

## 0310P AFS WALL SYSTEMS IN CONCRETE COMBINED

### Branded worksection

This branded worksection *Template* has been developed by NATSPEC in conjunction with **AFS Systems Pty Ltd**<sup>®</sup> and may be used whilst the Product Partner is licensed to distribute it. The copyright remains with NATSPEC. As with all NATSPEC worksections, it is the responsibility of the user to make sure it is completed appropriately for the project. The user should also review its applicability for local conditions and regulations. Check [www.natspec.com.au](http://www.natspec.com.au) for the latest updated version.

### Worksection abstract

This branded worksection *Template* is applicable to the use of concrete for building and associated structures together with specialist permanent formwork system products by AFS for external and internal concrete walls. 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*.

### 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](http://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.*
- *0612 Cementitious toppings.*
- *0613 Terrazzo in situ.*

### Material not provided by AFS Systems Pty Ltd<sup>®</sup>

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

- Concrete.
- Formwork other than AFS LOGICWALL<sup>®</sup> and AFS REDIWALL<sup>®</sup>
- Reinforcement.
- 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.
- Refer to NATSPEC TECHnote DES 006 on specifying concrete.
- See AS 2870, SAA 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*.
- Refer to CCAA Briefing 18 for information on design of concrete slabs for housing in flood-prone areas.
- This worksection contains text that may be adapted for use in design and construct projects.

The *Normal* style text of this worksection may refer to items as being documented elsewhere in the contract documentation. If required, make sure they are documented. For example:

- Applied finishes.
- Reinforcement layout, details, splice locations and concrete cover.
- Colour requirements.
- Dimensions and loadings.
- PT anti-burst reinforcement.
- PT stressing stages.
- Construction joints.

Search [www.environmentdesignguide.com.au](http://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 including additional text:

- Recycled concrete aggregate.
- Pre-consumer supplementary cementitious materials (SCM) as partial replacement for portland cement. e.g. fly ash, slag cement and amorphous silica.
- Reinforcing from recycled steel.
- Recycled plastic in fibre reinforced concrete.
- Re-use of formwork.
- Exposed concrete slab to reduce finish materials required.

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.
- Sustainable design strategies: NP PCH (Precast concrete handbook), e.g. for the use of hollow core floor planks as ducting system to channel air around the building.

## 1 GENERAL

AFS Systems Pty Ltd<sup>®</sup> has over 18 years' experience in supplying the construction industry with proprietary wall and framing systems. During this time AFS quickly earned a reputation for the manufacture and supply of innovative, permanent formwork walling solutions. So much so that CSR, the name behind some of the market's most trusted and recognised brands chose to acquire AFS.

To date AFS has completed in excess of 1,000 projects, including 30,000 multi-residential units, solidifying its position as a leading supplier of permanent formwork wall solutions.

Whether it be a builder, developer, architect or engineer AFS has earned a reputation throughout Australia and abroad for supplying innovative walling solutions coupled with a genuine commitment to service excellence.

### 1.1 RESPONSIBILITIES

#### General

Requirement: Provide cast concrete, as documented.

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

It is the designer's responsibility to select surface finish methods that are compatible with the requirements of floor finishes applied over concrete.

AFS: Provide AFS LOGICWALL<sup>®</sup> and AFS REDIWALL<sup>®</sup> systems, as documented.

#### Performance

Requirements:

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

### 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.

Formwork: The design of formwork is the contractor's responsibility, other than profiled steel sheeting composite formwork, standard AFS braces and AFS LOGICWALL<sup>®</sup> and AFS REDIWALL<sup>®</sup> panels. 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 profiled steel sheeting) or purpose-made formwork.

Structural design: To AS 3600.

AFS LOGICWALL<sup>®</sup>: To AS 3600.

AFS REDIWALL<sup>®</sup>: To AS 3600.

Post-tensioning: To AS 3600.

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

See AS 3600 Section 2 and AS 3600 Section 3 on design procedures and material properties and AS 3600 Section 4 on design for durability.

Delete if the work is fully documented in the contract documents.

## 1.3 COMPANY CONTACTS

### AFS technical contacts

Website: Go to [www.afswall.com.au](http://www.afswall.com.au) and follow the Contact Us tab.

## 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, formed surfaces: 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 also cites AS 2327.1-2003.

Specification and supply of concrete: To AS 1379.

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.

SAA HB 71 provides guidance on concrete design to AS 3600, and is jointly published with the Cement and Concrete Association of Australia. SAA 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*.

Residential ground slabs and footings: To AS 2870.

Post-tensioning: To AS 3600.

Concrete structures for retaining liquids: To AS 3735.

For concrete structures 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.

Design, installation and testing of post-installed and cast-in fastenings: To SA TS 101.

Delete standards not applicable to the works.

### Slip resistance

Classification: To AS 4586.

## 1.6 MANUFACTURER'S DOCUMENTS

### Technical manuals

Data and technical manuals: Visit [www.afswall.com.au](http://www.afswall.com.au) to login to the AFS Design Toolbox or order a free CD or hard copy of the AFS LOGICWALL<sup>®</sup> Designer Manual and AFS REDIWALL<sup>®</sup> AFS Rediwall.

## 1.7 INTERPRETATION

### Definitions

General: For the purposes of this worksection the following definitions apply:

- AFS LOGICWALL<sup>®</sup>: Fire and acoustic rated permanent formwork system for concrete walling for external and internal walls.
- AFS REDIWALL<sup>®</sup>: Polymer based permanent formwork system for concrete walling for external and internal walls.
- 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 relevant period at a site.
- Batch: A quantity of concrete containing a fixed quantity of ingredients and produced in a discrete operation.
- Concrete class – normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in conformance with AS 1379 clause 1.5.3.
- Concrete class – special: Concrete which 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.
- Formwork: Formwork: The surface, supports and framing used to define the shape of concrete until it is all self-supporting. Formwork types include:
  - . Jump formwork: Incrementally moved formwork.
  - . Lost formwork: Sacrificial formwork left in place.
  - . Slip formwork: Continuously slipped or moving formwork.

- . Table forms: Prefabricated and re-usable formwork systems for slabs and beams.
- Green concrete: Concrete which has set but not appreciably hardened.
- Production assessment: An assessment procedure for concrete specified by strength grade, carried out by the supplier on concrete produced by a specific supplying plant and based on the statistical assessment of standard compressive strength tests on concrete.
- Project assessment: An assessment procedure for concrete specified 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.

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 clause 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 and fixing: To AS 3600 clause 17.2.

Reinforcement and tendon position: To AS 3600 clause 17.5.3.

### Finishes

Formed surfaces finish quality: To AS 3610.1 Table 3.3.2.

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

Consider deleting for class 2 formwork. Delete for class 3-5 formwork.

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 Cement Concrete Aggregates Australia - 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.

### AFS wall systems

Position: Install AFS wall panels so that completed walls conform to AS 3600 clause 17.5.

The surface finish for AFS wall panels does not need to be specified in the concrete worksection as the finish is provided by the external face of the wall panel. However, the final quality of the finished wall needs to be specified in later **FINISH** worksections in accordance with AS/NZS 2589.

## 1.9 SUBMISSIONS

### Certification

Formwork design certification: For other than profiled steel sheeting composite formwork, submit certification by a professional engineer experienced in formwork design verifying conformance of the design.

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

Post-tensioned concrete certification: Submit independent certification by professional engineer of the design and erected framing.

### Design documentation

If design or completion of design is the responsibility of the contractor add the following *Optional text*.

Calculations: Submit structural performance calculations.

Formwork calculations: 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 for the following:

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

Post-tensioned calculations: Submit the following:

- Calculations of tendon jacking forces, theoretical extensions and losses for each stressing stage.
- 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.

### Execution details

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

- Table, slip and jump forms: Proposed method and sequence of moving the formwork to provide concrete of the documented quality and surface finish.
- Slip forms: The average rate of movement.

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

Consider back propping delay times for appropriate structural element.

Re-shoring: Submit details of any proposed re-shoring.

Surface repair method: Submit details of any proposed surface repair method before starting repairs.

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.
- 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.

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.

Delete if welding is not acceptable.

AFS: Provide the following information:

- If early removal of bracing is required, submit structural engineer's approval in writing. Panels are core-filled and supported by roof framing or floor above and removing braces prior to this or within 24 hours of pouring slab over, constitutes early removal of bracing.
- If AFS LOGICWALL<sup>®</sup> panels need to be cut on site for any reason, submit certification from AFS shop drawers before cutting.

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.
- Details of proposed gauging, stressing and grouting equipment and current calibration certificates for tensioning and tension measuring equipment.
- Concrete strength early age test results.
- Calculated tendon extensions (theoretical extensions) at final stressing and for staged stressing if required, before stressing operations begin.

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.

### Products and materials

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

- Certification by a JAS-ANZ accredited third party.

e.g. Reinforcement: To AS/NZS 4671.

- Report by a registered testing authority 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 liquid membrane-forming curing compound, including the following:

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

It is likely that polyvinyl acetate (PVA-based) products will not conform to water retention requirements, refer 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.

Void formers: Use void formers tested under laboratory conditions. 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. Submit certified test results to verify conformance with the following requirements:

- 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.

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

Post tensioning: Submit the following:

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

AFS LOGICWALL<sup>®</sup>: Submit the following:

- CSIRO test certificate for fire resistance, available by contacting AFS.

AFS LOGICWALL panels have been subjected to a fire resistance test carried out by the CSIRO. This test ascertained the following Fire Resistance Levels (FRL):

- AFS120 and AFS150 FRL = 240/240/180.
- AFS162, AFS200 and AFS262 FRL = 240/240/240.

Refer to NATSPEC TECHnote DES 020 on fire behaviour of building materials and assemblies, for further information.

- Certification of acoustic performance, available by contacting AFS.

AFS LOGICWALL walls have been extensively tested for acoustic performance both in the field and in the laboratory. The following results have been achieved with standard AFS LOGICWALL walls:

- AFS120 - RW = 50 Dnt,W+Ctr = 41-42.
- AFS150 - RW = 52 Dnt,W+Ctr = 45-46.
- AFS162 - RW = 52 Dnt,W+Ctr = 45-49.
- AFS200 - RW = 55 Dnt,W+Ctr = 46-48.
- AFS262 - RW = 57 Dnt,W+Ctr = 48-50.

### Records

Post-tensioned concrete: 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 method before casting final concrete as follows:

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

### Shop drawings

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

AFS LOGICWALL<sup>®</sup> drawings: Submit shop drawings of the AFS LOGICWALL<sup>®</sup> works before starting on site, showing details of the following:

- Edge form detail.

- Estimated m<sup>3</sup> of concrete required for each wall.
- Location of all penetrations.
- Location of any cast in elements.
- Panel dimensions.
- Panel elevations.
- Plan layout with wall numbers.
- Slab set-downs along wall line.

Shop drawings are not normally necessary for AFS REDIWALL<sup>®</sup>. If necessary, detail the requirements of the shop drawings here.

Formwork: Submit shop drawings including details of proposed linings, bolt positions, facings, 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.

#### 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/installer 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:

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

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

### 1.10 INSPECTION

#### Notice

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

- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Completed formwork and reinforcement, tendons, cores, fixings and embedded items fixed in place.
- Used formwork, after cleaning and before re-use.
- Concealed surfaces or elements before covering.
- Commencement of concrete placing.
- Stripping single storey suspended work, if conformance with AS 3610.1 is not possible.
- Commencement of initial, incremental or final stressing of tendons.
- Cutting and grouting tendons.
- Evaluation of the off-form finishes.
- Evaluation of surface finish.

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

**Hold points**, if required, should be inserted here. Consider including the following *Optional text*, as appropriate:

#### 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 AFS WALL SYSTEMS

#### General

Products: Visit [www.afswall.com.au](http://www.afswall.com.au) for more information.

AFS LOGICWALL® and AFS REDIWALL® are permanent formwork systems for concrete walling for external and internal walls. It consists of lightweight sandwich panels created by bonding hard-wearing, fibre cement sheets to galvanized steel stud frames. The panels are quickly and simply hand erected on site and then core-filled with concrete to achieve load bearing walls that are fire and sound rated. The fibre cement sheeting remains in place as sacrificial formwork and provides an excellent substrate for applied finishes such as skim coating, acrylic render and paint.

#### Panel type

Single reinforcement carriers: [complete/delete]

Double reinforcement carriers: [complete/delete]

The internal galvanized steel stud frame of the AFS LOGICWALL® panels and the internal webs of the AFS REDIWALL® panels allow for horizontal reinforcement to be placed centrally within the single reinforcement carrier product range and a layer in each face for the double reinforcement carrier range, both maintaining sufficient cover to the reinforcement in accordance with AS 3600. Available AFS product range:

Single reinforcement carriers:

- AFS120.
- AFS150.
- AFS162.
- AFS200.
- AFS REDIWALL® 150.
- AFS REDIWALL® 200.

Double reinforcement carriers:

- AFS200D.
- AFS262D.
- AFS REDIWALL® 200.

Select the products to be used above.

#### Sealant/adhesive

Polyurethane sealant/adhesive: [complete/delete]

AFS recommend the use of polyurethane based sealant/adhesives such as Sikaflex or Bostik Seal'n'Flex. Select the chosen sealant above.

A double bead of sealant must be applied under the floor track of all walls.

#### Panel Braces

General: Make sure that the AFS panels are suitably braced to maintain their integrity whilst core filling with concrete, in conformance with the methods set out in the AFS Designer Manual.

Panel braces: Standard AFS braces.

The standard AFS braces used by installers are a purpose manufactured adjustable brace, engineer certified and adequate for standard applications. In situations where panels higher than 3.6 m are being installed or on sites in areas known to be subject to adverse wind conditions, consider the use of alternative braces, specified and approved by a professional engineer.

## 2.3 CONCRETE

### Properties

Concrete mix and supply: Conform to the following:

- AFS LOGICWALL<sup>®</sup>: Special-class to AS 1379 clause 1.5.4 and AFS LOGICWALL<sup>®</sup> Mix Design detailed in the AFS LOGICWALL<sup>®</sup> Designer Manual.
- . Properties: As documented in the **Concrete properties schedule - performance**.

Document the properties of special class concrete on the structural drawings or in the **Concrete properties schedule - performance**. Edit this subclause as appropriate.

- AFS REDIWALL<sup>®</sup>: Special-class to AS 1379 clause 1.5.4 and the concrete mix detailed in the AFS REDIWALL<sup>®</sup> AFS Rediwall.
- 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 property schedule - performance**.

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

Document the properties of special class concrete on the structural drawings or in the **Concrete properties schedule - performance**. Edit this subclause as appropriate.

### General

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

### Aggregates

Standard: To AS 2758.1.

### Cement

Standard: To AS 3972.

If considering the use of geopolymers, refer to CIA Z16 for further information.

Age: Less than 6 months old.

Refer to CCAA TN59 for further information.

Storage: Store cement bags under cover and above ground.

### 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 the manufacturer's recommendations.

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

## 2.4 FORMWORK

### General

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

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

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

### Profiled steel sheeting composite formwork

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 two levels of protection offered by BlueScope:

- Z350: 350 g/m<sup>2</sup> zinc coating weight is recommended for use in non-aggressive areas.
- Z450: 450 g/m<sup>2</sup> 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: Adopt material and corrosion protection to match the profiled steel sheeting.

### **Plywood formwork**

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 special requirements or dimensions.

## **2.5 REINFORCEMENT**

### **Fibre reinforcement**

Standard: 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]

To AS/NZS 4671 clause 5.2(c): L (low), N (normal) or E (seismic).

**Strength grade:** [complete/delete]

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

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

### **Protective coating**

Standard: To AS 3600 clause 17.2.1.2.

Document any requirements for stainless steel reinforcement as this is not covered in AS 3600.

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 galvanising and coat cut ends.

- Zinc-coating (minimum): 600 g/m<sup>2</sup>.

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.

**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 by the entrance of cement paste or water from the concrete.

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, diameters on the drawings.

Quality: Make sure tendons have no nicks, 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.

Anchorage: To AS/NZS 1314.

Reinforcement: To AS/NZS 4671.

**2.7 MISCELLANEOUS****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 manufacturer's recommendations.

**Polymeric film underlay**

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

**Curing compounds**

Curing compounds: To AS 3799.

**3 EXECUTION****3.1 POLYMERIC FILM UNDERLAY****Location**

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

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**

General: Conforming to base type, as follows:

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

**Installation**

Standard: To AS 2870 clause 5.3.3.

General: Lay underlay over the base as follows:

- 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.

**3.2 FORMWORK****General**

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

**Preparation**

Cleaning: Before placing concrete, remove free water, dust, debris and stains from the formwork 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: Chamfer at re-entrant angles, and 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**

Inspection: In vertical formwork 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 linings and facings.

**Slip formwork**

Provision for inspection: Provide access below the moveable formwork for surface treatment and inspection.

**Profiled steel sheeting composite formwork**

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

**Steel linings**

Rust: Clean off any rust and apply rust inhibiting agent before 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.

**3.3 AFS WALL SYSTEMS****Substrate preparation**

Requirement: Concrete contractor must co-ordinate with AFS installer prior to placing concrete to determine concrete finish requirements at wall locations. Slab must be swept clean prior to installation of floor track for wall.

**AFS LOGICWALL<sup>®</sup> installation**

General: To AFS Designer Manual.

Floor track: Sign off the setting out of the wall positions prior to fixing the floor track to the concrete slab.

Sealant/Adhesive: Provide a double bead of polyurethane sealant/adhesive under the floor track of all external walls and any portion of wall that separates or adjoins wet-areas.

Panel joints: Use polyurethane sealant/adhesive in conjunction with self tapping screws for fixing at each vertical panel joint and between panel and floor track.

Braces: Fix to panel using 2-3 screws per brace. Make sure screws engage metal stud/joiner within panel. Fix to slab using proprietary screw style bolt, installed to manufacturer's recommendations.

Tolerance: Install to achieve an alignment of  $\pm 4$  mm over any 1.8 m vertical or horizontal plane.

Reinforcement: Place reinforcement as documented.

Concrete placement: To **PLACING AND COMPACTION**.

**AFS REDIWALL<sup>®</sup> installation**

General: To AFS AFS Rediwall.

Floor track: Sign off the setting out of the wall positions prior to fixing the floor track to the concrete slab.

Sealant/Adhesive: Provide a double bead of polyurethane sealant/adhesive under the floor track of all external walls and any portion of wall that separates or adjoins wet-areas.

Braces: Brace securely by fixing to formwork deck or by fixing horizontal walling planks to face of panels and bracing diagonally to ground with timber bracing or standard AFS braces.

Tolerance: Install to achieve an alignment of  $\pm 4$  mm over any 1.8 m vertical or horizontal plane.

Reinforcement: Place reinforcement as documented.

Concrete placement: To **PLACING AND COMPACTION**.

**3.4 REINFORCEMENT****Dowels**

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

Tolerances:

- Alignment: 1:150.
- Location:  $\pm$  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.

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

See AS 3735 Section 4 for durability exposure classification. Show concrete cover on the structural drawings.

**Supports**

Proprietary concrete, metal or plastic supports: To AS/NZS 2425 and 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:  $\leq 60$  diameters.
- Mesh:  $\leq 600$  mm.

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

For special conditions, pieces of stainless steel reinforcement welded to standard reinforcement may be used in place of the standard supports.

**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**

AFS works: Tying of reinforcement within wall panel is not required. Place reinforcement as documented and in conformance with the AFS Designer Manual.

Non-AFS works: 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: Tie bundled bars in closest possible contact. Provide tie wire of at least 2.5 mm and spaced not more than 24 times the diameter of the smallest bar in the bundle.

Refer to AS 3600 clause 8.1.10.8 for guidance on the use of bundled bars. If possible, avoid the use of bundled bars.

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

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

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

**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 and contaminants, including swarf, loose grease, oil and paint.

Tolerances: To AS 3600 clause 17.5.3.

Minimum concrete cover: As documented.

Shown on the design drawings.

Post-tensioning record: Provide details of the following :

- Concrete mix.
- Concrete placing and curing, 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 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.

### Anchorage

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. Depending on the application you may need to document other matters such as shop drawings, calculations, tests, certificates, prestressing records etc.

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.

### Couplers

Standard: To AS/NZS 1314 Section 5.

Cover: Position and fix couplers to provide adequate cover.

Laying: Give coupled strands the same lay to prevent rotation.

Couplers have a height and require adequate cover, coordination within the design is required.

### 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 at any time.

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

Stressing procedure: Carry out stressing after age test 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.

Initial force: If tendons are not marked at nil load, apply initial force or pressure if tendons are marked for measurement of elongations.

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 have been 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.
- 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.

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****General**

Conformance: As documented in the **Concrete properties schedule – performance**.

**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 a plant located on the construction site.

**3.7 TESTING****General**

Test authority: Concrete supplier or registered testing authority.

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

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<sup>3</sup> 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**.

Slump tests: Assess slump for every batch. Perform slump test on each strength sample.

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.

### Embedded pressure pipes

General: Complete leak tests before embedding pipes.

### Liquid retaining structures

Testing for liquid tightness: To AS 3735.

## 3.8 CORES, FIXINGS AND EMBEDDED ITEMS

### 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 the documented 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 placing. In locating cores, fixings and embedded items, displace but do not cut reinforcement, and maintain cover to reinforcement.

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

### 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 tolerance

Deviation: Flatness tolerance Class B.

### 3.10 PLACING AND COMPACTION

#### Placing

AFS LOGICWALL<sup>®</sup> specific requirements:

- Pump via a 50 mm diameter delivery hose.
- Walls up to 3 m in height: Fill in 2 passes and limit to 1.5 m high lift per pass.
- Walls of 3 m to 4.2 m in height: Fill in 3 to 4 passes and limit first 2 passes to 1 m high.

Standard AFS LOGICWALL<sup>®</sup> panels can be manufactured in any height from 200 mm up to 4.2 m. Heights exceeding 4.2 m can be manufactured upon request as a special order.

- Allow at least 1 hour between passes.

AFS REDIWALL<sup>®</sup> specific requirements:

- Pump via a 50 mm diameter delivery hose.
- Walls up to 3 m in height: Fill in minimum 1 pass.
- Walls of 3 m to 6.5 m in height: Fill in 2 to 3 passes and limit first 2 passes to 2.1 m high.
- Allow at least 1 hour between passes.

Other concrete works:

- 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

AFS LOGICWALL<sup>®</sup> specific requirements: Vibrate with a 40 mm diameter needle vibrator, placing the vibrator in the upper 300 mm of the wall panel and rattling the steel stud framework and reinforcement bars. For the last 300 mm lift of concrete, the vibrator can be placed directly into concrete. Over vibration or lowering the vibrator into the wall greater than 300 mm can cause concrete fluidisation and could result in bulges and blowouts of the panel.

AFS REDIWALL<sup>®</sup> specific requirements: Use a 40 mm diameter needle vibrator as appropriate to remove entrapped air and to fully compact the mix.

Other concrete works:

- 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.

AFS LOGICWALL<sup>®</sup>: Saturated panels should be left to dry, prior to placement of concrete.

**Time between adjacent placements**

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

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

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

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

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

Freezing : Prevent concrete from freezing.

**Placing in hot weather**

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 pouring in the cooler part of the day.
- Minimise delays.
- Control of loss of water through evaporation by the use of aliphatic alcohol.
- Protection of the concrete from wind and drying.
- 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:  $\leq 35^{\circ}\text{C}$ .
- For concrete strength grade less than 40MPa with section thickness  $\geq 1$  m in all dimensions:  $\leq 27^{\circ}\text{C}$ .

- For concrete strength grade 40 MPa or greater with section thickness  $\geq 600$  mm in all dimensions:  $\leq 27^{\circ}\text{C}$ .
- Formwork and reinforcement before and during placing:  $\leq 35^{\circ}\text{C}$ .

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  $35^{\circ}\text{C}$  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 or ice.

#### Placing under water

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

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

### 3.11 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  $10^{\circ}\text{C}$ , conforms to the following, unless accelerated curing is adopted:
  - . Fully enclosed internal surfaces/Early age concrete: 3 days.
  - . Other concrete surfaces: 7 days.
- End of curing period: Prevent rapid drying out at the end of the curing period.

Curing method: [complete/delete]

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

#### Curing compounds

Application: 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  $5^{\circ}\text{C}$  for the duration of the curing period.

#### Hot weather curing

Requirement: If the concrete temperature exceeds  $25^{\circ}\text{C}$ , or the ambient shade temperature exceeds  $30^{\circ}\text{C}$ , 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.

### 3.12 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.

**3.13 SURFACE MODIFIERS****General**

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

**3.14 FORMED SURFACES****General**

Surface finish: Provide formed concrete finishes as documented in the **Formed surface finishes schedule**.

**Evaluation of formed surfaces**

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

**Surface repairs**

Method: If surface repairs are required, submit proposals.

**Finishing methods**

Refer to the AFS LOGICWALL Designer Manual for any required applied finish to the wall panel and document such requirement in the relevant FINISH worksection.

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

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: Remove the vertical face formwork 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.

Floated finishes:

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

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

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

### 3.15 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.

#### Surface repairs

Method: If surface repairs are required, submit proposals.

#### Finishing methods – primary finish

Machine float finish:

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

Steel trowel finish: After machine floating finish, as follows:

- Use power or hand steel trowels to produce a smooth surface relatively free from defects.
- When the surface has hardened sufficiently, re-trowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.

Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy 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 provide 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 provide 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 Road Note 64, Section 011 for more information on suitability for residential streets and public footpaths.

### 3.16 TRAINING

#### General

AFS training: Training for the installation of AFS LOGICWALL<sup>®</sup> panels can be provided upon request from AFS. Contact AFS Systems Pty Ltd<sup>®</sup> for further information.

### 3.17 COMPLETION

#### Formwork removal

Extent: Remove formwork, other than profiled steel sheeting composite formwork and lost formwork, including formwork in concealed locations.

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

Stripping:

- General: To AS 3600 where it is more stringent than AS 3610.1.
- Vertical formwork: To AS 3610.1 Appendix B Table B1.
- 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.

#### AFS brace removal

General: Do not remove bracing within 24 hours of pouring slab above or until roof has been attached. If early brace removal is desired, submit proposals to structural engineer for approval.

#### 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 completion 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 SCHEDULES

#### 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.

#### 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.

#### Formed surface finishes schedule

Property	A	B	C
Location			
Surface finish class to AS 3610.1			
Formwork lining type			
Colour control			
Bolt hole filling			
Surface finish type			
Abrasive particles 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 to AS 3610.1: For applicability of surface classes, see AS 3610.1 Table 3.2.1.

Abrasive particles type: e.g. steel shot or fine aggregate.

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

#### Surface finish class 1 formwork

Colour control: [complete/delete]

Critical faces of elements: [complete/delete]

Distance between face steps (mm): [complete/delete]

Formwork face span and direction of span: [complete/delete]

Repairs: Not permitted.

Surface pattern details and accuracy: [complete/delete]

Surface treatment pattern of part of surface: [complete/delete]

Tie rod pattern: [complete/delete]

#### Surface finish class 2 formwork

Add class 3 formwork if appropriate.

Colour control: [complete/delete]

Critical faces of elements: [complete/delete]

Distance between face steps (mm): [complete/delete]

Formwork face span and direction of span (class 2 only): [complete/delete]

Liner details, pattern and accuracy: [complete/delete]

Surface pattern details and accuracy: [complete/delete]

Surface treatment of whole: [complete/delete]

Surface treatment pattern of part of surface: [complete/delete]

Tie rod pattern: [complete/delete]

**Concrete properties schedule – performance**

Property	A	B	C
<b>Normal and special class</b>			
Air entrainment – air volume (%)			
Maximum aggregate size (mm)			
Assessment process			
Slump (mm)			
Strength grade/characteristic compressive strength $f'_c$ (MPa)			
<b>Special class</b>			
Bleeding (mL/mm <sup>2</sup> )			
Cement type			
Density of hardened concrete (kg/m <sup>3</sup> )			
Density of plastic concrete (kg/m <sup>3</sup> )			
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.

**Concrete for AFS LOGICWALL®**

The concrete infill is a proprietary mix designed with enhanced flow characteristics. The mix is designed such that segregation and blowouts are minimised whilst achieving the required level of compaction. Basic characteristics are:

- $f'_c$  = 25-50 MPa as required by the structural design.
- 7-10 mm maximum aggregate.
- Batched at 80 mm slump before addition of admixtures.
- Admixtures include plasticiser and fly ash added to increase slump to 140-160 mm. Request slump test on site.

**Concrete for AFS REDIWALL®**

The concrete infill is a proprietary mix designed with enhanced flow characteristics. The mix is designed such that the required level of compaction is achieved. Basic characteristics are:

- $f'_c$  = Min 25 MPa as required by the structural design.
- Maximum 10 mm rounded aggregate.
- Minimum 100-125 mm slump at the point of discharge.

- Maximum water:cement ratio: 0.55
- The use of fly ash is not recommended.

**General**

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

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

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  $\neq$  crack control.*

If the concrete is special class only because of the documentation of a drying shrinkage less than 1000  $\mu\epsilon$ , 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.

**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	

**Unformed surface finishes schedule**

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

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: 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, SAA HB 197 and SAA 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.

Surface modifier: Select to manufacturer's recommendations.

### 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 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 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 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 3600	2009	Concrete structures
AS 3610		Formwork for concrete
AS 3610.1	2010	Documentation and surface finish
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 6669	2016	Plywood - Formwork
AFS Designer Manual	2015	AFS LOGICWALL Designer Manual
AFS Rediwall	2017	AFS REDIWALL Installation Guide
CIA CPN35	2003	Fibres in concrete
SA TS 101	2015	Design of post-installed and cast-in fastenings for use in concrete

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

AS 3600 Supp 1	2014	Concrete structures - Commentary
AS 2327.1	2003	Simply supported beams
AS/NZS 2589	2017	Gypsum linings - Application and finishing
AS 3600	2009	Concrete structures

AS 3735	2001	Concrete structures retaining liquids
AS 3735 Supp 1	2001	Concrete structures retaining liquids - Commentary (Supplement to AS 3735-2001)
AS 4312	2008	Atmospheric corrosivity zones in Australia
SAA HB 28	1997	Design of residential slabs and footings
SAA HB 71	2011	Reinforced concrete design in accordance with AS 3600-2009
SAA HB 84	2006	Guide to concrete repair and protection
SAA HB 197	1999	An introductory guide to the slip resistance of pedestrian surface materials
SAA 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 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	2011	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 T58	2007	Climate-responsive house design with concrete
CCAA TN59	2017	Cements - manufacture, characterisation and use - The requirements of AS 3972 - 2010
CCAA Road Note 64	2003	Beyond the pavement
CIA CPN17	2008	The use of galvanized reinforcement in concrete
CIA CPN28	2005	Watertight concrete structures
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	2009	Atmospheric corrosivity categories for ferrous products
NATSPEC DES 020	2011	Fire behaviour of building materials and assemblies
NATSPEC GEN 006	2007	Product specifying and substitution
NATSPEC GEN 024	2015	Using NATSPEC selections schedules
NATSPEC TR 01	2017	Specifying ESD
NP PCH	2009	Precast concrete handbook
SRIA Seismic Guide	2015	Guide to seismic design and detailing of reinforced concrete buildings in Australia