criteria.
- Satisfying quality and inspection requirements.
- Compatible with documented applied finishes.

It is the designer's responsibility to select surface finish methods that are appropriate for the following trades and finishes.

1.2 DESIGN

This worksection can be used to document a variety of design and construct approaches. For example:

- Full design and construct: The contractor designs the whole of the project.
- Partial design and construct: The documents show some design details and all the design parameters for the project.

If the design, or completion of the design, is not the responsibility of the contractor, delete this clause.

General

Formwork: The design of formwork is the contractor’s responsibility, other than profiled steel sheeting composite formwork and any of the Max Frank formwork technologies. Allow for dimensional changes, deflections and cambers resulting from the following:

- Imposed actions.
- Concrete shrinkage and creep.
- Temperature changes.
- The application of prestressing forces (if any).

This applies to all formwork types, including conventional, proprietary (non composite formwork) or purpose-made formwork.

Structural design: To AS 3600.

The NCC cites AS 3600-2009.

Post-tensioned concrete: To AS 3600.

Concrete structures retaining liquids: To AS 3735.

Requirements

Authority requirements: [complete/delete]

In particular, draw attention to any specific requirements of the DA and other regulatory bodies. Consider attaching DA conditions, if appropriate. Nominate if any part of the design is a NCC Performance Solution.

Requirements in addition to AS 3600: [complete/delete]

1.3 COMPANY CONTACTS

Max Frank technical contacts

Website: www.maxfrank.com.au.

1.4 CROSS REFERENCES

General

Requirement: Conform to the following:

- *0171 General requirements*.

0171 General requirements contains umbrella requirements for all building and services worksections.

List the worksections cross referenced by this worksection. *0171 General requirements* references the *018 Common requirements* subgroup of worksections. It is not necessary to repeat them here. However, you may also wish to direct the contractor to other worksections where there may be work that is closely associated with this work.

NATSPEC uses generic worksection titles, whether or not there are branded equivalents. If you use a branded worksection, change the cross reference here.

1.5 STANDARDS

General

Formwork design and construction: To AS 3610.1.

CIA Z36 provides guidance on the safe design and construction of formwork.

Plywood formwork: To AS 6669.

Composite steel-concrete construction, including profiled steel sheeting and shear connectors: To AS/NZS 2327.

The NCC cites AS 2327.1-2003.

Reinforced concrete construction: To AS 3600.

AS 3600 Supp 1 provides background reference material to AS 3600-2009, indicates the origin of particular requirements and departures from previous practice, and explains the application of certain clauses.

SA HB 71 provides guidance on concrete design to AS 3600-2009, and is jointly published with Cement, Concrete and Aggregates Australia. SA HB 84 gives guidance on concrete repair and protection. CIA Z13 provides performance criteria for concrete in marine environments. On fibres in concrete, see CIA CPN35. Concrete is deemed-to-satisfy to the BCA requirements for fire hazard properties (see BCA C1.10). For super-workable concrete refer to CIA Z40.

For guidance on design and detailing for seismic conditions refer to SRIA Seismic Guide*Guide to seismic design and detailing of reinforced concrete buildings in Australia*.

Specification and supply of concrete: To AS 1379.

Residential ground slabs and footings: To AS 2870.

Post-tensioned concrete: To AS 3600.

The technical requirements for post-tensioning are covered generally in AS 3600 but depending on the application, you may need to specify other matters such as calculations, certificates, prestressing records, shop drawings, and tests in the appropriate clauses.

Concrete structures for retaining liquids: To AS 3735.

For concrete structures for retaining liquids, AS 3735 and AS 3735 Supp 1 take precedence over the requirements of AS 3600. For watertight concrete structures refer to CIA CPN28.

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

For information on the causes of failures in anchorage zones and examples of detailing of reinforcement, see CIA CPN29. For requirements for anchorages, refer to AS/NZS 1314.

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

Formed surfaces: To AS 3610.1.

See CCAA T57 for guidance on how to achieve good quality off-form finishes. It discusses the factors influencing the quality of off-form concrete finishes from planning and design to construction and maintenance.

See CCAA T59 for guidance on the various options for colouring and finishing the concrete surface and related construction issues. It has been prepared to assist designers, specifiers and contractors with the important aspects of particular flatwork finishes and their detailing, specification and construction to ensure that the element provides a high level of performance and serviceability during its design life.

Delete standards not applicable to the works.

Slip resistance

Classification: To AS 4586.

1.6 MANUFACTURER'S DOCUMENTS

Technical information

Products: www.maxfrank.com/au/products/index.php.

Technical assistance: www.maxfrank.com/au/service/index.php.

1.7 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions given in AS/NZS 1314, AS 3610.1 and the following apply:

- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Anti-burst reinforcement: Reinforcement cage surrounding anchorages to control the tensile bursting stresses.
- Average ambient temperature: Average value of the daily maximum and minimum ambient temperatures over the defined period at a site.
- Batch: A quantity of concrete containing a fixed amount of ingredients and produced in a discrete operation.
- Concrete class – normal: Concrete that is specified primarily by a standard compressive strength grade up to 50 MPa and otherwise in conformance with AS 1379 clause 1.5.3.
- Concrete class – special: Concrete that is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in conformance with AS 1379 clause 1.5.4.

If special-class concrete is documented for the project, document the relevant parameters in the **Concrete properties schedule – performance**.

- Early age strength: a mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.
- Production assessment: An assessment procedure for concrete defined by strength grade, carried out by the supplier and based on the statistical assessment of standard compressive strength tests on concrete, specified by compressive strength and produced by a specific supplying plant.
- Project assessment: An assessment procedure for concrete defined by strength grade, specified at the customer's option, which provides additional test data for the statistical assessment of concrete supplied to a specific project.
- Sample: A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples, prototypes and sample panels.
- Specimen: A portion of a sample which is submitted for testing.
- Weather – cold: Ambient shade temperature less than 10°C.
- Weather – hot: Ambient shade temperature greater than 30°C.

AS 3610.1 clause 1.5 includes definitions and Appendix E includes a glossary of terms.

Edit the **Definitions** subclause to suit the project or delete, if not required. List alphabetically.

1.8 TOLERANCES

Formwork

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

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

Position: Construct formwork so that finished concrete conforms to AS 3600 clauses 3.3 and 17.5 and as documented in the **Formwork dimensional deviation schedule**.

AS 3600 clause 17.5.2 states the limits beyond which the design rules of the standard no longer apply. They are not intended as building tolerances. More stringent tolerances may be suitable.

Reinforcement

Fabrication: To AS 3600 clause 17.2.

Reinforcement and tendon position: To AS 3600 clause 17.5.3.

Formed surfaces

Finish quality: To AS 3610.1 Table 3.3.3.1.

Document required surface finish class in the **Formed surface finishes schedule**.

Unformed surfaces

Flatness: To the **Flatness tolerance class table,** using a straightedge placed anywhere on the surface in any direction, for the documented class of finish.

Flatness tolerance class table

Class	Measurement	Maximum deviation (mm)
A	2 m straightedge	4
B	3 m straightedge	6
C	600 mm straightedge	6

These classes have been adopted by NATSPEC in the absence of such in Australian Standards. It has been assumed that smoothness and projection tolerances form part of substrate preparation for the applicable floor finishes. The straightedge does not consider the frequency of surface undulations or waves. Consequently a Class B finish containing one wave under the straightedge may be more effective than a Class A finish with multiple waves.

For further information refer to the *CCAA Data Sheet Tolerances for concrete surfaces.*

Typical applied finishes for each flatness tolerance class are:

- A: Resilient finishes.
- B: Unfinished (plantrooms), carpet, substrates for bituminous coatings.
- C: Floor tiles (scored finish).

Flatness tolerance class C is specifically stated for areas where the local flatness (600 mm) is not critical to the applied finishes. This varies from the minimum standard for flatness in AS 3600 clause 17.5.2.4.

1.9 SUBMISSIONS

Certification

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

Formwork execution certification: For other than Max Frank formwork systems 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.

Design documentation

If design or completion of design is the responsibility of the contractor include this *Optional* style text by changing to *Normal* style text.

Structural concrete calculations: Submit structural performance calculations.

Formwork calculations: For other than Max Frank formwork systems submit calculations by a professional engineer experienced in formwork design to show that allowable concrete stresses will not be exceeded and formwork capability will be maintained if the following is proposed:

- Formwork procedures or loadings that differ from those documented.
- Props above a floor that do not coincide with the props below.
- Undocumented formwork shoring or stripping procedures.
- Loadings from stacked materials.

Post-tensioned calculations: Submit the following:

- Calculations of tendon jacking forces, theoretical extensions and losses for each stressing stage and at final stressing, before stressing operations begin.
- Amount of draw-in expected in seating anchorages, friction along tendon (wobble) coefficient and friction curvature coefficient for tendons and duct-forming material.

Substantiating field data may also be required. Unless specified otherwise, the draw-in is 6 mm for wedge anchored strand post-tensioning and to the proprietary system recommendations for bar and wire. Friction wobble coefficient and friction curvature coefficient to AS 3600.

Execution details

Moveable formwork: Provide the following details on the formwork drawings:

- Table form and climbing formwork: Proposed method and sequence of moving the formwork to provide concrete of the documented quality and surface finish.
- Continuously climbing formwork (Slipform): The average rate of movement.

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 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.
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Details of any proposed welding of reinforcement to AS/NZS 1554.3.

Delete if welding is not acceptable. Welding of reinforcement shall not be made less than 3 bar diameters in length from any part of bar that has been bent or re-straightened.

Post-tensioning: Submit the following:

- Details of the proposed post-tensioning system tested and certified to AS/NZS 1314, including performance test certificates for each type and size of anchorage and coupler.
- Safe work method statements including the name and contact details of the subcontractor.

A post-tensioned strand, when tensioned, contains a considerable amount of stored energy. In the rare event of a strand breaking, serious injury to persons and damage to equipment can be caused by the sudden release of energy. Therefore, reasonable precautions must be taken when working with or near strands which have just been or are in process of being tensioned but are not yet grouted. These precautions must be included in the contractor's safe work method statement.

- Details of proposed gauging, stressing and grouting equipment and current calibration certificates for tensioning and tension measuring equipment.
- Concrete strength early age test results.

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

Consider back propping delay times for appropriate structural element.

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

- Changes to the concrete mix.
- 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.
- Sawn joints: Submit details of proposed methods, timing and sequence of sawing joints.

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

- For special-class performance concrete: Documented 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 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.

Surface repairs: If surface repairs are required, submit proposed methods.

Surface repairs may not be permitted depending on which surface finish class is selected.

Products and materials

Void formers: Submit test results as evidence of conformance to requirements of PRODUCTS, **MATERIALS**, **Void formers**.

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

Although AS 3600 Table 3.2.1 includes stainless steel reinforcement to BS 6744, AS 3600 later states in clause 17.2.1.1 that all reinforcement shall conform with AS/NZS 4671.

Post-tensioning: Submit the following:

- Grout: Proposed grout mix and certified test results (including grading, proportions, compressive strength, shrinkage and additives if any).

Grouting is usually done with a standard mix, method and equipment. Previous results are often accepted as sufficient, especially for smaller projects.

- Epoxy grout: If required, proposed formulation.
- Duct-forming material: Samples of proposed material.
- Prestressing steel: Test certificates to AS/NZS 4672.2 for every delivery of strand, bar or wire proposed.

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

- Certification by a JAS-ANZ 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:

- Certified test results for water retention to AS 3799 Appendix B for liquid membrane-forming compounds.

Polyvinyl acetate (PVA-based) products may not conform to water retention requirements, refer to AS 3799 Informative Appendix D clause D5.5.2.

- 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.

Prototypes

Test panels: Provide test panels to AS 3610.1 clause 3.7 and as documented in the **Test panels schedule**.

Test panels are optional for Class 3 surface finish and are generally not required for Class 4 or 5 surface finish.

Manufacture: Cast the panels using the form, concrete, compaction equipment, form release agents, curing and formwork removal methods which are to be used in the final work.

Storage: Once accepted, maintain the panels on site undamaged and protected from the weather, as reference prototypes for evaluation of completed work.

Surface treatment: Do not proceed with the related work until the acceptable range of surface treatments has been determined.

Records

Post-tensioning: Submit the following:

- Post-tensioning record.
- Post-tensioning stressing schedule.
- Post-tensioning grouting record.

Samples

Coloured concrete: Submit sample blocks of coloured concrete produced using the proposed mix and casting method before casting final concrete, as follows:

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

Shop drawings

Formwork: Submit shop drawings including details of proposed forms, falsework, form liners, bolt positions, release agents and, where applicable, re-use of formwork.

Post-tensioned drawings: Submit shop drawings showing the following:

- Profiles, sizes and details of tendons, tendon numbers, 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.

Theoretical extensions should not be shown on shop drawings.

Cores, fixings and embedded items: Submit the proposed locations, clearances and cover and show any proposed repositioning of reinforcement.

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.

Delete if supplier details are not required.

Tests

0171 General requirements covers tests in **Definitions** and calls for an inspection and testing plan under **SUBMISSIONS**, **Tests**.

Requirement: Submit test results, as follows:

Detail the tests required in **PRODUCTS** or **EXECUTION**, as appropriate, and list the submissions required here.

- Concrete compressive strength test results to AS 1012.9.
- Slip resistance test of completed installations.

1.10 INSPECTION

Notice

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

- Used forms, after cleaning and before re-use.
- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Completed formwork and reinforcement, tendons, cores, fixings and embedded items fixed in place before placing concrete.
- Concealed surfaces or elements before covering.
- Commencement of concrete placing.
- Evaluation of the off-form finishes.
- Evaluation of surface finish.

Amend to suit the project, adding critical stage inspections required.

The party responsible for the structural design of the element is usually responsible for the inspection.

Normal practice for post-tensioned concrete is for at least one inspection to be made after tendons are fixed in place and before concreting. Inspection is usually not made of initial, incremental, final stressing or grouting, unless required for particular elements to address specific concerns in the case of non-conformance or for quality assurance. If required, consider including this *Optional* style text by changing to *Normal* style text.

- Commencing initial, incremental or final stressing of tendons.

- Grouting and cutting tendons.

Hold points, if required, should be inserted here. If required, consider including this *Optional* style text by changing to *Normal* style text.

Hold points

General:

- Approval of proposed post-tensioning system tested to AS/NZS 1314, before work begins.
- Approval of actual post-tensioning extensions, before tendons are cut off or made inaccessible for stressing.

Approval of the proposed post-tensioning system is essential to make sure anchorages meet AS/NZS 1314, before work begins. Comparison of theoretical and actual extensions is a fundamental quality assurance requirement for virtually all post-tensioning. To allow tendons to be re-stressed and/or de-stressed and/or tendon force re-verified, tendons should not be cut off, or otherwise made inaccessible for stressing, until approved by the responsible party.

Post-tensioned steels are not weldable. After cutting off there is usually insufficient length to mechanically couple or to de-stress the tendon in a controlled manner.

Processing of extensions must be done promptly (within 24 hours of submission) to maintain integrity and credibility of the process and to avoid delays and additional costs.

Add the approving party and any approval time constraints, if known.

2 PRODUCTS

2.1 GENERAL

Product substitution

Other products: Conform to PRODUCTS, **GENERAL**, **Substitutions** in *0171 General requirements*.

The *0171 General requirements* clause sets out the submissions required if the contractor proposes alternative products. Refer also to NATSPEC TECHnote GEN 006 for more information on proprietary specification.

2.2 MAX FRANK SYSTEMS

General

Products: Visit www.maxfrank.com.au for more information on the technical specifications of the various Max Frank products.

Max Frank provides a diverse portfolio of products to be used in concreting works. The products can be divided into five specific categories of:

- Spacers.
- Formwork technologies.
- Reinforcement technologies.
- Sealing technologies.
- Building acoustics.

Detailed information regarding the individual products and systems that comprise the five categories above can be found on the Max Frank website.

Spacers

Description: Specialised spacer products used to maintain the specified cover to the reinforcement both before and during concreting works.

Requirements: As documented in the **Spacers schedule**.

Extruded fibre concrete:

- Blocks and bars: Compliant with requirements of AS/NZS 2425. Providing cover depths from 25 mm to 100 mm in increments of 5 mm.

Options with or without galvanised or stainless steel tying wire, spring clip connections, custom shapes and sizes and approved products suitable for drinking water applications.

- Distance tubes: Used in conjunction with threaded tie-bars to maintain concrete wall thickness before and during concreting works. Available in lengths of up to 1.25 m, with internal diameters of 22 mm, 27 mm, or 32 mm and a wall thickness of 9 mm, 12 mm or 15 mm.

Options for drinking water applications also available.

Cast concrete: Compliant with requirements of AS/NZS 2425. Providing cover depths from 20 mm to 50 mm in increments of 5 mm.

Connection options of plastic shuttlecock, plastic clip or loop wire.

Plastic: For use in situations where durability is not a concern. Available as ring or bar spacers to provide cover depths from 15 mm to 50 mm, generally in increments of 5 mm. Plastic distance tubes are also available.

U-Korb steel continuous high chair: Used as spacers between the lower and upper reinforcement layers in bases, slabs and walls. Available in heights of 20 mm to 380 mm.

Formwork technologies

Description: Specialised formwork products, including liners to improve concrete aesthetics and durability, special foundation forms, formwork for construction joints and other forms for precast and in situ applications.

Requirements: As documented in the **Formwork technologies schedule**.

Pecafil universal formwork systems: Lost formwork system for ground beams, pile caps, foundations and ribbed slabs, consisting of steel mesh with varying bar diameters and a heat shrunk polyethylene film. Supplied as flat material or curved or bent to specified dimensions.

Pecavoid ground movement solution: An expanded polystyrene cellular void former designed to reduce uplift pressure on concrete slabs, rafts and piled foundations by compressing when ground movement occurs. Capable of allowing for required voids of 50 mm to 200 mm.

Also available with an insulation layer and as the Pecavoid reduced depth range which can reduce excavation and spoil removal requirements.

Stremaform formwork elements: A deflection resistant expanded steel mesh welded between longitudinal and transverse steel bars, which can incorporate a metal or rubber bar water stop, for use in forming construction joints and expansion joints.

Other options, such as indented joints, acoustic separation joints, controlled crack joints, special shape formwork and the profiled expanded metal sheet Stremaboard are also available.

Tubbox column formers: Single use formwork for the production of circular columns to a range of diameters and heights with a choice of three finishes, spiral, smooth and blowhole free. Using special inserts can form a variety of different geometrical shapes, oval, rectangular, octagonal, etc. Tubbox Multi is suitable for multiple uses.

Fratec shaping formwork: Custom formwork for special shapes, capitals and bases, cornices and recesses and sculptural forms.

Zemdrain CPF formwork liner: Attached to formwork to remove excess air and water from the formwork/concrete interface during concreting works. Produces a high quality concrete surface with significantly increased durability properties. Used primarily for infrastructure projects such as drinking water reservoirs, water treatment plants and marine structures, but can be used for all concrete structures.

Permanent formwork elements: Fibre concrete, fibre cement and cement-based wooden chipboard formwork for permanent applications, including edging for semi-precast and precast elements, shutter panels, bevelled edge elements, lintels and balcony and slab edges.

Box-out shutters and recess formers: Steel and cardboard box-out forms to create apertures and recesses in concrete elements.

Accessories: Concrete formwork accessories including Trennfit concrete release agent, threaded steel tie bars and plastic corner form profiles.

Reinforcement technologies

Description: Specialised reinforcement connection systems for use in construction joints and expansion joints.

Requirements: As documented in the **Reinforcement technologies schedule**.

Stabox connection system: Reinforcement connection system using re-bendable steel for force transmission at joints between concrete elements. Available in single-row or twin-row types in bar diameters of 8 mm to 14 mm.

Stabox S is for standard applications, Stabox T is for situations with high shear forces and Stabox F for watertight applications.

Threaded steel coupler system: Reinforcement connection system with 100% load transmission, for both static and dynamic load. Conforms to the requirements of AS 1391 and AS/NZS 4671. Available in single box and multiple coupler boxes.

Egcodorn transverse force dowel system: Stainless steel shear dowel systems suitable for transverse force transmission for static and dynamic loads.

Edgcodubel transverse force dowel system: Shear dowel system that transmits transverse forces at expansion joints without impeding the horizontal movement of each component.

Egcobox cantilever connection system: Insulated reinforcement system for connecting cantilevered concrete elements, helping to prevent thermal bridging between buildings and external structural members.

Shearail punching shear reinforcement: Prefabricated punching shear reinforcement system for flat piled and post-tensioned concrete slabs.

Sealing technologies

Description: Specialised joint sealing systems for waterproof concrete structures.

Requirements: As documented in the **Sealing technologies schedule**.

Fradilex metal water stop: Supplied with an adhesive coating on one or both surfaces. The coating forms a bond with fresh concrete to seal construction joints.

The Fradilex water stop is also available with an integral crack inducer for both single and twin wall systems.

PVC water stops: For the sealing of construction joints against hydraulic pressure. Internal water tops are completely embedded in the concrete, whilst external water stops are embedded in the rear face of the concrete.

Intec injection hose system: Secure, simple and rapid method for sealing horizontal and vertical construction joints. Suited for sealing applications using the injection hose only and for supplementary sealing only when leaks are discovered. Sealant material available in PUR, epoxy and acrylic resins, cement suspension and cement paste.

Cresco expanding water stop: Watertight seal for construction joints with complicated geometrical joint shapes. The seal is achieved when the water stop swells after water ingress into the joint.

Synkoflex non-expanding adhesive water stop: Water stop for construction joints subjected to saline water or extreme cycles of wetting/drying.

The Synkoflex FR water stop is suitable for construction joints in concrete structures exposed to hydrocarbon liquid.

Permur liner pipes: Fibre cement pipe and seal insert for durable wall penetrations in areas with and without hydraulic pressure.

Rub'R Nek: Precast concrete joint sealant and joint wrap. Available in standard and fuel-resistant versions.

Max Frank also supply a full range of fully bonded sheet membranes, self-adhesive membranes and spray applied sheet membranes for waterproofing.

Building acoustics

Description: Specialised products to reduce the transmission of sound through concrete structures.

Requirements: As documented in the **Building acoustics schedule**.

Egcotritt dowel system: A shear force dowel system for acoustic decoupling. Up to 32 dB impact sound reduction achievable.

Egcosono bearing system: Acoustic decoupling system to reduce impact sound transmissions in staircases. The stair landing connection to the staircase walls is acoustically decoupled. Up to 31 dB impact sound reduction achievable.

Egcostep stair flight decoupling system: Acoustic decoupling system for the vertical joint between in-situ concrete stair landings and the stair flight. Up to 14 dB impact sound reduction achievable.

Egcoscal stair bedding system: Acoustic decoupling system for the bearing joint between concrete stair flights and concrete stair landings. Minimum 31 dB impact sound reduction achievable.

Two load cases available of 43 kN/m and 61 kN/m. Four standard lengths available of 1 m, 1.1 m , 1.2 m and 1.5 m. Other lengths available on request.

Egcodist wall and floor bearings: Acoustic decoupling pads suitable for the support of concrete slabs onto load bearing walls.

Available as elastic bearings, slide bearings or plane bearings.

Egcovoid former: A lost formwork system, available in two thicknesses of 35 mm and 50 mm, suitable for creating voids intended as a horizontal or vertical acoustic separation layer. After the concrete has achieved the desired strength, the void is achieved by injecting water into the Egcovoid former, causing the former to collapse producing the desired void.

Capable of supporting a maximum load of 150 kN/m^2.

Sorp 10 absorber: Combined sound absorption element and reinforcement spacer. Developed for use in thermally active slabs, but also suitable for use with most concrete elements.

2.3 CONCRETE

General

Stockpile: If uniform, consistent colour is documented, stockpile sand, cement and aggregates.

Properties

Concrete mix and supply: Conform to the following:

- Normal-class: To AS 1379 clause 1.5.3.
  - . Properties: As documented in the **Concrete properties schedule - performance**.

AS 1379 clause 1.5.3.2 nominates basic parameters including strength grade, slump and aggregate size that must be documented on the structural drawings or in the **Concrete properties schedule - performance**.

- Special-class: To AS 1379 clause 1.5.4.
  - . Performance properties: As documented in the **Concrete properties schedule - performance**.

Document the properties of special-class performance concrete on the structural drawings or in the **Concrete properties schedule - performance**.

  - . Prescription properties: As documented in the **Concrete properties schedule - prescription**.

Document the properties of special-class prescription concrete on the structural drawings or in the **Concrete properties schedule - prescription**.

Edit this subclause as appropriate.

Aggregates

Standard: To AS 2758.1.

Cement

Standard: To AS 3972.

Refer to CCAA TN59. If considering the use of geopolymer cement, refer to CIA Z16 for further information.

Age: Less than 6 months old.

Storage: Store cement bags under cover and above ground.

Supplementary cementitious materials:

- Fly ash: To AS/NZS 3582.1.
- Slag: To AS 3582.2.
- Amorphous silica: To AS/NZS 3582.3.

Water

Standard: To AS 1379 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.

Chemical admixtures

Standard: To AS 1478.1, used to manufacturer's recommendations.

Special-purpose admixtures are covered in AS 1478.1 Informative Appendix B clause B11.

Early strength

Early strength for post-tensioned concrete:

- For initial stressing stage: [complete/delete]
- For final stressing stage: [complete/delete]

List the early concrete strength requirements here, if not shown on the drawings.

2.4 NON-MAX FRANK FORMWORK

General

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

Trapped forms: 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.
- Collapse and loss of load carrying capacity occurs not more than 48 hours after flooding with water, creating a void at least 60% of the original depth of the void former.

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.

Minimum steel grade: G550.

Amend if appropriate.

Zinc coating weight: [complete/delete]

Nominate one of the following two levels of protection:

- Z350: 350 g/m^2 zinc coating weight is recommended for use in non-aggressive areas.
- Z450: 450 g/m^2 zinc coating weight is recommended for severe and aggressive environment where a build-up of airborne corrosive contaminants can affect the coating.

Make sure that the product documented has the level of galvanizing selected. Refer to NATSPEC TECHnote DES 010 on atmospheric corrosivity categories for ferrous products.

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

Plywood forms

Material: To AS 6669.

AS 6669 does not cover off-form surface finish Class 1.

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

Refer to AS 6669 for information on surface quality, veneer qualities, and stress grades.

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

Tolerances: To AS 3610.1 Section 3.

Document any special requirements.

2.5 NON-MAX FRANK REINFORCEMENT

Fibre reinforcement

Steel fibres: To AS 3600 clause 16.7.1.

Other fibres: To CIA CPN35.

Steel reinforcement

See the ARC*Reinforcement handbook* for information on steel reinforcement.

Standard: To AS/NZS 4671.

Shape: [complete/delete]

R (round), D (deformed ribbed), I (deformed indented) or Welded wire mesh.

Ductility class: [complete/delete]

L (low), N (normal) or E (seismic).

Strength grade: [complete/delete]

AS/NZS 4671 considers 3 strength grades; 250 MPa, 300 MPa and 500 MPa. See AS 3600 clause 17.2 for material and construction requirements.

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

See www.steelcertification.com for information on the Australian Certification Authority for Reinforcing and Structural Steels (ACRS) certification scheme for steel reinforcement. If certification to this (or any alternative) scheme is a project requirement, document such requirements here and in **SUBMISSIONS**.

Protective coating

Standard: To AS 3600 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.

- Thickness: 200 µm minimum.

Galvanizing: To AS/NZS 4680, as follows:

- Sequence: If fabricating after galvanizing, repair damaged galvanizing and coat cut ends.
- Zinc-coating (minimum): 600 g/m^2.

Consider whether passivation of the galvanizing needs to be documented. Refer to CIA CPN17 on the use of galvanized reinforcement in concrete to assess whether the default thickness is appropriate. Do not mix galvanized reinforcement with uncoated steel in an electrolyte (moisture) as adverse galvanic action can result.

Tie wire

General: Annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

Supports

Standard: To AS/NZS 2425.

2.6 POST-TENSIONING

Grout properties

Standard: To AS 3600 clause 17.1.8.

Maximum shrinkage: 1% by volume after 24 hours.

Maximum water:cement ratio: 0.45 (by weight).

Compressive strength: 32 MPa at 7 days.

Grout mixes for post-tensioned tendon ducts are usually determined by the contractor. Performance and testing requirements, if any, may be documented here if not shown on the drawings. Test frequency is dependent on the size of the project.

Grout materials

Fine aggregates: Do not use aggregates for post tensioning grout unless cross sectional area of ducts is 5 times the cross sectional area of the tendon.

Aggregates are rarely used for grouting of post-tensioning.

Cement: To AS 3972 and free from calcium chloride and less than two months old.

The use of GB cements for grouting is now accepted practice.

Admixtures: To AS 1478.1. Include an anti-bleed additive.

Fly ash: To AS/NZS 3582.1 and proportioned according to early strength requirements.

Water: To AS 1379. Clean, free from oil, acid, alkali, organic or vegetable matter and including not more than 500 mg/l of chloride ions.

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 deterioration or electrolytic action due to cement paste or water from the concrete entering the duct.

Profile: [complete/delete]

For example, corrugated steel or plastic. Document here, or show on the drawings.

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

Size: To allow feeding of tendons and grouting.

Tendon material

Prestressing steel: Type and grade of strand, wire or bar, to AS/NZS 4672.1.

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

Show size designations, ductility and diameters on the drawings.

Quality: Make sure tendons have no nicks, pitting, indents, damage or foreign matter such as mud and dirt. Inspect at delivery and store the prestressing steel 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 bars with surface imperfections more than 0.40 mm deep.

Other steel

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

Anchorages: To AS/NZS 1314.

Reinforcement: To AS/NZS 4671.

2.7 MISCELLANEOUS

Polymeric film underlay

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

Curing compounds

Liquid membrane-forming compounds: To AS 3799.

Surface modifiers

Hardeners, sealants and protectors: If documented, proprietary products conforming to the manufacturer's recommendations.

Slip resistance treatment: If documented, proprietary products conforming to the manufacturer's recommendations.

3 EXECUTION

3.1 MAX FRANK SYSTEMS

General

Requirement: Install Max Frank products in conformance with Max Frank's recommendations. For product installation guidelines and applications go to www.maxfrank.com.au.

3.2 POLYMERIC FILM UNDERLAY

Location

Requirement: 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.

Note: For NSW and SA damp-proofing membranes are required. See BCA clause 3.2.2.6.

Provision of a vapour barrier for external slabs on ground prevents water loss to the subgrade and has the potential to reduce slab curling at edges and corners.

AS 2870 clause 5.5 provides additional requirements and detailing of damp-proofing membranes for concrete slabs and footings exposed to either saline or acid sulphate soils. AS 2870 clause C5.5 and CCAA T56 provide information on concrete exposed to saline soils.

Base preparation

Requirement: Conform to base type, as follows:

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

Installation

Standard: To AS 2870 clause 5.3.3.

Requirement: 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.
- Continue 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 formwork has been removed.

3.3 NON-MAX FRANK FORMWORK

General
Requirement: As documented in the **Formed surface finishes schedule.**

Substrates
Cleaning: Before placing concrete remove free water, dust, debris and stains from the form face and the formed space.

Bolt holes
Formwork tie bolts left in the concrete: Position more than 50 mm from the finished surface.

Corners
Work above ground: Bevel with a chamfer at re-entrant angles, and a fillet at corners.

Face of bevel: 25 mm.

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

Openings
Requirement: In vertical forms provide 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 panels for placing concrete.

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

Climbing formwork
Provision for inspection: Provide access below the movable formwork, from which surface treatment and inspection may be carried out.

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

Steel linings
Rust: Clean off any rust and apply rust inhibiting agent prior to re-use.

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

3.4 NON-MAX FRANK REINFORCEMENT

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

Tolerances:

- Alignment: 1:150.
- Location: ± half the diameter of the dowel.

Grade: 250 N.

Amend this default if required.

Cover
Concrete cover generally: To AS 3600 clause 4.10.

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

Concrete cover for residential ground slabs and footings: To AS 2870.

Show concrete cover on the structural drawings.

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.

For special soffit finish, avoid metal chairs.

Spacing:

- Bars: ≤ 60 bar diameter.
- Mesh: ≤ 600 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

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.

Refer to AS 3600 clause 8.3.1.7 for requirements on the use of bundled bars. If possible, avoid the use of bundled bars.

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.

AS 3600 clause 13.2 specifies requirements for mechanical splices. Determine whether limits on non elastic deformation (slip) are also needed.

Fibre-reinforced concrete

Steel fibres: To AS 3600 Section 16.

3.5 POST-TENSIONING

See *0313 Concrete post-tensioned* for further information on grouting pumps, concreting, post-tensioning, measurement of site extensions, cutting tendons, grouting, grout openings and grout pressure.

General

Protection: Protect post-tensioning tendons, anchorages, ducts, supports and grout from damage or contaminants, including from swarf, loose grease, oil and paint.

Tolerances: To AS 3600 clause 17.5.3.

Minimum concrete cover: As documented.

Show on the drawings.

Post-tensioning record: Provide details of the following:

- Concrete mix.
- Concrete placing and curing methods, including dates.
- 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).
- Early age test results for strength.

- Tendon breakage and non-conformance reports.

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.

Sheathing: If ducts are formed with sheaths, provide sheathing material capable of transferring the tendon stresses into the body of the concrete.

Sequence: Assemble tendons on site by installing strand, bar or wire within the duct before concreting.

It is not standard practice to install tendons after the concrete, however, if required consider using the following *Optional* style text by changing it to *Normal* style text.

Stiffening: If installing tendons after concreting, provide temporary stiffening within the sheath to maintain the duct shape and profile during concreting. After concreting, remove the temporary stiffening and prove the duct using a suitable gauge before installing the tendon.

Damage: If damaged, repair ducts as follows:

- Small holes: Waterproof adhesive tape.
- Larger holes: Metal strips wrapped around the duct, with 100 mm overlap and sealed by a waterproof adhesive tape.

Crossover points: If ducts running in opposite directions clash, consult the professional engineer. Do not relocate ducts without approval.

Anchorages

Anti-burst reinforcement: As documented.

Anti-burst reinforcement is part of the structural design and must be co-ordinated by the structural designer. The post-tensioning contractor may be consulted for the system specifics.

Tendons

The technical requirements for prestressing tendons are generally covered by AS 3600 clause 17.3.

Care: Do not weld tendons. Do not expose tendons 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 as documented in the **Tendon schedule**.

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

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

If encasing of external tendons is required, provide details of proposed procedure and materials.

Slab marking: If there is possibility for future slab penetrations, mark the tendon locations, either on the slab surface or the soffit.

Before casting the slab, stainless steel staples may be used to secure the ducts to formwork. When the formwork is removed the tendon locations are obvious.

Alternately, chalk lines may be marked on the slab top surface to aid in the location of post-tensioning tendons. These procedures will assist in locating future openings away from tendons.

Gauges and jacks

Standard: To AS 1349.

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

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

A particular gauge and jack, often of the same number, are usually used and calibrated together.

Gauges are sensitive to rough handling. Digital gauges may be used that provide equivalent accuracy.

Sets: Calibrate and use jacks and gauges as a set.

Stressing

Post-tensioning: To AS 3600 clause 17.3.4.5.

Concrete strength: Complete early age tests before stressing.

Achieving sufficient concrete strength before each stage of stressing is critical to avoid failures of concrete in anchorages.

Stressing procedure: Carry out stressing after age tests results indicate concrete has attained the required strength.

Stressing stages: As documented.

Generally carried out in 2 stages:

- Initial stressing stage: 25% of the stressing force is applied when the concrete strength reaches 7 to 9 MPa.
- Final stressing stage: 100% of stressing force is applied when the concrete strength reaches 22 MPa for 12.7 mm diameter strands and 25 MPa for 15.2 mm diameter strands. (Usually between 4 and 7 days based on site cured test cylinders).

If a particular stressing system is required, document the system and the technical requirements either here or on the drawings. If tendons are to be stressed in a particular sequence or in stages, show on the drawings.

Concrete strength at initial stressing stage is sometimes referred to as transfer strength.

Required transfer strength is critical for safety and structural adequacy. Transfer strength is governed by avoiding failure of concrete at anchorages and may be separately governed by structural adequacy.

Marking: Mark strands after wedges are installed and before initial stress.

Slip: Check markings whilst stressing to make sure there is no slip of strands.

Stress records: Measure gross extensions on site and include initial and final stress extensions.

Site extensions: Submit the site extensions on the same day as measured for review and approval by the structural engineer.

Non-conformance: If the difference between theoretical and measured extensions is greater than 10%, provide an explanation of the cause.

Cutting tendons: Do not cut tendons until the actual extensions are approved.

Re-stress or de-stress: Adjust stress in tendons if necessary, after the theoretical and site extensions are compared.

Post-tensioning stressing schedule: Provide a stressing schedule, including the following information.

- 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, but not marked at nil load.
- Force applied (dynamometers).
- Pump or jack pressure and area of the piston.
- Elongation before anchoring.
- Elongation remaining after anchoring.

Grouting

Timing: Grout tendons as soon as practicable after stressing and for corrosive environments within 3 weeks, or as documented.

Time limit: [complete/delete]

Atmospheric corrosivity categories are defined in AS 4312.

Grout tendons within:

- One week for high (Category C4, C5 and T) corrosivity level.
- Two weeks for medium (Category C3) corrosivity level.
- Three weeks for low (Category C1-C2) corrosivity level.

Provide adequate protection procedures in situations defined as Category C5.

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.

Grout caps: Provide at each anchorage and seal for grouting and venting operations.

Post-tensioning grouting record: For each duct grouted, provide the following:

- Duct and tendon identification.
- 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).

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).

3.6 CONCRETE SUPPLY

Elapsed delivery time

General: Make sure 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°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

AS 1379 nominates a limit of 90 minutes which can be waived by agreement between the customer and supplier, if, after that period, the consistency of the concrete allows placing without the addition of more water to the mixer.

Pre-mixed supply

Addition of water: To AS 1379 clause 4.2.3.

Transport method: Select to prevent segregation, loss of material and contamination of the environment, and not to adversely affect placing or compaction.

Site mixed supply

Emergencies: If mixing by hand, provide details.

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

3.7 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.

Assessment process of test results

Standard: To AS 1379.

Method of assessment: Project assessment.

Consider changing the default to Production assessment, if satisfactory for the particular project. Document also the method of assessment in the **Concrete properties schedule - performance**. If the method of assessment is not documented, production assessment will be carried out by the concrete production plant.

Sampling

Method of sampling: AS 1012.1.

Sampling locations: To AS 1012.1 and the following:

- Slump 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 Sections 5 and 6 and the following:

- Slump 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: Columns and load bearing wall elements/batch	Minimum number of samples: Other elements/day
1	1	1
2-5	1	2
6-10	1	3
11-20	1	4
each additional 10	1	1 additional

For project assessment, AS 1379 clause 6.5.2 requires one sample from each 50 m^3 of concrete. For columns and load bearing walls, one sample from each batch is recommended, and for all other elements, sampling to the per day defaults of the table. The table default values are considered good practice but specifiers may amend the table to reflect the quality control and accepted level of risk they deem suitable for the project.

Making and curing of specimens

General: To AS 1012.8.1 and AS 1012.8.2.

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

Specimen size:

- Aggregate size ≤ 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:

- General: As documented in the **Concrete properties schedule – performance**.
- Early age compressive strength: As documented in the **Control tests schedule**.

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

For shrinkage sensitive structures the duration of air drying should be 56 days.

Liquid retaining structures

Testing for liquid tightness: To AS 3735.

3.8 NON-MAX FRANK CORES, FIXINGS AND EMBEDDED ITEMS

General

Requirement: Install fasteners to manufacturer's recommendations and the assumptions of AS 5216 Appendix D.

Adjoining elements

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

Protection

General: Grease threads. Protect embedded 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 surface finish.

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

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 that provides minimum cover to reinforcement.

Tolerances

General: Maximum deviation from correct positions:

- Anchor bolt groups for structural steel: To AS/NZS 5131.

- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

Edit as necessary to suit project requirements.

3.9 CONCRETE WORKING BASE

Finish

Membrane support: Wood float finish or equivalent.

Installation

General: Lay over the base or subgrade and screed to the required level.

Surface flatness tolerance

Maximum deviation: 6 mm from a 3 m straightedge.

This is equivalent to flatness tolerance class B for unformed surfaces.

3.10 PLACING AND COMPACTION

Placing

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

Methods: 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.

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

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

Vertical elements

Placement: Limit the free fall of concrete to maximum of 2000 mm.

Placing in cold weather

The CCAA Data Sheet Cold-weather concreting recommends taking precautions when the air temperature falls below 10°C.
The effects on placing concrete in cold weather include:

- Extended setting times of concrete.
- Slower strength gain.
- Increased risk of cracking.
- Freezing of the concrete.

Actions to prevent damage from cold weather include protecting the concrete from cold winds and reduced temperature.

Cement: Do not use high alumina cement.

Temperature limits: Maintain the following:

- Freshly mixed concrete: ≥ 5°C.
- Forms and reinforcement before and during placing: ≥ 5°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 ≥ 5°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 forms, materials, and equipment coming in contact with the concrete.

Freezing: Prevent concrete from freezing.

Placing in hot weather

The CCAA Data Sheet Hot-weather concreting recommends taking precautions when the air temperature rises above 30°C and increases with high wind speeds or low humidity. The effects on placing concrete in hot weather include:

- Setting time reduced.
- Workability and slump reduced.
- Strength development altered.
- Poor surface and texture appearance.
- Plastic shrinkage cracking increased.
- Thermal cracking.

Actions to prevent damage from hot, dry and windy weather include:

- Keep temperature down, by wetting, shading and placing in the cooler part of the day.
- Minimise delays.
- Control the loss of water through evaporation by the use of aliphatic alcohol.
- Protection of the concrete from drying winds.
- Proper curing.

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

Temperature limits: Maintain the following:

- Normal concrete in footings, beams, columns, walls and slabs: ≤ 35°C.
- For concrete strength grade less than 40 MPa with section thickness ≥ 1 m in all dimensions: ≤ 27°C.
- For concrete strength grade 40 MPa or greater with section thickness ≥ 600 mm in all dimensions: ≤ 27°C.
- Forms and reinforcement before and during placing: ≤ 35°C.

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

Temperature control: Select one or more of the following methods of maintaining the temperature of the placed concrete at 35°C or less:

- Cool the concrete using liquid nitrogen injection before placing.
- Cover horizontal transport containers.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water.

Placing under water

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

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

3.11 NON MAX FRANK 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, 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 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.

Slip joints

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

3.12 SURFACE MODIFIERS

General

Application: Apply to clean surfaces, to the manufacturer's recommendations.

3.13 FORMED SURFACES

General

Surface finish: As documented in the **Surface finish class schedule** and the **Formed surface finishes schedule.**

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

Curing

Requirement: If formwork is stripped before the minimum curing period for the concrete has elapsed, continue curing the exposed faces as soon as the stripping is completed.

Evaluation of formed surfaces

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

Finishing methods

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

Form removal: If vertical face formwork needs to be removed for finishing methods, while the concrete is green, make sure the concrete has sufficiently set to prevent slump.

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.

Document the type of abrasive particles in **SELECTIONS**.

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: While the concrete is green, wet the surface and scrub with stiff fibre or wire brushes, flushing continuously with clean water, until the aggregate is uniformly exposed. Do not use acid etching. Rinse the surface with water.

See CCAA Briefing 02 for information on exposed aggregate finishes for flatwork.

Floated finishes:

- Sand floated finish: 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: 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: 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.

Only the more common finishing methods are listed. Add other project specific requirements (e.g. polished, coloured).

3.14 UNFORMED SURFACES

General

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

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

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 finish, uniform in texture and appearance, and free of trowel marks and defects.

For burnished concrete finishes see the following publications:

- CCAA Briefing 05.
- CCAA Data Sheet The specification of burnished concrete finish.

The Datasheet provides suggested specification clauses which may be considered for inclusion by the engineer in the appropriate concrete worksections.

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 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 machine floating and steel trowelling, use a damp sponge to wipe the surface to produce an even textured sand finish.

Exposed aggregate finish: After floating and when concrete has stiffened, wet the surface and scrub with stiff fibre or wire brushes, flushing continuously with clean water, until the aggregate is uniformly exposed. Rinse the surface with water.

See CCAA Briefing 02 for information on exposed aggregate finishes.

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: After machine floating, apply a proprietary liquid or dry shake material to the manufacturer's recommendations and trowel to achieve the required appearance.

Stamped and coloured faux paved or cobblestone finish: Provide a proprietary finishing system.

Polished finish: After steel trowelling, grind the cured surface of the concrete.

For polished or honed concrete finishes see the following publications:

- CCAA Briefing 05.
- CCAA Data Sheet The specification of honed or polished concrete finishes.

The Datasheet provides suggested specification clauses which may be considered for inclusion by the engineer in the appropriate concrete worksections. The range of treatments to achieve and to embellish polished concrete surfaces is large, and includes colouring, texturing, patterning by saw cutting or inlaying of metal or timber strips or of tiles or pavers. The effect required should be comprehensively documented by the architect.

For slip resistance a number of the unformed surface finishes listed satisfy the requirements, to differing degrees. Refer to CCAA Data Sheet Slip resistance of polished concrete surfaces and CCAA Data Sheet Slip resistance of residential concrete paving surfaces.

3.15 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 minimum 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 the following, unless accelerated curing is adopted:
  - . Fully enclosed internal surfaces/Early age strength 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.

Curing method: [complete/delete]

To limit early age shrinkage: Consider using an aliphatic alcohol before the application of particular curing compound.

Curing compounds

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

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

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.

Water curing

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

3.16 COMPLETION

Formwork removal

Extent: Remove formwork, other than Max Frank permanent formwork products, and other permanent forms or trapped forms, including formwork in concealed locations.

Timing: Do not disturb formwork until concrete has reached sufficient hardness to withstand formwork movements and removal without damage.

Stripping:

- General: To AS 3600 where it is more stringent than AS 3610.1.
- Vertical formwork: To AS 3610.1 Appendix C Table C2.
- Multi-storey work: Remove formwork without disturbing props supporting succeeding floors.
- Post-tensioned concrete: Remove formwork supporting post-tensioned concrete members to AS 3600 clause 17.6.2.7.

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.

Curing: If formwork is stripped before the minimum curing period for the concrete has elapsed, continue curing the exposed faces as soon as the stripping is completed.

Protection

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

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

Completion tests

Slip resistance of completed installation: To AS 4663.

Delete if not required. See NATSPEC TECHnote DES 001.
The wet-barefoot inclining platform test and the oil-wet inclining platform test cannot be performed in situ.

4 SELECTIONS

Schedules are a way of documenting a selection of proprietary or generic products or systems by their properties. Indicate their locations here and/or on the drawings. Refer to NATSPEC TECHnote GEN 024 for guidance on using and editing schedules.

4.1 MAX FRANK SCHEDULES

Spacers schedule

Property	A	B	C
Type			
Article number			
Distance tube closing option			
Distance tube sealing option			
Drinking water application			

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

Edit codes in the **Schedule** to match those on drawings.

Type: e.g. Extruded fibre block, Extruded fibre bar, Plastic, etc.

Article number: Specific product number of the spacer required, obtained from Max Frank Product List.

Distance tube closing option: Specific product number of the spacer required, obtained from Max Frank Product List. Delete if not required.

Distance tube sealing option: Specific product number of the spacer required, obtained from Max Frank Product List. Delete if not required.

Drinking water application: Yes or No.

Formwork technologies schedule

Property	A	B	C
Type			
Article number			
Pecafil width (mm)			

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

Edit codes in the **Schedule** to match those on drawings.

Type: e.g. Pecafil, Stremaform, Tubbox, etc.

Article number: Specific product number of the formwork required, obtained from Max Frank Product List.

Pecafil width (mm): Select from 600, 900, 1200, 1500 or 1800.

Reinforcement technologies schedule

Property	A	B	C
Type			
Article number			

A, B, C: These designate each instance or type of the item scheduled. Edit to align with the project's codes or tags.
Edit codes in the **Schedule** to match those on drawings.
Type: e.g. Stabox, Coupler, Egcobox, etc.
Article number: Specific product number of the reinforcement product required, obtained from Max Frank Product List.

Sealing technologies schedule

Property	A	B	C
Type			
Article number			

A, B, C: These designate each instance or type of the item scheduled. Edit to align with the project's codes or tags.
Edit codes in the **Schedule** to match those on drawings.
Type: e.g. Fradiflex, Intec, Cresco, etc.
Article number: Specific product number of the sealing product required, obtained from Max Frank Product List.

Building acoustics schedule

Property	A	B	C
Type			
Article number			

A, B, C: These designate each instance or type of the item scheduled. Edit to align with the project's codes or tags.
Edit codes in the **Schedule** to match those on drawings.
Type: e.g. Egcotritt, Egcostep, Sorp 10, etc.
Article number: Specific product number of the building acoustics product required, obtained from Max Frank Product List.

4.2 OTHER SCHEDULES

Formwork dimensional deviation schedule

Dimension or measurement	Location or element	Deviation (mm)

Dimension or measurement: e.g. Absolute position.
Location or element: e.g. Class 2 surface, Class 3 surface.
Deviation (mm): e.g. 15. 20, 25.

Tendon schedule

Structural element	Tendon material	Tendon size (mm)

It is preferable for the tendon material and size to be shown on the drawings. If not, it may be scheduled here (do not duplicate).
Tendon material: Specify the type and grade of strand, wire or bar. See AS/NZS 4672.1 and AS/NZS 4672.2.
Tendon size: State the number and nominal diameter of strands, wires or bars in each tendon.

Concrete properties schedule – performance

Use this schedule if normal-class or special-class performance concrete is specified. Otherwise delete.

Property	A	B	C
Normal and special-class			

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

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

Edit codes in the **Schedule** to match those on drawings.

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

- Water tight structures: Normally between 500 to 550 με.
- Concrete up to and including strength grade 32: 650 με.
- Higher strength grades: 700 με.

Specifying unrealistically low standard 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 ≠ crack control*.

If the concrete is special-class only because of the documentation of a drying shrinkage less than 1000 με, delete the special-class section of the schedule and simply document the required drying shrinkage.

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

Concrete properties schedule – prescription

Use this schedule if special-class prescription concrete is specified. Otherwise delete

Property	A	B	C
Aggregate water absorption, maximum (%)			
Admixtures: Proportions			

Property	A	B	C
Admixtures: Types			
Coarse aggregate: Proportions			
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			

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

Edit codes in the **Schedule** to match those on drawings.

Control tests schedule

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

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	

Test panels schedule

Application	Incorporated features	Panel size

Formed surface finishes schedule

Property	A	B	C

Property	A	B	C
Location			
Surface finish class to AS 3610.1			
Formwork lining type			
Bolt hole filling			
Surface finishing method			
Abrasive particle type			
Evaluation			

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

Edit codes in the **Schedule** to match those on drawings.

Surface finish class to AS 3610.1: For applicability of surface classes, see AS 3610.1 Table 3.2.3.

Abrasive particle type: eg Steel shot or Fine aggregates.

Evaluation: Required. For evaluation of surface tolerance or colour. Delete if not required.

Surface finish class schedule

Property	Class 1	Class 2	Class 3
Colour control			
Critical faces of elements			
Distance between face steps (mm)			
Form face span and direction of span			
Repairs	Not permitted		
Liner details, pattern and accuracy			
Surface pattern details and accuracy			
Surface treatment pattern			
Tie rod pattern			

Unformed surface finishes schedule

Property	A	B	C
Location			
Flatness tolerance class			
Primary finish			
Supplementary finish			
Slip resistance treatment			
Slip resistance classification			

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

Edit codes in the **Schedule** to match those on drawings.

Flatness tolerance class: e.g. Class A, B or C.

Primary finish: e.g. Machine float, Steel trowel, Burnished, Wood float, Broom, Scored or scratch, Sponge or Exposed aggregate.

Suggested primary finish and flatness tolerance class for typical applied finishes:

- Resilient finishes: Steel trowelled finish, tolerance Class A.
- Carpet: Machine float finish, tolerance Class B.
- Floor tiles: Scored finish, tolerance Class C.
- Unfinished (plantrooms): Machine float, tolerance Class B.
- Substrates for bitumen membranes: Wood float or light broom finish, tolerance Class B.

Supplementary finish: e.g. Steel shot abrasive blast, Fine aggregate abrasive blast, Coloured applied, Stamped and coloured faux paved or cobblestone finish, Polished. Add product, method, colour, pattern and texture as required.

Slip resistance treatment: Select to manufacturer's recommendations.

Slip resistance classification: For selections refer to NATSPEC TECHnote DES 001, SA HB 197 and SA HB 198, and CCAA Data Sheet Slip resistance of residential concrete paving surfaces. Select the slip resistance test and classification to suit the location and application.

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 1012.8.1	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/NZS 1314	2003	Prestressing anchorages
AS 1349	1986	Bourdon tube pressure and vacuum gauges
AS 1379	2007	Specification and supply of concrete
AS 1391	2007	Metallic materials - Tensile testing at ambient temperature
AS 1397	2011	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 2327	2017	Composite structures - Composite steel-concrete construction in buildings
AS/NZS 2425	2015	Bar chairs in reinforced concrete - Product requirements and test methods
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 3600	2018	Concrete structures
AS 3610		Formwork for concrete
AS 3610.1	2018	Specifications
AS 3735	2001	Concrete structures 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 3972	2010	General purpose and blended cements
AS 4586	2013	Slip resistance classification of new pedestrian surface materials
AS 4663	2013	Slip resistance measurement of existing pedestrian surfaces
AS/NZS 4671	2001	Steel reinforcing materials
AS/NZS 4672		Steel prestressing materials
AS/NZS 4672.1	2007	General requirements
AS/NZS 4672.2	2007	Testing requirements
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 5131	2016	Structural steelwork - Fabrication and erection
AS 5216	2018	Design of post-installed and cast-in fastenings in concrete
AS 6669	2016	Plywood - Formwork
CIA CPN35	2003	Fibres in concrete

The following documents are mentioned only in the *Guidance* text:

AS 2327		Composite structures
AS 2327.1	2003	Simply supported beams
AS 3600	2009	Concrete structures

AS 3600 Supp 1	2014	Concrete structures - Commentary
AS 3735 Supp 1	2001	Concrete structures retaining liquids - Commentary
AS 4312	2008	Atmospheric corrosivity zones in Australia
SA HB 28	1997	Design of residential slabs and footings
SA HB 71	2011	Reinforced concrete design in accordance with AS 3600-2009
SA HB 84	2018	Guide to concrete repair and protection
SA HB 197	1999	An introductory guide to the slip resistance of pedestrian surface materials
SA HB 198	2014	Guide to the specification and testing of slip resistance of pedestrian surfaces
ARC Handbook	2010	Reinforcement handbook - Your guide to steel reinforcement
BCA 3.2.4	2016	Acceptable construction - Footings and slabs - Site classification
BCA C1.10	2016	Fire resistance - Fire resistance and stability - Fire hazard properties
CCAA Data Sheet BCF	2010	The specification of burnished concrete finish
CCAA Data Sheet CWC	2004	Cold-weather concreting
CCAA Data Sheet HPC	2010	The specification of honed or polished concrete finishes
CCAA Data Sheet HWC	2017	Hot-Weather Concreting
CCAA Data Sheet SRP	2006	Slip resistance of polished concrete surfaces
CCAA Data Sheet SRR	2003	Slip resistance of residential concrete paving surfaces
CCAA Data Sheet TCS	2005	Tolerances for concrete surfaces
CCAA Fact Sheet	2012	Specifying low drying shrinkage ≠ crack control
CCAA Briefing 02	2007	Exposed-aggregate finishes for flatwork
CCAA Briefing 05	2006	Polished concrete floors
CCAA Briefing 11	2010	Sustainable concrete materials
CCAA Briefing 12	2010	Thermal mass benefits for housing
CCAA Briefing 13	2010	Sustainable concrete buildings
CCAA Briefing 18	2011	Houses for flood-prone areas
CCAA T49	2003	Guide to residential floors
CCAA T56	2005	Guide to residential slabs and footings in saline environments
CCAA T57	2006	Guide to off-form concrete finishes
CCAA T58	2007	Climate-responsive house design with concrete
CCAA T59	2008	Guide to concrete flatwork finishes
CCAA TN59	2017	Cements - manufacture, characterisation and use - The requirements of AS 3972 - 2010
CIA CPN17	2008	The use of galvanized reinforcement in concrete
CIA CPN28	2005	Watertight concrete structures
CIA CPN29	1996	Prestressed concrete anchorage zones
CIA Z13	2001	Performance criteria for concrete in marine environments
CIA Z16	2011	Geopolymer recommended practice handbook
CIA Z36	2016	Formwork handbook
CIA Z40	2005	Super-workable concrete
NATSPEC DES 001	2016	Slip resistance performance
NATSPEC DES 006	2007	Specifying concrete
NATSPEC DES 010	2015	Atmospheric corrosivity categories for ferrous products
NATSPEC GEN 006	2007	Product specifying and substitution
NATSPEC GEN 024	2015	Using NATSPEC selections schedules
NATSPEC TR 01	2018	Specifying ESD
SRIA Seismic Guide	2015	Guide to seismic design and detailing of reinforced concrete buildings in Australia
BS 6744	2016	Stainless steel bars - Reinforcement of concrete - Requirements and test methods
ISO 9001	2015	Quality management systems - Requirements