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Pr9903 - Specification for Building and Structural Works

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References	Refer to Appendix B of this document

Version Review

Revision	Reviewed by	Approved by	Date approved	Revision type
0.1	A. Mills	-	11/04/2016	Amalgamation of separate building and structural works specifications, general SME review
1.0	A. Mills	A. Schoenmaker	21/04/2016	Written Direction – based review
2.0	B. Maule	-	04/05/2017	New sections for: 5.15 Security Fencing and 5.16 Electric Sliding Gate
3.0	B. Maule	A. Creevey	05/11/2018	3.1 General - update 5.8 Lighting and Power - new 5.10 Alternate Roof Sheeting and Insulation Material – new 5.16 Waterproofing – new 5.19 Security Bollard – new 5.20 Demolition Work - new 6.4 Special Class Concrete S40 – Calcareous Aggregate – new 6.9 Corrosion Protection - update 6.12 Production and Placing of Concrete - update 8.15 Welding of Stainless Steel - update 8.17 Stainless Steel Fabrications - update 8.20 Bolts, Nuts, Washers and Jointing Materials – update 8.21 Masonry Anchors - update
4.0	B. Maule	B. Van Wegen	29/01/2020	6.22 Repair of Existing Structural Concrete – new 8.2.3 Galvanised Steel fabricated items insulated from concrete - new
5.0	L. Bryson	N/A	N/A	30/07/2021 Minor amendment to update template and SafeWork QLD Code of Practice references. No change to next review date.

6.0	R. Kohpaei
	Y. Skinner
		I. Beirne,
		Head of Asset Management
			19/05/2022	Periodic review:
				• Section 2.0 update to current legislation
				• Minor corrections/modifications to following sections: 6.2, 6.14, 6.22 and 8
				• Terminology updates:
				  ○ Job Specification to Project Specification
				  ○ Approved to Accepted

7.0	B. Ingram RTO - Link Resources	I. Beirne, Head of Asset Management	25/08/2022	Superseded Manual of Uniform Traffic Control Devices – Part 3 – 2010 (MUTCD) reference updated to reflect current Queensland Guide to Temporary Traffic Management (QGTTM).
8.0	L. Bryson	N/A	N/A	24/05/2023 Minor admin amend to replace manhole terminology with maintenance hole.
9.0	J. Munro Document Control Officer	N/A	N/A	20/09/2023 Minor admin amend align with template format

Contents

1. Purpose

The purpose of this Specification is to set down the minimum requirements for the construction of building and structural work to ensure satisfactory quality of materials and workmanship in order to achieve strength, durability, performance and quality of finish.

This Specification shall be read in conjunction with relevant project drawings (where applicable), Project Specification and supplementary specifications.

2. Scope

This Specification applies to the provision of all plant, labour and materials and shall include all work necessary to complete the whole of works in accordance with this Specification, the Project Specification, other relevant Specifications and the Drawings.

The work shall be undertaken in accordance with the relevant sections of the *Building Act 1975*, *Plumbing and Drainage Act 2018*, *Work Health and Safety Act 2011*, the Building Code of Australia and any other relevant acts together with all amendments thereto.

All work shall be performed in the best tradesman like manner, fully in accordance with all applicable standards and to the written instructions of the manufacturer. Where the Superintendent deems that the work does not comply with the required standard, the Contractor shall demolish and remove the offending work and carry out the work again at its own cost.

This Specification shall be used in conjunction with the stated requirements of the local government or other authority in whose area the works shall be constructed.

3. Building works

3.1. Extent of work

The building construction work comprises the supply, installation, quality assurance, finishing and defects liability of all building structural and trade work, as shown on the drawings or specified herein.

The installation shall be complete with all necessary items for sound structural performance, efficient operation and high standard of finish.

3.2. Site earthworks

Site earthworks shall conform to the requirements of the Project Specification, the *Specification for Civil and Earth Works* (Pr9902) and any other nominated specifications.

3.3. Excavation and backfilling

Site earthworks shall conform to the requirements of the Project Specification, the *Specification for Civil and Earth Works* (Pr9902).

The Contractor shall take care to ensure that all excavation for structure foundations are made to the lines, levels and forms shown on the drawings.

3.4. Masonry

3.4.1 Materials

All masonry units shall be of an accepted brand. Concrete masonry units shall be of the thickness indicated on drawings, either hollow or solid as specified and complete with all special blocks where required, such as corners, halves, lintels, sills, jambs and column blocks.

Clay masonry units shall have the texture and colour as nominated in the Project Specification or Schedule of Finishes and shall be well burnt, of uniform size, shape and colour, first quality face bricks.

All concrete masonry units shall have a minimum characteristic unconfined compressive strength (f1uc) of 15 MPa.

All clay masonry units shall have a minimum characteristic compressive strength of 7.0 MPa.

All hollow concrete units which are specified to have concrete filling shall have clean open cavity through the full depth of the unit. Blocks with partly obstructed cavities shall be rejected. Clean-out blocks shall have one fully open vertical face.

Broken or damaged units shall not be used in unrendered walls. Units damaged after laying shall be replaced.

Samples of units shall be submitted to the Superintendent and acceptance before use or delivery. Units which do not conform to the accepted standard shall be rejected.

Cement shall be Type "GP" general purpose Portland cement of an accepted brand and shall comply with AS 3972 – Portland and Blended Cements.

Sand shall be clean, sharp, pit or freshwater sand, free from loam, saline or vegetable matter or other impurities and shall not contain soft or weathered particles and if directed shall be washed when used with cement. Sand shall conform to the following grading and properties:

Table 1 – Sand Grading Sieve Sizes

Sieve Aperture	Per Cent Passing
4.76 mm	95 - 100
2.36 mm	95 - 100
1.18 mm	95 - 100
600 µm	30 - 100
300 µm	10 - 50
150 µm	0 - 10
75 µm	0 - 4
Fineness Modules	1.5 - 2.8

3.4.2 Mortar

The mortar shall comply with the requirements of Clause 2.2 of AS 3700 for a mortar of M3 classification. Compressive and flexural strength of the masonry shall be determined in accordance with Appendix A of AS 3700. Such testing shall be conducted on samples of materials to be incorporated in the works, prior to any brickwork commencing on site. The specimens shall be prepared by the same tradesmen to be employed on the works and shall be prepared in the presence of the Superintendent or his representative. The Superintendent will arrange for testing of the specimens and the Contractor shall deliver the specimens to the testing place nominated by the Superintendent.

Additional strength testing shall be conducted during construction in accordance with clause 8.5 of AS 3700.

The average strengths of the specimens tested prior to construction commencing shall be not be less than the following:

- Compressive strength f1m = 8.8 MPa;
- Flexural tensile strength f1mt = 0.34 MPa.

For testing during construction, strength values shall comply with clauses 8.5.4 and 8.6 of AS 3700. The characteristics strengths shall be taken as:

- Compressive strength f1m = 6.3 MPa;
- Flexural tensile strength f1mt = 0.2 MPa.

All masonry construction represented by a sample deemed not to comply in accordance with clause 8.6 of AS 3700 shall be demolished and removed entirely from the site. The Contractor shall then construct new masonry in accordance with this specification, at no additional cost to the Principal.

The mortar shall be mixed in an accepted mixing machine for not less than three minutes. Hand mixing shall not be employed unless specifically accepted by the Superintendent. The dry ingredients shall be thoroughly mixed prior to the addition of water which shall be then worked thoroughly through the mixture. Mortar which, in the opinion of the Superintendent, has become excessively stiff so as to make placement difficult shall be rejected. Retempering of mortar is permitted for up to one hour after initial mixing.

3.4.3 Workmanship

Masonry units shall be laid to straight and vertical lines and to the layout shown on drawings, in accordance with Manufacturer's instructions and with AS 3700, SAA Masonry Code.

All concrete masonry units shall be laid dry and blocks stockpiled on the Project shall be well protected from weather. Tops of all walls shall be covered upon stoppage of work to prevent moisture penetration.

Prior to being used in the work, clay masonry units shall be thoroughly wetted and the top of all brickwork left overnight shall be thoroughly wetted before recommencement of work.

Except where reinforced concrete filling is required, all cavities which extend below external ground level shall be filled with fine waterproof concrete.

Unless otherwise shown on the drawings or in the Project Specification, junctions of frames and other metalwork with blockwork shall be raked back 15 mm to receive mastic pointing specified in Section 3.13 (Tiling).

Where concrete masonry walls are built up to the underside of beams, stairs or slabs, unless shown otherwise on the drawings, the walls shall finish with 100 mm high blocks or cut solid blocks, whichever are required to close the opening.

For concrete masonry walls behind basins, sinks, shelves, showers and similar items, except where reinforced concrete filling is specified, the contractor shall provide a course of solid blocks. All fixings into blocks shall be with accepted brand plugs of the required sizes.

Cutting of masonry units shall be avoided wherever possible. Masonry units shall be cut to rake under stairs and similar positions.

Masonry shall be laid in stretcher bond. Brickwork shall be laid in even courses with 7 courses to each 600 mm height of wall.

Intersecting masonry walls and partition walls shall be bonded as shown on the drawings or by galvanised steel ties at 400 mm centres in the vertical direction. Medium duty wall ties shall be provided in cavity walls in accordance with Clause 3.8 of AS 3700 unless otherwise specified or shown on the drawings.

Masonry units shall be bedded in even courses properly levelled and plumbed and bonded and laid with uniform close joints, not exceeding 10 mm thick and not less than 6 mm thick. Vertical joints shall be laid with a sufficiency of mortar to extend across the full face of the masonry. The joints shall be tooled flush with the face of the masonry.

Reinforcement of brickwork shall be provided generally in the bed joint of every fourth course throughout and in the bed joint of the top course of all walls. The reinforcement shall consist of accepted fabricated galvanised steel wire mesh at least 60 mm wide in each face. One continuous strand shall be built into the bed joint throughout. Concrete block work shall be reinforced as detailed on the drawing.

All joints shall be properly filled with mortar and shall be struck or grooved as specified. Unless otherwise specified, directed or to match existing masonry, concrete masonry joints shall be grooved and brickwork joints shall be fully raked.

Internal work shall, where required, have joints left rough ready for rendering, tiling and similar finishes.

When directed by the Superintendent samples of joints shall be prepared by the Contractor and accepted before work proceeds.

Concrete masonry bond beams to the exterior of the building shall be constructed of 200 mm high knock-out bond beam blocks filled with fine aggregate Class SS32 concrete as shown on the drawings, or specified in the Project specification. Reinforcement shall not be less than two 12 mm diameter bars cross tied at 300 mm intervals with No. 8 gauge wire stirrups. Bond beams shall not be continuous across control joints.

Lintels in 200 mm concrete masonry walls shall be constructed of 400 mm deep lintel blocks and shall be concrete filled and reinforced as shown on the drawings.

Vertical control joints shall be constructed at the following maximum spacings in concrete masonry walls:

- Where no joint reinforcement – 8 m;
- Where 600 mm vertical spacing of joint reinforcement – 10 m;
- Where 400 mm vertical spacing of joint reinforcement – 12 m.

Vertical control joints shall be constructed at a maximum spacing of 18 m or where shown on the drawings in clay masonry walls.

When required the joints should be located:

- At major changes in wall height;
- At changes in wall thickness other than for piers and buttresses;
- At control joints in footings, in roof and in floors;
- At chases and recesses for piping, columns, fixtures, etc.;
- At one or both sides of wall openings;

- Near wall intersections;
- Near return angles in L, T and V shaped structures.

No power-driven type fixings shall be permitted for any fixings where the member is under tensile stress or in 110 mm work.

Hot dip galvanised mild steel arch bars or angles shall be provided above window and door openings as shown on the drawings or specified in the Project Specification.

All workmanship shall be in accordance with Clause 8 of AS 3700.

3.4.4 Face work

The Contractor shall set out face work to avoid cutting of blocks. Units in single leaf walls with face work both sides shall be specially selected.

The Contractor shall keep perpends in alternate courses in vertical alignment.

3.4.5 Wall ties

Unless specified to the contrary in the Project Specification, wall ties shall be as set out below.

Ties to concrete shall be provided at every fourth bed joint in brickwork or 90 mm high blockwork and at every second bed joint in 190 mm high blockwork, as follows:

- Tie masonry walls abutting concrete walls or columns with 38 x 1.6 x 300 mm galvanised steel straps;
- Bend and cast straps into concrete or if permitted by the Superintendent, fix to face of concrete with power fixings or masonry anchors, and provide at least 75 mm embedment in mortar joint;
- Tie block linings faces of concrete elements with 4 mm diameter galvanised wire ties cast into concrete, carry across cavities if any, and build into blockwork at not more than 600 mm centres horizontally and stagger vertically.

Ties for tying masonry walls to steel columns shall be 3.15 mm diameter galvanised steel.

The Contractor shall loop ties around rods welded to columns as shown on structural steelwork drawings and building into masonry every:

- Fourth bed joint in brickwork or 90 mm high blockwork;
- Second bed joint in 190 mm high blockwork.

3.4.6 Masonry walls

All concrete masonry blocks shall be manufactured in accordance with AS 2733. All blocks shall have a minimum characteristic compressive strength of 15 MPa.

All clay masonry units shall be Traditional Bricks in accordance with AS 1225 with a minimum characteristic compressive strength of 7.0 MPa.

The mortar shall comply with the requirements of Clause 2.2 of AS 3700 for a mortar of M3 classification. Mortar joints shall be stuck flush with the blockwork where plaster is to be applied or grooved with a round tool where a blockwork finish is required.

All reinforced cores of the blockwork walls shall be concrete filled using a Class N20 fine aggregate concrete.

Horizontal reinforcing bars in bond beams shall be held in position by the use of purpose made chairs.

All workmanship shall be in accordance with Section 8 of AS 3700.

Cleanout openings shall be provided at the base of all walls and columns at each lift.

All cores shall be cleaned of all mortar protrusions by rodding from the top of the wall.

All mortar droppings and foreign matter shall be removed at the clean-out openings.

The vertical reinforcement shall be fixed in position by tying to the bars protruding from the floor slab or previous wall section.

Formwork shall be fixed in place to seal all openings.

Core-filling concrete shall be placed in 2.0 metre maximum height lifts.

At horizontal bond beams the blockwork shall be constructed to the underside of the bond beam and cores filled. The blockwork shall then be constructed to the top of the bond beam, reinforcement installed and the bond beam filled with concrete. Blockwork shall not be constructed above the bond beam until concrete is cast in the bond beam.

Core filling concrete shall be compacted by rodding or the use of small immersion vibrators. Rodding of cores using core reinforcement shall be strictly prohibited. Placement of concrete shall be carried out in one continuous operation. The top surface of core concrete in walls or columns shall be prepared as a construction joint in accordance with the attached Specification for Plain, Reinforced and Prestressed Concrete.

At the completion of construction all masonry walls shall be cleaned down, as directed by the Superintendent, to remove stains. Acid cleaning shall not be permitted.

3.4.7 Services installation

The Contractor shall:

i. Form all chases necessary for other trades and form any necessary coring, corbelling, oversailing or set-back courses, splays or rebates as required;

ii. Provide and build-in all accepted patent plugs where practicable and grounds for securing joinery as required;

iii. Build-in all bolts, plugs, straps and similar items as work proceeds; also door and window frames, angle guards and flashings as specified;

iv. Building-in all items, including pipes and sleeves, set in position or supplied by subcontractors as required;

v. Form holes for rainwater and other pipes, Telecom and communications cables and similar items as required and make good after other trades;

vi. Form holes through walls for mechanical equipment and specialist hydraulic equipment, as shown on the drawings.

Wherever possible, service pipes and conduits shall be built into walls and walls shall not be chased after construction. Particular care shall be taken in setting out conduit and other services so that no pipes are exposed or chased into face of walls which are finished as face blockwork.

Where chases are required in unfinished work, these shall be made by cuts with an abrasive saw to the required depth, the remainder being chiselled out. No chases shall be made without the prior approval of the Superintendent.

3.4.8 Sills

The Contractor shall lay full-height centre block sills where shown on the drawings. Sills shall match the colour of face blocks.

Sill blocks shall be set out symmetrically so that no block is less than three quarters of full width.

3.4.9 Cappings

At positions shown on the drawings, and where otherwise required, the Contractor shall provide a 40 mm thick capping block to top of external concrete masonry bond beam walls.

3.4.10 Cleaning down

Face blockwork shall be protected from damage and staining during erection and all face work shall be kept clean as work proceeds. Finished work shall be cleaned down after the mortar has hardened by rubbing down with a piece of block, carborundum stone or wire brushing. Only clean water may be used, acid cleaning shall not be permitted. The Contractor shall follow dry cleaning with hosing down.

Vanadium (green) stain shall be wetted and treated with 10% soda in water. The Contractor shall hose the work down well after application.

Timber stain shall be wetted and treated with 10% oxalic acid using rag swab on a stick used in accordance with the manufacturer's recommendations. Finally, the work shall be hosed down well.

The whole of the masonry shall finish clean and free from all defects and stains.

3.4.11 Damp-proof Courses and Flashings

Flashings shall be provided at all places necessary to ensure the weather-tightness of the building.

Flashings and damp-proof courses shall be heavy aluminium core and be UP Building Products "Aluminium Flashing" and Dimet Construction Products "Alcor DPC" or similar approved products respectively.

Flashings and damp-proof courses shall be lapped 300 mm at changes of direction only. Joints shall be double folded and sealed with butumastic adhesive. The contractor shall step flashings where necessary. Where stepped, flashing shall be turned up in cavity at the inner end and dressed down at outer end so that water cannot run back into cavity.

3.5. Carpentry

3.5.1 Materials

All Acts and Regulations governing the use of timber in buildings shall be strictly observed. All timber shall be in accordance with the Standards laid down in Queensland Forest Service Pamphlet No. 5 with regard to quality, seasoning and species to be used in any particular position within the structures and in accordance with any strength group specified herein or on the drawings.

Joinery, flooring and mouldings shall be seasoned to the requirements of *The Timber Users' Protection Act*.

Pine shall be a species of Queensland grown pine listed in Forest Service Pamphlet No. 5 and shall be "A" grade as described in Government Gazette No. 76 of 30th October 1951. Cypress pine shall not be used.

Grades of hardwood shall be as described in AS 082 –1965 Sawn Eastern Australian Hardwoods.

Hardwood rafters and battens to be not less than strength group B.

Where not specified to the contrary in the Project Specification, all nails, bolts, nuts and washers shall be hot dip galvanised. All screws for fixing hardware shall be chrome plate brass.

3.5.2 Workmanship

All carpentry work shall be carried out in a thorough and tradesman - like manner and shall be erected and fixed in position to the correct level, plumb and straight with all exposed joints close and flush; all in accordance with the best building practice.

All timber work shall be subject to the approval of the Superintendent.

All bearings must be solid. No packing will be allowed.

All timber to be used in the construction of the buildings shall receive adequate cover and protection following its arrival on the sites.

All joiners' work must be framed together and inspected before being fixed into position and together with the carpenter's work must be finished in a most tradesman - like manner with all joints flush and close.

All carpenter's works showing externally must be framed and painted at joints in stiff oil paint. Priming paint shall be kept clear of surfaces to be oiled.

All nails in such timber shall be punched below the surface and nail holes stopped prior to painting.

Exposed stops shall be primed before fitting, after priming the ends and surfaces they abut.

All exposed timber shall be dressed and neatly arrised.

On completion of the works, all rubbish must be cleared away, all gutters cleaned leaving all work neat and tidy. Doors are to be eased if necessary, locks oiled as required and all left in proper working order.

3.6. Joinery

3.6.1 Materials

All joinery timber shall be select grade and species free from all defects and thoroughly seasoned.

All joinery timber shall be first class of the type as shown on the drawings or as specified in the Project Specification.

All concealed internal joinery timber shall be of selected first class Queensland pine.

All particle board shall be CSR 'Pyneboard – Hydro Panel HMR' or accepted equivalent product and shall be highly moisture resistant. Particle board which has not been treated for moisture resistance shall not be used in any location.

Hardboard shall be an approved brand 5 mm thick, unless otherwise specified.

Laminated plastic sheet shall be an approved first quality melamine type of selected plain colour as detailed in the Project Specification or Schedule of Finishes.

The finished surface shall be as specified:

- The thickness shall be 1.5 mm for horizontal surfaces and 0.8 mm for vertical surfaces unless otherwise specified;
- The contractor shall fix the sheeting by gluing with urea formaldehyde in accordance with manufacturer's instructions and butt and chamfer where returned around salient edges.

Where specified, bench tops, fronts, backs, both sides of doors and drawer fronts and all edges of doors and drawers fronts shall be sheeted with selected laminated plastic sheeting. Pre-sheeted particle board may be used for door and drawer fronts only. Timber edge strips may be deleted when plastic laminate is specified.

3.6.2 Details

The drawings and the description contained in the Project Specification are intended to indicate the final appearance of the work rather than the complete construction.

Sound construction of the components shall be the responsibility of the Contractor who shall ensure that recognised forms of joints in appropriate positions are made by the manufacturer.

3.6.3 Workmanship

The whole of the joinery work shall be accurately set out and framed together in accordance with the best practice as soon after the commencement of the work as possible.

Should any joints in joinery or other work open or show themselves in the defects liability period, such joinery shall be replaced with new and all work disturbed in connection therewith shall be made good.

The Contractor shall properly protect all joinery work where liable to injury and replace work which is marred or damaged during the progress of the works.

Site dimensions shall be checked before manufacture is commenced.

All joinery work shall be hand dressed and scraped and sanded where considered necessary to provide a first class fine even surface.

Generally, approved waterproof glue shall be used for all work. Work to be painted shall be primed before leaving the workshop.

The Contractor shall conceal fastenings where possible, use a minimum of surface nailing and punch nail heads below surface and fill with putty coloured to match finish. Adhesives and jointing compounds shall be non-staining and kept off visible faces. Surface screws where necessary shall, if visible, be Phillips head, countersunk flush or be provided with cover caps.

The Contractor shall thoroughly prime the backs and ends of all frames and linings and all exposed work generally before fixing in position.

All visible edges of veneered work including plywood shall be edge stripped.

Visible faces of edge strips shall match the face veneers of the work. Edge strips to external flush doors shall be hardwood. Edge strips to room doors and unlined particle board shelves and divisions shall be solid timber. Edge strips to cupboards shall be of veneer stripping.

3.6.4 Doors

Doors shall be 40 mm thick, ply - lined with a solid core of the dimensions detailed and scheduled.

Doors shall be obtained from an approved manufacturer.

Framing timbers shall be kiln dried stress free approved softwood and non-susceptible or treated for immunity to Lyctus Borer or of species specified.

The core shall be formed from kiln dried, stress-free approved softwood core members assembled by the "Torweggie" process and butt jointed and treated with an approved preservative.

Both stiles of each flush door leaf shall be edged with timber edge strips of 12.5 mm (finished) thickness, extending full thickness of door and finishing flush with face.

The strips shall be of an approved timber species and where a decorative veneer is specified or scheduled of a similar species.

Any door exposed to the elements shall be weatherproof quality and all adhesives used shall be warranted waterproof.

3.6.5 Joinery fittings

Fittings shall be plumb and level and neatly scribed to floors, walls, columns, etc.

All work shall be left clean on completion, free of blemishes.

Sizes given are approximate only, actual sizes shall be confirmed on site prior to fabrication.

3.7. Hardware

3.7.1 Materials and workmanship

Door handles, catches, locks, etc. shall be set at heights as directed by the Superintendent.

Hardware, unless otherwise described, shall have a satin chrome plate finish.

Exposed screws shall be chrome plated brass. All other screws shall be brass or stainless steel.

Internal doors to toilets, showers, change rooms, etc. shall be fitted with privacy door sets whilst the remaining internal doors shall be fitted with passage sets.

Where trade names and reference numbers are used, fittings of different manufacture but of equivalent performance and quality may be accepted by the Superintendent.

All hinges shall be stainless steel butt hinges unless extended hinges are shown on the drawings or specified in the Project Specification. Extended hinges shall also be stainless steel.

3.7.2 Keying

Plastic tags shall be fitted to all keys, which shall be labelled appropriately and handed over on completion to the Superintendent.

All lock combinations shall be master keyed as provided in the Project Specification. The Contractor shall supply two duplicates of each master key and stamp each lock cylinder and key with letter and number references. Keys shall be nickel alloy, not brass.

3.7.3 Responsibility for performance

The Contractor shall be responsible for ensuring the proper fixing and operation of all hardware. All hardware shall be removed and refixed as required for painting of doors.

3.8. Lighting and power

Lighting shall be in accordance with *Specification for Electrical Installation at Treatment Plants (Pr9835)*.

3.9. Plumbing

3.9.1 Materials

Unless shown otherwise on the drawings or in the Project Specification, materials shall be:

- Soil pipes - rigid PVC.
- Vents and anti-syphon vents - rigid PVC.
- Vent cowls - basket type, bird proof.
- Water service:
  - external – copper;
  - internal – lagged copper.

All piping shall be complete with bends, offsets, junctions, inspection openings and lugs as necessary.

Cold water piping laid in ground shall be wrapped with self-adhesive polythene tape.

3.9.2 Fixtures

Hand basins and toilet suites (pan and cistern) and wall-hung urinals shall be solid vitreous china of approved brand and of the type and colour nominated in the Project Specification, the drawings and the Schedule of Finishes.

Taps and accessories such as toilet roll holders and pan cleaning brushes shall be of matching design and colour.

Kitchen sinks and continuous urinals shall be of stainless steel of approved brand of the type nominated in the Job Specification or drawings.

Fixtures shall be securely fixed to their mounting surfaces using the best tradesman-like practice.

Fixtures shall be fitted flush and plumb and any gaps shall be caulked with an approved elastic silicone sealant of matching colour, suitable for mating surfaces and having a minimum product warranty of ten (10) years. The surface of the caulking shall be neatly finished using a suitable tool, to give an even, concave profile between surfaces at right angles.

3.9.3 Workmanship

All work shall be carried out by licensed tradesmen in first class manner and laid out in accordance with accepted plans.

The Contractor shall rigidly fix all pipes to avoid the occurrence of water hammer.

The Contractor shall prevent foreign matter from entering pipes and protect piping and fittings from damage.

Wherever possible the Contractor shall conceal pipes. Exposed pipes and fittings internally shall be chrome plated copper or brass complete with chrome plated flanges and fixings.

The Contractor shall build in sleeves where pipes pass through masonry floors and walls.

Chases shall not be permitted in hollow and unrendered concrete block or "off-form" concrete. Where allowed, all chases shall be formed with sawn grooves.

The Contractor shall flash vents at roof line and securely stay vents. The whole installation shall be tested on completion in accordance with regulations.

3.10. Sheet metal roofing

3.10.1 General

The Contractor shall provide the whole of the buildings where specified to have metal roofing with a fully watertight and birdproof roofing system of the type shown and specified, complete with all necessary accessories, trim and roof plumbing including capping, flashings, gutters, outlets and overflows.

Where shown on the drawing or specified in the Project Specification the roof system shall include an insulation blanket supported on wire mesh to the satisfaction of the Superintendent.

The roof shall be left clean and free from debris on completion. The Contractor shall ensure that no debris is allowed to enter the drainage system during construction and cleaning activities.

Materials shall be the best of their respective kinds. Unless otherwise specified, all roofing materials shall be ‘colourbond’ finished.

Roofing shall be installed by tradesmen skilled and experienced in the types specified and in accordance with manufacturer's instructions.

The Contractor shall carry out all necessary operations for the satisfactory performance of the roof, including cutting at junctions, trimming around penetrations and flashings.

Before roofing work commences all work above roof level shall be complete or, if not, the Contractor shall be responsible for protecting the roof fabric from damage.

The Contractor shall avoid construction loads on roof.

3.10.2 Materials

Roof sheeting shall be of the profile shown on the drawings or as specified in the Project specification and unless otherwise specified shall be ‘colourbond’ finished as manufactured by Lysaght Brownbuilt Industries or an alternate approved manufacturer.

Roof sheets shall be in single lengths to suit each section and to fall from the high point to the gutter with no intermediate joints. Manufacturer's accessories shall be used unless shown or specified otherwise.

Where shown or specified 50 mm thick ‘Bradford Anticon’ roofing blanket shall be provided and installed in accordance with manufacturer's instructions.

Fascia and wall sheeting shall be of the profile shown on the drawings or as specified in the Project Specification and unless otherwise specified shall be ‘colourbond’ finished as manufactured by Lysaght Brownbuilt Industries or an alternate approved manufacturer.

Sheets shall be in single lengths to suit each section and to be fixed to supports with approved clips or fasteners in accordance with the manufacturer's recommendations.

Flashings, trims, rib and stops and all sundries unless otherwise specified shall be 'colourbond' finished steel to match adjacent material.

Joint sealants shall be butyl sealing tapes and silicone caulking compounds.

All jointing materials, wedges, holdfasts, tacks, collars and connections as required and necessary shall be of a material compatible with the basic materials used. All rivets and roof and wall screws shall be Grade 316 stainless steel.

3.10.3 Workmanship

Roof, fascia and wall sheeting:

- Roof, fascia and wall sheeting shall be laid strictly in accordance with manufacturer's printed directions to falls indicated on drawings;
- Roof sheeting shall be laid in single lengths to roof slope with uniform falls at right angles to purlins;
- Should it be necessary to use more than one sheet to provide full-length coverage, the Contractor shall commence sheet laying at the gutter line and lay subsequent sheets over this sheet to the ridge or fascia, allowing a minimum end lap of 150 mm:
  - End laps in roofs of less than five degrees pitch (approximately 1 in 12) shall be sealed with an approved sealant;
  - The minimum end lap for vertical wall cladding shall be 100 mm.
- Where roof pitches are less than fifteen degrees or where the roof is exposed to extreme weather conditions, the Contractor shall turn sheet ends up approximately eighty degrees at the high end of the roof, that is at ridges or fascia and turn downwards approximately fifteen degrees at gutters, with the turn-up/-down tool;
- Sheeting shall be fixed to purlins and girts in strict accordance with the manufacturer's printed recommendations;
- The Contractor shall provide all trims, accessories, etc., required where roof surface is penetrated by pipes, services, etc.;
- The Contractor shall provide all flashings to parapets, upstands, holes and other penetrations and trims required to ensure that the roof is entirely watertight.

Insulation and sisalation:

- Where provided, roofing blanket shall be placed under sheeting before fixing:
  - Insulation projecting past the gutter purlins into the box gutter to be trimmed off;
  - Roofing blanket shall be supported on wire mesh to the satisfaction of the Superintendent;
- Unless specified to the contrary in the Project Specification, heavy duty insulation shall be provided on all sheeted surfaces:
  - The sheeting shall be laid over the purlins or girts before the roof sheets are laid.

Sealed joints:

- Where sealed joints are required, the Contractor shall use a sealant in conjunction with mechanical fasteners;
- Approved sealants include GE Silpruf silicone rubber sealant, Dow Corning (Selleys) 780, Silicoflex, Silicoseal N-1 or 2, Persempre W234, Expandite Silicone 88, Norton Bear-4, Zincoseal, Ramset RZ805, Zbond V-4 or 60, Poly-Flexiseal and Borden Metal to Metal;
- Zincalume shall not be soldered;
- Sealant to gutter joints shall be compressed between the lap rather than an overlay of sealant at the joint face.

Dissimilar metals:

- The Contractor shall follow Table 2 of AS 1562 as a guide to compatibility of metals and ensure that direct contact between incompatible metals does not occur;
- Where in contact with each other, aluminium and steel surfaces shall be coated with two (2) coats or alkali-resistant bituminous paint or with an accepted adhesive tape.

Box gutters:

- The Contractors shall provide box gutters to roofs where shown, fabricated from 0.8 mm Grade 316 stainless steel sheet, to sizes as shown:
  - Minimum fall shall be 50 mm to each 5 m length;
  - The gutter shall be folded as shown on the drawings, with stop ends at parapet abutments and expansion joints at high points;
  - Sumps at outlets shall be minimum 100 mm deep tapered with falls to outlets;
- Top edges of gutters shall be gauged to underside of roof sheeting and separated, turned back 25 mm wide at 45 degrees; similarly, edges shall be turned back at stop ends and capped at expansion joints;
- Box gutters shall be laid loosely and held down at edges;
- Upstand 'saddle' joint shall be used at expansion joints;
- Joinings shall be riveted and sealed and bottoms dressed into outlet sumps at downpipes;
- The Contractor shall provide 0.8 mm Grade 316 stainless steel sheet outlets to rainwater heads in the positions shown on the drawings;
- At each end of gutters, the Contractor shall provide 100 mm diameter stainless steel overflows set to project 25 mm past external face of wall.

Fascia gutters:

- Fascia gutters shall be prefabricated selected profile ‘colourbond’ steel or treated aluminium fascia gutter as appropriate fixed with similar colour treated fascia brackets at 900 mm centres or approved proprietary fixings.

Downpipes:

- Concealed downpipes shall be Grade 316 stainless steel or 90 mm internal diameter PVC as shown on the drawings;
- Thimbles from sumps shall be 150 mm long increasing to 25 mm larger opening in the bottom of the gutter;
- Joints between downpipes and thimbles shall be sealed and riveted;
- Downpipes shall be full length from gutter or outlet to drain and shall be built flush against the structure in positions shown on the drawings;
- Stack drops shall be vertical at entry of drains;
- Unless shown otherwise on the drawings or specified in the Project Specification, external downpipes shall be 100 x 100 mm 'colourbond' finished sheet steel, treated aluminium or Grade 316 stainless steel downpipes as shown;
- Downpipes shall discharge into stormwater drains via concrete encased bends;
- The Contractor shall securely fix downpipes to the structure using 'Unistrut' pipe guides or accepted straps of the same material to the downpipe.

Flashings, trims, etc:

- Flashings and trims, including over-flashings, shall be installed at verges, abutments, junctions, etc. and at pipes passing through roofs and wherever necessary to make the whole installation birdproof and watertight;
- The material shall be the same as the roof;
- Cappings shall be carried over the top of parapet walls and turned down maximum 150 mm on the internal face of external parapet walls;
- On the external face the capping shall be turned down as detailed on the drawings;
- Flashings shall be in long lengths with joints lapped 100 mm in direction of prevailing weather. Joints shall be riveted and sealed with sealant selection as per Sealed joints (within Section 5.10.3 – Sealed Joints);
- Flashings shall be notched over roof sheeting ribs and dressed down to trays where angled to ribs and to extend over a minimum number of two (2) ribs;
- Flashings shall be pop riveted to ribs and set in caulking compound;
    - Expansion joints shall be provided in long flashings, at 6 m maximum centres in accepted locations;
    - All expansion joints shall be separated a minimum of 6 mm and be turned back 35 mm and an expansion cap fitted, turned into the folds;
    - The cap shall follow the profile of the flashing;
    - Joints which are flashed shall have minimum cover of 100 mm vertically and 150 mm horizontally.
- Pipe flashings to roof shall be counter flashed, pop-riveted and set in caulking compound;
- All roof penetrations shall be counter flashed.

Rainwater heads:

- Rainwater heads shall be provided in positions shown on the drawings and shall be fabricated from 1.0 mm 'colourbond' finished and treated aluminium or Grade 316 stainless steel sheet as shown;
- Heads shall be approximately 350 x 350 x 150 mm wide to the profile shown on the drawings and shall be complete with tapered outlet to suit 100 x 100 mm downpipe and with overflow splitter;
- Open-top rainwater heads shall be provided with hail guards fabricated from 0.8 mm wire mesh supported along its perimeter by 6 mm diameter aluminium rods, welded at corners.

Roof lights:

- Roof lights shall be Atlas Skylights Pty. Ltd. or equivalent accepted manufacturer, ventilated commercial roof lights with polycarbonate glazing of the size shown on the drawing or as specified in the Project Specification;
- Roof lights shall be fixed strictly in accordance with the manufacturer's printed instructions and shall be fully weatherproofed;
- The Contractor shall provide all necessary timber trimmers and 6 mm Villaboard II linings where opening into fibrous cement or plaster board lined ceilings.

Expansion and contraction:

- The Contractor shall refer to AS 1562 Design and Installation of Metal Roof, regarding deleterious expansion and make adequate provision for thermal movement in the installation of roof assemblies;
- The Contractor shall pay special attention to joints and fastenings, particularly in sheet metal and thin sections;
- The Contractor shall prevent all detrimental effects including tearing, buckling, opening of joints, undue stress and fatigue;
- Any leaks in the roofing and displacement of roofing where due to faulty workmanship or materials shall be rectified by the Contractor.

3.10.4 Samples

Where directed by the Superintendent, a strip of roofing, sufficient to indicate laying, dressing around vents, flashings and general quality of workmanship shall be laid for approval prior to final erection.

3.10.5 Testing

The Contractor shall, after installation, test gutters, sumps and overflows to a running overflow condition for one (1) hour.

Where faults are apparent, the Contractor shall remedy all defects and re-apply the test. The Contractor shall provide all necessary test apparatus.

3.10.6 Alternate roof sheeting and insulation material

The Contractor may submit to the Superintendent for approval an alternative roofing material type.

'Metecnospan' Insulated composite metal roofing and ceiling panel or accepted equivalent may be more cost-effective solution in specific situations and may be considered as an alternative to the standard roofing, insulation and mesh arrangement as stated in Section 5.10 Sheet Metal Roofing.

3.11. Aluminium Windows, Doors and Louvers

3.11.1 Materials

All aluminium windows, doors and louvers shall be fabricated from alloy 6063 T5 heavy duty extruded framing conforming to AS 1866 Aluminium and Aluminium Alloys – Extruded Rod Bar, Solid and Hollow Shapes.

The finish of the framing shall be as shown on the drawings or as specified in the Project Specification.

Glass shall be bronze tinted reflective float glass complying with AS 1288 Glass in Buildings – Selection and Installation unless noted or specified otherwise.

3.11.2 Workmanship

The Contractor shall supply and install aluminium window, door and louver units complete with glass, glazing and/or louver blades and all fittings including handles, catches, locks and latches.

The Contractor shall protect windows, doors and louvers from damage of any kind and provide strippable plastic protective film before delivery to site.

Any damaged units shall be made good and all broken, scratched or cracked glass shall be replaced by the Contractor at no extra cost to the Principal.

The Contractor shall supply and build in window, door and louver units strictly in accordance with the manufacturer's instructions.

Where the sizes are not standard, window, door and louver units shall be specially fabricated to suit. All sizes shall be checked on site before manufacture.

Where shown or specified all aluminium shall be anodised to 10 microns thickness to comply with first quality standards.

All doors, frames, louvers and glazing shall comply with the wind loadings shown on the drawing or specified in the Project Specification and the requirements and intentions of the drawings and specification to achieve waterproof conditions at all times.

Fixed louvered units shall be provided with an accepted bird-proofing.

3.11.3 Fixing

All fixing shall by stainless steel screws or bolts in accordance with the required standards of first quality workmanship to achieve strength for wind loadings and weatherproofing and to ensure that all stress, weights, dynamic loads, shock loads etc. are transmitted into the structure through such fixings.

3.11.4 Tolerances

All necessary allowances shall be made for thermal movement in the design and detail of the fixings.

Frames shall be designed and installed to fit and operate without buckling, opening of joints or undue stress on hinges, fasteners, tracks or guides.

3.11.5 Dissimilar materials

Aluminium shall be prevented from contacting dissimilar materials by the use of suitable tapes, gaskets, washers, sleeves, etc.

3.11.6 Rejections

All aluminium components, units, assemblies, fixings, completed units, etc. that do not, in the opinion of the Superintendent, meet the requirements outlined above, shall be liable to rejection, in which case they shall be removed from the Project and replaced at the Contractor's expense.

3.11.7 Fabrication

Fabrication drawings of all windows, doors, frames and louvers shall be supplied to and accepted by the Superintendent, before fabrication commences.

Frames shall be so designed to support the weight of the proposed doors without distortion or deflection.

3.11.8 Certificates

The Contractor shall provide, concurrently with supply of shop drawings, a certificate, from an approved Testing Authority for each window, door and louver type, certifying compliance with AS 2047, Aluminium Windows for Buildings, for the relevant design wind pressure.

3.12. Plastering

3.12.1 Definitions

Plastering, plasterwork and rendering are terms which shall be considered synonymous in so far as they mean the range of operations involved in the application of plaster or render as undercoats and/finishing coats to masonry, concrete or internal lining panels.

3.12.2 Materials

The Contractor shall keep materials segregated, clean and dry. Proprietary line materials shall be delivered to the works as despatched from the manufacturers, in sealed containers, and shall be used strictly in accordance with their recommendations. The Contractor shall co-operate with the Superintendent in providing material samples for test if required.

Portland cement shall be of accepted manufacture complying with AS 3972 Portland and Blended Cement.

The Contractor shall use an accepted brand of hydrated lime delivered in sealed bags. All lime shall comply with AS 1672 Building Limes.

The Contractor shall use hard, clean sand complying with AS CA27 Code for Recommended Practice for Internal Plastering on Solid Backgrounds, graded according to the appropriate tables in the Appendix to CA27 and complying with samples which shall be submitted to the Superintendent for approval before use.

Water shall be clean, fresh and free from vegetable or organic matter in solution or suspension.

3.12.3 Workmanship

The Contractor shall clean platforms, tools and mixing machines before each batch is mixed.

Where mixed on-site, the Contractor shall proportion materials by volume in accepted measuring devices.

Mixing may be done by hand on a clean platform or by machine. The ingredients shall be thoroughly mixed until the mixture is uniform in colour and consistency.

Mixes containing cement shall not be used after initial set has occurred and under no circumstances will retempering be permitted after one (1) hour of initial mixing. The mix for each successive coat should never be of a type richer in cement than the mix used for the coat to which it is applied.

When permitted by the Superintendent, accepted admixtures may be used to retard or accelerate setting, improve workability or reduce water content. Admixtures which in the opinion of the Superintendent may have an adverse effect on the plaster or render or associated materials shall not be used.

Plastering work shall only be carried out by competent tradesmen.

Generally, the Contractor shall delay plasterwork until the risk of damage by building operations and installation of services is at a minimum, consistent with completion of the contract by the date of practical completion and with due consideration for the maturity of plasterwork before application of paint and other finishes.

The Contractor shall not carry out plasterwork when weather conditions are likely to adversely affect the results and shall protect adjacent work from possible damage caused by plasterwork operations.

The work shall be executed with long rules and straight edges run off temporary screeds to ensure that surfaces finish plumb, true and even and proper thickness of coats is maintained.

With each coat, the Contractor shall finish complete areas where possible in one operation or in one day's work. The Contractor shall continue or match up in such a manner to leave no evidence of a joint in the finished work, unless otherwise specified or shown.

Where applied to expanded metal lathing or over the winds of metal corner beads, the plaster shall be firmly pressed through the apertures.

The Contractor shall thoroughly scratch comb undercoats as they become stiff to form an effective key.

Before applying a subsequent coat, the Contractor shall ensure that the previous coat has thoroughly set, dust down the surface and dampen where necessary.

The Contractor shall finish surfaces free from defects and with angles plumb and straight and finish curved surfaces to true radii.

Any imperfect or drummy work shall be cut out and replastered to the satisfaction of the Superintendent.

Unless specified otherwise, the wood float finish shall provide an even texture obtained by wood floating the screeded surface and finishing with a clean sponge.

Internal wall and ceiling panel joints shall be treated strictly in accordance with the manufacturer's written instructions. A three-coat jointing system shall be used on all recessed, butt and external corner joints. A two-coat system shall be used on internal corner joints.

External corner joints shall be protected by a perforated galvanised steel angle fixed to the wall prior to application of the first coat.

All recessed and butt joints shall be taped using perforated paper tape during application of the first coat in accordance with manufacturer's instructions. On internal corner joints self-adhesive fibreglass tape may be used.

Screw and nail heads and scuff marks shall be stopped with plaster during application of the first joint coat. During each subsequent joint coat, cover screw heads overlapping each previous coat by a minimum 25 mm.

The manufacturer's minimum time intervals between coats are to be strictly adhered to in order to ensure a sound, integral coating system.

The edges of all joints and plaster areas shall be neatly feathered flush with the linerboard.

After the recommended drying time, all joints and plaster areas shall be sanded flush and smooth with 150 grit paper or cloth or 220 grit sanding mesh. Care shall be taken not to scuff the linerboard at the joint edges.

3.12.4 Tolerances

All surfaces of final coats of plaster and render shall finish to true planes within a tolerance of 3 mm in 3 metres as determined by a 3 metre straightedge placed anywhere over the finished surface.

3.12.5 Angles and joints

Unless otherwise shown, the Contractor shall finish internal and external angles true and square.

Where plaster or render abuts other materials, it shall be cut in with a neat bevel. Plaster shall finish with a neat bevelled fair edge against adjoining unplastered work such as face brickwork.

3.12.6 Sample areas

When directed by the Superintendent, the Contactor shall prepare in positions sample panels of sufficient area (not less than 1 m2) of each of the plaster and render finishes specified in this Specification, including examples of the junction details and trim.

These samples when accepted by the Superintendent shall be used as the standard of finish texture and colour and shall be preserved until all work of its type is complete.

3.12.7 Protection and curing

The Contractor shall not allow rapid or uneven drying out of plaster and shall not allow coats of gypsum plaster to become damp after setting.

Cement plaster and render shall be cured by keeping it in a damp condition. Unless otherwise specified, the Contractor shall allow undercoats to dry out after curing before applying subsequent coats.

The Contractor shall protect external angles with timber boards or other accepted means and keep in position until removal is required or permitted by the Superintendent.

3.12.8 Preparation of surfaces

The Contractor shall make good any defects in the background which may adversely affect the quality of plasterwork before plastering is commenced.

No claim for extras related to the suitability or otherwise of the base, substrate, background, edges and the like will be considered.

Joints of blockwork shall be raked out to provide key.

The Contractor shall thoroughly scabble surfaces of concrete which are not sufficiently rough to provide key and break off any excessive projections and fill voids, hollows and honeycombs with 1:2.5 cement and sand before plaster or render coats are applied.

The Contractor shall ensure that water pipes are sheathed to enable thermal movement and all pipes and conduits which are to be concealed behind plaster or render are chased and fixed in position and the building in of items from other trades is completed before plastering is commenced.

The Contractor shall cover all chased sections or holes greater than 50 mm wide with strips of expanded metal lath fixed with 25 mm concrete or masonry nails at 150 mm centres or by other accepted means, extending lathing a minimum 75 mm beyond each side of chases and holes.

All surfaces shall be thoroughly brushed to remove dust and dampened where necessary to provide even suction.

The Contractor shall apply a dash coat to all surfaces and allow it to harden under damp conditions before subsequent coats are applied. The dash coat shall consist of 1 part cement to 2 parts coarse sand or crushed stone mixed wet and forcibly applied onto surfaces.

3.12.9 External render

External render shall be applied in two coats to a minimum 12 mm finished thickness.

The first coat shall comprise cement, sand and lime, mixed in the proportions of 2:8:1, applied to the surface to fill all hollows and to finish to a generally true 8 mm minimum thickness. The Contractor shall scratch the surface whilst green to provide a key.

The second coat shall comprise cement, sand and lime mixed in the proportions of 4:16:1 and finished 4 mm minimum thickness. The Contractor shall trowel off a true plumb, level surface to an accepted fine even finish with a wooden float and clean sponge.

3.12.10 Internal render

Internal wall areas which are specified to be rendered shall be provided with a 15 mm minimum finished thickness in two coats. All indents and irregular faces shall be dubbed out and scratched before plastering is commenced, using the same mix as for the first coat.

The first coat shall be composed of fifteen parts sand, four parts cement and one part lime, rendered to a true even thickness with a wood float, and scratched lightly as a key for the second coat. The Contractor shall finish the second coat without joins in the height or length of walls.

The second coat shall be composed of four parts accepted silica sand, two parts cement and one part hydrated lime evenly and regularly worked into the whole surface, and finished in its own moisture to an accepted fine, even sand finish with a plastic foam pad fixed to a wooden float.

A minimum time of forty-eight (48) hours shall elapse between coats.

Mixes for scrub fines shall be screened through a No. 30 sieve before water is added.

3.12.11 Textured coatings

General:

- Where specified or shown on the drawings, a textured coating shall be supplied to all external masonry and concrete surfaces of the building:
  - The textured coating shall comprise a decorative coating for application to concrete and masonry surfaces;
- A written guarantee shall be submitted prior to the issue of the Practical Completion Certificate covering all surfaces to which a decorative coating is applied, against material deterioration or defect or faulty workmanship in application of the material for the period of 10 (ten) years from the Date of Practical Completion;
- An applied sample shall be provided on the site for approval before proceeding with the work:
  - An applied sample of not less than 4 (four) square metres in area shall be applied to a surface where directed, such surface encompassing all the variations likely to be encountered in the coating of the substrate in its entirety;
  - The applied sample shall be as near as practicable in colour and texture to the design or site sample supplied by the coating manufacturer or the agent for the decorative coating which shall be kept on site for reference;
  - When accepted, the panel will be used as the standard of finish on the project;
- The design or site sample shall have a grainy texture of the applied coating system when dry with the selected colour;
- The design or site sample shall be supplied by the coating manufacturer or the manufacturer's agent soon after the commencement of construction;
- The applied sample shall present the colour, texture and minimum dry film thickness of the completed coating:
  - The applied sample shall be applied no later than one month after sufficient of the substrate has been constructed and made good to provide the range of variations of substrate condition that are likely to be encountered in the coating of the substrate in its entirety;
- The panel shall be preserved until all work of its type is completed.

Material:

- The decorative coating shall be Rockcote Armour manufactured and supplied by Rockcote Pty Ltd or a similar accepted product;
- All materials comprising the coating system shall be delivered to the site with all containers, seals and product identification intact; they shall be fully protected against frost and damp during transport and while on site;
- The coating system shall consist of a 6 mm average thickness of Rockcote Skimcote, an acrylic modified cement render, followed by one coat of Rockcote sealer primer, an acrylic PVA primer which shall be followed by an application of 1 mm average thickness Rockcote Armour, an acrylic heavy duty coating:
  - The binder shall comprise acrylic emulsions, titanium dioxide, concentrated anti-fungicides and highly durable pigments and fillers;
  - The texture-building ingredients shall comprise quality graded fillers and aggregates, with the pigment of selected colour throughout the coating and having a satin finish.

Workmanship

- All work shall be carried out by a specialist firm accepted by the manufacturer of the decorative coating and designated by the manufacturer as an "accepted applicator" and accepted by the Superintendent;
- All work shall be carried out in strict accordance with the manufacturer's recommended application procedures;
- The Contractor shall ensure that the applicator of the decorative coating is satisfied with the standard of the substrate to enable the finish of the decorative coating to match that of the applied sample; for off the form, fair faced concrete, the minimum standard of the substrate shall be as described in AS 3610 Table 3.3.1 as Class 2 concrete;
- For masonry, the minimum standard of the substrate shall be as described in AS 3700; as the natural joint pattern is not to appear, blockwork shall be fair faced and flush jointed;
- All masonry shall be rubbed down with a piece of concrete masonry prior to the application of the decorative coating;
- All substrate shall be free of dirt, grease, paint, scaling and laitance, efflorescence, mould, fungi, infection, stains, rust, form oil, mastic compound and any other foreign matter; it shall not be subjected to continual wetting or hydrostatic pressure;
- The Contractor shall make good any substrate which is not in accordance with these standards; adequate protection shall be provided to all surfaces adjacent to the surfaces onto which the decorative coating is to be applied and shall be removed on completion of the application;
- Application should not be carried out at below 5 degrees C nor above 36 degrees C particularly in dry and windy conditions;
- Any day work joints of the coating shall be accepted by the Superintendent;
- Internal and external angles shall be true and square; the Contractor shall cut in against other materials to provide a true joint as directed;
- All expansion joints shall be sealed or filled after the coating has been applied; care shall be taken when joints are sealed or filled so as not to stain or interfere with the final coating;
- All work shall be finished even, hard and true, free from stains or other imperfections. Any drummy work shall be cut out and made good;
- The finished coating shall match the accepted applied sample in colour, texture and uniformity;
- All finished work shall be properly protected against damage from the sun, freezing, rain, workmen on site or any other cause:
    - The work shall be provided with protection from freezing not less than 48 hours after application, from abrasive contact for a period of not less than 7 days after application and with protection against direct impingement of water or other liquids not less than 24 hours after application;
- The Contractor shall refer to the drawings or the Schedule of Finishes for the extent of the decorative coatings externally;
- All concrete surfaces and blockwork externally shall have the decorative coating applied;

- The Contractor shall generally make good after all other trades. The Contractor shall undertake all pointing and stopping necessary and leave the finish of all walls and all other surfaces in a neat and tidy condition, ready for painting or handing over.

3.13. Tiling

3.13.1 Preparation of surfaces

The Contractor shall prepare concrete surfaces to receive applied finishes and remove all laitance.

If necessary, the Contractor shall use a special accepted plasticised epoxy bonding agent where toppings are applied to concrete surfaces.

3.13.2 Workmanship

All work shall be carried out by skilled tradesmen in a first class workmanlike manner. All tools, screeds and grounds shall be kept clean.

Surfaces shall be checked to ensure correct finished alignments and levels. The Contractor shall ensure that built-in elements, anchors and grounds are fixed prior to commencing and protect adjoining or abutting surfaces against damage through any cause.

Permanent and temporary grounds shall be fixed where and as necessary to ensure straight even surfaces and accurate lines.

The Contractor shall keep surfaces even, true, free from blisters, dropping, trowel marks or other defects and shall screed at all angles, corners and elsewhere as necessary.

All external openings shall be covered to prevent too quick drying and ensure that freshly completed work can neither dry out nor sweat out to the detriment of the surfaces.

The Contractor shall dispose of compo mixed with cement longer than one and a half hours. Retempering shall NOT be allowed after this time.

Where necessary, brass angles 3 mm thick, shall be provided at doorways to build up tiled areas above the general floor level.

3.13.3 Protection

The finished work shall be protected from damage by the weather and building operations and keep covered and moist for a minimum of seven (7) days.

3.13.4 Cleaning

On completion the Contractor shall clean down surfaces to remove all dirt, stains, etc. and buff polish all tiled surfaces to give a smooth, even appearance.

3.13.5 Samples

The Contractor shall submit to the Superintendent at least one sample of each type and colour for approval prior to commencing work.

3.13.6 Ceramic floor tiles

Ceramic floor tiles shall be an accepted Australian brand tile 50 x 50 x 6 mm first quality fully vitrified tile of the colour shown on the drawing or specified in the Project Specification or Schedule of Finishes.

Floor tiles shall be laid on 1:1/2:4 cement, lime and sand bedding of 20 mm minimum thickness throughout. The back of tiles shall be coated with 1.5 mm thick neat skim coat and shall be bedded well down into position, to an even fall to floor waste and to a level line around all walls.

Tiles shall be cut with an abrasive saw, or nipped and ground to profile. Work shall be set out to full tiles wherever practical.

Tiles shall be set out with 2.5 mm joints and filled with grout.

Tiles shall finish to true, even surfaces, regular lines, evenly graded to outlets and free from defects.

3.13.7 Quarry floor tiles

Quarry tiles shall be an accepted Australian brand tile 150 x 150 x 12 mm with non-slip surface, the colour shall be as shown on the drawings or as specified in the Project Specification or Schedule of Finishes.

Quarry floor tiles shall be laid in accordance with clause 5.133.13.6 of this Specification.

3.13.8 Ceramic wall tiles

Wall tiles shall be an accepted Australian brand fully glazed tile 150 x 150 x 6 mm cushion edged of colour and glaze as shown on the drawing or specified in the Project Specification or Schedule of Finishes.

Tiles shall be fixed with a two-part water proof adhesive to fibrous cement or rendered masonry walls. Where necessary fibrous cement walls shall be rendered to achieve the tolerance given below.

Tiles shall be laid with joint lines levels and plumb and accurately set out. Cutting of tiles shall be at internal angles as necessary. Edges and external corners shall finish with glazed edge tiles. Tiles shall be stack bonded.

The Contractor shall build in all accessories and other elements as required. Where necessary, the contractor shall drill for fixing of other attachments and cut tiles close up around plumbing fixtures and other brackets and fittings.

3.13.9 Grouting

After tiles have been fixed for a minimum of 24 hours, the Contractor shall grout up with white cement, well worked into joints and rake back exposed edges of tiles and point and grout as for face of tiles.

Junction of tiles with joinery and door frames shall be cut 5 mm wide for the full depth of tile and bedding and be pointed up with one part polysulphide sealant, of accepted brand, applied in accordance with manufacturer's directions.

3.13.10 Tolerances

All surfaces which are tiled shall finish to true lines or planes within a tolerance of 3 mm in 1.5 metres.

3.14. Painting

3.14.1 Materials

All paints shall be ready mixed, of accepted brand and type complying with all relevant Standards and Codes.

All materials shall comply with Government regulations regarding the use of non-poisonous paints. Paint shall be brought on the Project in its original sealed containers. The use of bulk materials other than the best quality shall not be permitted.

Thinners, stainers, primers and undercoats shall be of the type supplied by the manufacturers for use with the various types of paint.

Putty shall be first grade linseed oil – whiting putty stained as necessary to match adjoining work. Plaster based patching powder compound shall be used for porous and fibrous cement surfaces.

3.14.2 Colours

Colours shall be generally as listed in the Schedule of Finishes. The Contractor shall submit proposed colours and colour chart to the Superintendent for approval prior to ordering.

Sample Panels

Sample boards for each colour, 450 mm square shall be prepared, made up on material appropriate to the purpose for which the paint is to be used. Boards shall be coated with primers, undercoats and finishing coats to the same specification as required for the particular finish.

The Superintendent's approval shall be obtained before proceeding with the work. Samples shall be held available for reference on the Project until completion of the work.

3.14.3 Workmanship

All painting shall be carried out by competent tradesmen in a first class manner. All paints shall be thoroughly mixed and stirred before use. All mixing shall be done on the Project but not on the floor of the building.

Primed or undercoated work shall not be left in an exposed unsuitable situation for an undue period of time before applying subsequent coats.

An adhesive tape test shall be applied to plastered walls before painting commences. Painting shall not commence until surfaces are in an accepted finished condition to receive paint.

3.14.4 Preparatory work

Timber:

- All knots and gum veins shall be treated with patent knotting;
- All nail holes, open joints and cracks shall be filled;
- All woodwork shall be rubbed down with sandpaper and all roughness removed;
- All work specified to be clear finished shall be filled with accepted patent filler and sanded down to smooth surface;
- All exposed corners shall be provided with a uniform arrise by hand planning.

Metal:

- All metal surfaces shall be clean, smooth and dry, free from mill scale, grease, rust, tar, oil and other foreign matter. Surfaces shall be properly sanded and brushed down;
- Metal work shall be degreased with mineral turpentine prior to applications of priming coat, etch primer or red oxide primer as appropriate. All galvanised surfaces shall be etch primed. Shop primed metalwork shall be spot primed on site with matching primer;
- Cast iron pipes shall be filled and sealed with an accepted industrial coating compatible with the finish coats nominated in the Project Specification or Schedule of Finishes.

Masonry surfaces:

- All nibs shall be removed and all minor cracks and imperfections filled and sanded down;
- Where acrylic paint is specified, the Contractor shall dampen masonry surfaces as recommended by the manufacturer, prior to application of paint;
- Where satin and flat enamel finishes are specified, masonry surfaces shall age for at least 6 weeks and gypsum plaster and fibrous cement surfaces for at least 30 days, before painting.

Rubbing down:

- All timber and joinery work shall be lightly rubbed down between coasts with fine sandpaper and brushed clean.

Application:

- All materials shall be used strictly in accordance with manufacturer's written instructions. Paint shall not be spread beyond its covering capacity;
- All coats of paint shall be evenly and smoothly applied with full cover to all parts, finished free from blotches, brush marks, runs, sags, and other defects;
- The Contractor shall be held responsible for failure to obtain a first class finish; each coat of paint shall vary in tint from the preceding coat;
- Each coat of paint shall be allowed to harden in accordance with the manufacturer's instructions before the next is applied;
- Painting shall not be carried out in adverse weather conditions; no clear finishes shall be applied in wet or foggy weather;
- Painting shall be left till such time in the work program to ensure that other trades have completed work in painted areas thereby minimising damage and patchwork to the finished surface;
- The Contractor shall comply with all necessary safety precautions as recommended by the manufacturer and any relevant authority when handling and applying paint coatings; this shall include the use of protective clothing, skin creams and breathing masks as appropriate; adequate ventilation and lighting shall be maintained at all times during the application and drying of paints;
- The Contractor shall finish one colour against another to a true straight line and cut in against glass, metal frames and other junctions similarly;
- The Contractor shall adequately protect all floors, fittings and other surfaces during painting with drop sheets and masking as necessary;

- All door hardware, switch plates and similar items shall be removed before adjoining surfaces are painted and replaced accurately on completion.

3.14.5 Clean up

All paint spots shall be removed from floors, tiles, light fittings, switch plates. hardware, stainless steel, aluminium, chrome plate, glass and all similar surfaces;

Glass and metalwork shall be cleaned and polished and the work of this trade shall be left in first class condition;

After completion of painting work, the job shall be thoroughly cleaned and tidied;

The Contractor shall be fully responsible for any damage by their staff, suppliers and sub-contractors and shall make all repairs as deemed necessary by the Superintendent.

3.15. Termite management

The Contractor shall provide termite management materials and systems to all slab-on-ground penetrations and slab joints to concealed spaces.

Termite barriers shall comply with AS 3660.1 in particular:

- Concrete slab barrier Standard: To AS 3660.1 Section 4;
- Termite cap and strip shields Standard: To AS 3660.1 Section 5;
- Woven stainless steel mesh barriers Standard: To AS 3660.1 Section 6.

The Contractor shall give sufficient notice so that inspection may be made of the completed termite barriers.

Installation shall be performed by an accredited installer. The terms and condition of the termite management system shall be as offered by the termite mesh manufacturer and accredited installer.

Ensure that no waste materials which could attract termites remain on the site.

At the end of the defects liability period, inspect the termite control systems and submit a report on their efficacy and status.

3.16. Waterproofing

The contractor shall provide waterproofing to all structures as required, to ensure that the structures/buildings are completely waterproofed.

A waterproofer shall be qualified and shall be capable to apply, install and repair waterproofing systems including surface preparation and apply or install material or systems for the prevention of moisture penetration.

Waterproofers must hold a Waterproofing Licence and be accepted by Unitywater. The licence can be:

a) a current Certificate III in Construction Waterproofing CPC31411;

b) a recognition certificate as a qualified waterproofer.

Waterproofing membranes can be:

a) Membrane systems that provide a proprietary membrane system suitable for the intended external waterproofing.

b) Tanking system that provides a proprietary membrane system suitable for the intended below ground tankering.

The manufacturer must confirm in writing regarding the compatibility of their waterproofing treatment to other coatings. It shall be the responsibility of the manufacturer/installer of the waterproofing treatment to take whatever measures are necessary, including testing, to ensure adhesion of their waterproofing treatment.

The contractor shall develop Quality Inspection and Test Plans (ITP's) to ensure the waterproofing has been installed and tested in accordance with the manufacturer's requirements

The surface preparation including surface defect repairs shall be in accordance with the manufacturer's requirements.

The application and curing of the waterproofing compound shall be in accordance with manufacturers requirements.

The completed waterproofing treatment shall be tested to provide compliance with standards.

The Contractor shall guarantee the waterproofing installation against defects and leakage caused by faulty product or workmanship for a period of no less than 15 years from the date of completion.

3.17. Security fencing

Security fencing to Unitywater sites shall be in accordance with AS1725.1 Chain link fabric fencing – Security fences and gates – General requirements.

The minimum standard height security fence is 2100mm high PVC coated chain link fencing topped with 3 strands of barbed wire atop of the fencing.

Minimum fencing requirements:

- *Type 2-B-R/B-T* Bottom rail only, 3 barbed top security fencing (vertical top);
- Barbed strands to be equally spaced at 150mm crs max;
- Where 45° angle top section is specified:
  - it shall be inward facing with continuation of the main vertical post supports (not an add-on section);
  - it shall have four (4) strands of barbed wire secured at the top of the fencing equally spaced at 120mm crs max.
- *Gates:*
  - To match finished fence height and barbed topping:
  - Set on 100NB HD Galv. posts;
  - Gate chain 10mm chain HD Galv. for securing gates (including pedestrian gates) to be welded to gate frame.
- *Chain link Fabric:*
  - to be 2100mm high (min) heavy duty galvanised 3.15mm wire diameter (min.) PVC coated black;
  - must have solid bottom rail to support the chain link fencing fabric;

- the combination of selvedge shall be 'knuckle barbed' (KB), (i.e.) knuckled bottom and barbed top.

- Posts – Class 1 (medium quality) (powder coated black) to provide improved durability and life, for long term security purposes;
- Security signage, (Unitywater's standard security sign), warning of no or restricted access to be attached to the fencing at 30m crs (min.);
- Provide concrete mowing strip (min. 150mm width) under all fencing.

3.18. Electric sliding gate

3.18.1 General

This specification is for the design, supply and installation of a Unitywater standard motorised cantilever type sliding gate at the road entry/exit point to Unitywater's site facilities.

The gate shall be designed as a heavy duty track and roller type for commercial, industrial and security applications to eliminate the need for ground tracks and overhead rails.

The width of each gate opening shall be determined on site and shall be for the entire road width.

All key switches are to be keyed from the facility master key system.

All works to be compatible with Unitywater's Security System Provider.

3.18.2 Gate entry

For site gate entry, provide a dual height industrial grade hot dip galvanised and powder coated 'Safety yellow' bollard (car and truck) to accommodate card reader operated switches to enable entry through the sliding gate.

The card reader switches are to be mounted at 1,100 mm and 2,300 mm above the finished road level complete with 300 mm x 300 mm weather proof enclosure.

Where specified in the contract documents, provide at the motorised gate location adjacent to each card reader switch location, a caller facility for personnel without card access.

3.18.3 Gate exit

For site gate exit, all gates to be fitted with dual inground safety detection loops connected to a single loop detector.

The inground loops will provide both vehicular safety and auto close function.

Loop cable to be vehicle detection type cable as specified by Queensland Department of Transport and Main Roads.

3.18.4 Security camera

The gate shall be fitted with security camera for both entry and exit viewing including all conduiting.

The security cameras shall be in accordance with Unitywater's "Enterprise" Security System.

3.18.5 OHS requirements

Each installation shall be fitted with two (2) minimum LED flashing (Amber) operational strobe safety lights, to each face of the main support gate frame, for indicating opening and closing functions.

Each installation shall be fitted with one (1) operational buzzer to alert personnel that gate is in operation during both opening and closing.

Each installation shall be fitted with transmit-receive photo-electric beams to create a curtain array detection field across the opening to detect all type of vehicles or personnel and to prevent the gate closing when vehicle or personnel is detected.

All exterior components (Photo-electric beams, Strobe safety lighting) to be weatherproof IP68 rated and suitable for long term UV exposure.

All signage is to be supplied and installed as required to meet statutory requirements.

3.18.6 Gate construction

The manufacture of the gate frame, support frame and back runner shall be fully welded RHS or SHS steel sections. (Stitch welding not permitted).

The design of the gate shall allow for single leaf cantilever to suit the required opening.

Typical member sizes shall be as follows pending confirmation of design requirements by the Contractors supplier:

- Top rail: 100 mm SHS;
- Bottom Rail: 200 mm x 100 mm RHS;
- Side Posts: 100 mm SHS;
- Central Post: 75 mm x 25 mm RHS;
- Vertical Bars: 20 mm SHS at 125 mm minimum centres fully welded into the surround frame;
- Spikes: 20mm x 200mm long spikes at 125mm centres to top rail.
- Height of Gate: 2400 mm. (top rail to ground)
- Gate Speed: 640 mm/s. (variable at start-up and close)
- Finish: Hot Dipped Galvanised in accordance with *Pr9693 - Specification for Mechanical Installation*.

The main drive rack shall be steel reinforced hardened polycarbonate material.

The gate will be fitted with four (4) main gate tower support guide rollers- two mounted to suit the top rail and two to suit the bottom rail.

Each of these rollers shall be fitted with two sealed bearings. Install on top and bottom rails either side a 75x3mm aluminium strip the entire length of the gate to support roller guides.

The cantilever gate system shall have two main front rollers on a pivot assembly and three rear pivot assembly rollers.

The front main roller body shall zinc plated mild steel.

Each roller shall be fitted with two sealed bearings and a 30mm S/Steel 316 axle.

The minimum load rating on the main roller shall be 40 tonnes.

The gate system shall be bolted to a concrete footing using chemical anchors and raised off the ground via jacking nuts.

3.18.7 Fencing

The sliding gate shall be fully enclosed in the retracted/open position within a security fence enclosure.

This fence shall include a lockable personnel gate to provide access to the control panel enclosure and the gate mechanisms.

The fence shall be constructed to provide 1.0m min. clearance from the gate on 3 sides.

3.18.8 Concrete footing

Concrete footing will be designed with RPEQ certification and be subject to local soil conditions.

3.18.9 Motor

Industrial grade 0.75kW 3 phase motors with easily adjustable limit switches and easy release gear boxes.

3.18.10 Gearboxes

Industrial grade gearboxes with cast iron gearboxes fitted with torque limiting devices suitable for gates up to 12 m.

3.18.11 Drive rack

Gate system is to be fitted with reinforced nylon racking. The rack shall mesh directly with the drive cog.

3.18.12 Torque limiting device

All motor gearboxes must be fitted with torque limiting devices for added safety

3.18.13 Fixings

All fixings/anchors must be Stainless Steel Grade 316.

3.18.14 Usage

Motors and controls must be suitable for ‘High Cycle’ continuous use – 100 % duty.

3.18.15 Controls and enclosure

All works are to be carried out in accordance with *Pr9380 – Electrical Installations at Network Sites*.

Gate controls are to be microprocessor and invertor controlled. They are to be mounted in IP66 rated marine grade stainless steel powder coated enclosures with lockable hinged lids.

Site As-Built Electrical Drawings are to be drafted showing all changes and a copy sent to Unitywater and a hardcopy left on site within the cabinet.

All locks are to comply with Unitywater’s standard locking system.

The cabinet shall be mounted within the gates fenced area on the secure side of the property.

Inclusion of an external mains isolation switch (bollard mounted) is required adjacent to the cabinet.

Invertor controls are to allow gentle ramping up and down of speed throughout the opening and closing cycles of the gate.

Controls shall incorporate a battery back-up, to enable the gate to open if the 240V AC supply is interrupted.

Inclusion of a reed switch to deactivate the gate from operating in the event of opening the cabinet is required.

The gate control shall include transmit-receive photo-electric beams to create a curtain array detection field across the opening to detect all type of vehicles or personnel and to prevent the gate closing when vehicle or personnel is detected.

Each equipment module shall have a din rail mounted test button installed within the enclosure. This button when depressed shall pulse the gate system open. Closing will be automatic through the safety systems and/or timeout facility.

A gate buzzer is to be fitted inside the control equipment enclosure. The buzzer is not to have excessive noise level.

3.18.16 Preferred equipment supplier

The electric sliding gate supplier shall be an industry specialist in the design, supply and installation of this type of sliding gate and shall provide written evidence proving satisfactory performance of existing installations.

The supplier/installer shall liaise with Unitywater's security provider to ensure compliance.

3.19. Security bollard

Security bollards, where required to Unitywater sites, shall be the "Fixed Type", HD Galvanised, Powder Coated "Safety yellow", fixed in accordance with manufacturer's requirements.

Generally bollards shall be manufactured from steel tube (141.3 OD x 4.8mm wall thickness) to a height of 1.0m and a 4 bolt base plate fixing.

Bollards can be provided as Concrete infill or Welded top cap.

Bollards shall be designed and fabricated to meet the following standards:

- AS1428.4.1 Tactile Ground Surface Indicators, for orientation of people with vision impairment, within public areas;
- AS1742.10 Manual of Uniform Traffic Control Devices: "Pedestrian Control and Protection"
- AS1627.4 Metal Finishing – Preparation and Pre-treatment of Surfaces – Abrasive blast cleaning of steel;
- AS4680 Hot Dip Galvanizing;
- AS4506 Metal Finishing – Thermoset Powder Coatings.

All welding to be in accordance with AS1554.1 Cat GP Welding, with all sharp edges and burrs removed

All fixing bolts, nuts and washers to be stainless Steel grade 316 with suitable anti-galling lubricant.

3.20. Demolition works

All demolition work shall be carried out in accordance with the Demolition Work Code of Practice 2021 Workplace Health and Safety Queensland.

A demolition Safe Work Method Statement shall be submitted by the Contractor and accepted by the Superintendent prior to any demolition works commencing.

Prior to demolition, all infrastructure to be demolished or removed shall be examined to determine whether they are a fire or explosion risk, or other hazardous material.

The Contractor shall provide for exclusion zones to prevent unauthorised personnel entering the work area.

No demolition shall take place until all infrastructure effected by the demolition works is isolated and tagged off.

The contractor shall be responsible for maintaining existing structures and equipment to be retained throughout the contract period.

Access shall be maintained to all existing infrastructure by the Contractor for the duration of the works.

All demolished and removed material shall be disposed off site to a registered disposal facility.

4. Concrete works

4.1. General

This Section of the Specification shall apply to plain and reinforced cast-in-place concrete and to precast concrete for general purposes. It shall be read in conjunction with all other relevant Sections of the Specification and the Drawings.

Where errors in dimensions occur which in the opinion of the Superintendent prejudice the structural or hydraulic effectiveness of the structures, the Contractor shall demolish and reconstruct the offending part of the work to the satisfaction of the Superintendent.

4.2. Materials

Concrete shall be to the grade noted on the Drawings. If no grade is shown on the drawings, then the Superintendent will specify the grade.

The Contractor shall submit all proposed concrete mixes for the Works to the Superintendent for approval.

Where water retaining structures form part of the Contract scope of works, the Contractor shall submit for the approval of the Superintendent a S40 mix with 10 mm aggregate in the event that structural elements may warrant its use.

Materials for concrete shall comply with Section 17 of AS 3600 – 2009 and Section 5 of AS 3735 – 2001.

4.3. Normal Class Concrete N20, N25 and N32

Concrete shall be supplied in accordance with AS 1379-2007 except where modified by this specification.

N20 – Over break of excavations and blinding layers.

N25 - Pipeline thrust (anchor) blocks, pipeline encasement, screeding and benching, kerb and guttering and road/foot pavement laid on grade.

N32- All other reinforced concrete structures not specified above and excluding liquid retaining structures.

The maximum shrinkage for Grade N25 and N32 concrete tested at 56 days shall be 900 x 10-6 (+5% maximum) when determined in accordance with Clause 5.6 of AS 1379.

Unless agreed otherwise, nominal slump at the point of acceptance shall be 80 mm with allowable deviation of + 15 mm. Unless agreed otherwise, the maximum nominal size of aggregates shall be 20 mm.

A minimum of three weeks prior to commencement of concrete works, details shall be submitted to the Superintendent of each proposed concrete mix, test results/ historical records of each mix proportions and certificates from an independent laboratory with appropriate NATA registration, stating that the nominated mix and its mix constituents meet the requirements of this specification.

The concrete mix details shall include the individual proportion of slag and fly ash in the binder. The details shall also include source of material(s) to be used, the moisture condition of the aggregates on which the mix is based and methods of mixing and transport.

Submission of the mix details and certificate(s) shall constitute a hold point for design compliance.

4.4. Special Class Concrete S40

The special class S40 concrete shall be used for all sewerage and liquid retaining structures.

Minimum binder content of 380 kg/m3 with a maximum of 60% Portland cement replacement.

Water/cement ratio should not exceed 0.45.

The maximum shrinkage at 56 days shall be 650 x 10-6 (+5% maximum) when determined in accordance with AS 1012.13. Nominal slump at the point of acceptance shall be 80 mm with allowable deviation of +15 mm.

Unless indicated otherwise, maximum Concrete temperature at the time of placement shall be 35ºC.

Maximum nominal size of aggregates shall be 20 mm.

Aggregate used for Special Class Concrete shall be Calcareous Aggregate conforming to WSA PS-358 and in accordance with SEQ Accepted Civil Products and Materials list.

A minimum of three weeks prior to commencement of structural concrete works, details shall be submitted to the Superintendent of each proposed concrete mix(s), test results of each mix proportions and certificates from an independent laboratory with appropriate NATA registration, stating that the nominated mix(s) and its mix constituents meet the requirements of this specification. The concrete mix details shall include the individual proportion of slag and fly ash in the binder. The details shall also include source of material to be used, the moisture condition of the aggregates on which the mix is based and methods of mixing and transport.

In addition to the above, supplier of the mix shall also submit individual and combined grading curves for aggregates.

Submission of the mix details, aggregate grading curves and certificate(s) shall constitute a hold point for design compliance.

4.5. Cementitious material

Unblended Portland cement shall comprise at least 60% of the total weight of cementations material mix.

Fly ash, ground granulated iron blast furnace slag and silica fume may be used separately or in combination, in concrete. The cementations material may be supplied separately or as blended cement. The Contractor shall state the proportions of each cementations material in the mix design and provide a test certificate in accordance with the relevant part of AS 3582. The Contractor shall only obtain cementations material from a source accepted by the Superintendent.

Fly ash shall conform to and be used in accordance with AS 3582.1. Fly ash shall not be used together with an air entraining agent in a concrete mix, unless tests, to the satisfaction of the Superintendent, prove that the amount of air entrained can be controlled and that the compressive strength is satisfactory. The proportion of fly ash by weight shall not exceed 30% of the cementations content.

Slag shall conform to and be used in accordance with AS 3582.2. The proportion of slag by weight shall not exceed 40% of the cementations content.

Silica fume shall conform to and be used in accordance with AS 3582.3.

4.6. Reactive Alkali content

The total reactive alkali content as determined in accordance with Clause A4.1 of AS 2758.1 shall not exceed 3.0 kg Na20 (equivalent) per cubic metre.

4.7. Chemical content

The chemical content of concrete shall comply with the requirements of Clause 2.7 of AS1379.

4.8. Admixtures

Chemical admixtures shall be in accordance with AS 1478. For liquid retaining structures Chemical admixtures shall be from reputable suppliers and submitted to the Superintendent for approval.

Admixtures shall only be used if accepted in writing by the Superintendent.

Admixtures shall only be accepted when it is proved that such admixtures, agents or agencies will not have deleterious effect on the essential qualities of concrete is supported by substantial evidence.

4.9. Corrosion protection

Concrete structures in aggressive environments shall include a protective lining accepted by the Superintendent over the complete internal surface and splash zones terminating at the benching for corrosion protection and ease of maintenance.

Structures that are normally full of raw sewage shall be protected from 600 mm below Bottom Water Level upwards to include submerged and splash exposures.

The lining shall be AKS PE lining or accepted equivalent, light coloured polyethylene minimum 2.5 mm thick with an accepted anchor system cast into the concrete.

The lining shall be installed and tested per manufacturer's procedures and specifications by an accepted installer. All joints and penetrations shall be sealed as per manufacturer's procedures. A 12 mm thick sponge neoprene gasket shall be installed beneath all supports attached to lined surfaces to protect the lining. The minimum Warranty period shall be 10-years.

Alternative epoxy protection systems may be considered by the Superintendent where the application of PE liners is considered impractical. Epoxy protection systems shall consist of reinforced Polibrid 705 (or accepted equivalent) with a dry film thickness of no less than 6 mm. The coating shall be applied strictly in accordance with the manufacturer's written instructions and undertaken by an accepted applicator. Adhesion testing shall be performed and proven as instructed by the Superintendent. Any repair work required must be in accordance with manufacturer's instructions.

For existing concrete showing signs of corrosion/spalling from hydrogen Sulphide (H2S) attack and/or significant general corrosion, the full extent of damaged areas shall be removed, reinstated and the complete structure protected with an epoxy coating in accordance with the above paragraph.

Lining to be tested as per requirements of WSA-02 Section 22.8.

When saw cutting of an existing concrete structure results in exposed reinforcement or where redundant fixings (both Galv. or Stainless Steel) protrude from the concrete structure, these shall be trimmed back to a depth equivalent to the structures reinforcement cover and coat the exposed steel with Parchem 'Nitoprime Zincrich' or accepted equivalent. Apply Parchem 'Renderoc' or accepted equivalent, in accordance with the manufacturers requirements to create a flush surface. This requirement is mandatory regardless of the concrete surface protection system used.

4.10. Formwork

Formwork shall comply with Section 19 of AS 3600 and with AS 3610.

All concrete walls constructed below ground level, which form part of water retaining or water excluding structures, shall be formed on both faces, unless accepted otherwise by the Superintendent.

No concrete pour shall be commenced until the formwork, pipes to be embedded and preparation of surfaces involved in the placing have been inspected and accepted in writing by the Superintendent's representative.

The exposed edges of all columns, beams, floor slabs, landings, steps, kerbs, footpath slabs, plinths and top edges at walls shall be chamfered. The chamfer shall be 20 mm by 20 mm unless shown otherwise on the drawings. All joints between formwork parts and between formwork and the permanent structures shall be sealed water tight.

'Slip form' or other similar construction techniques shall not be used.

The surfaces of concrete to be subsequently protected or exposed shall have a surface finish of Class 2 in accordance with Section 3 of AS 3610. All other surfaces shall have a Class 3 surface finish.

Formwork for precast concrete shall be capable of producing members to their correct shape and the dimensional tolerances required by Section 19 of AS 3600. In general, the fabrication tolerances of the formwork shall be one-half those required for the products they are to produce.

4.11. Reinforcement

Reinforcement shall not be welded except where shown on the contract drawings or as requested by the Contractor and accepted by the Superintendent. Such welding shall comply with the requirements of AS 1554, Part 3 - Welding of Reinforcing Steel.

Welding shall not be carried out within 75 mm of a bend having an internal diameter less than 12 bar diameters or at any point in a bar which has been re-bent.

Reinforcement may only be bent on site following approval by the Superintendent, following a request by the contractor outlining the procedure they wish to adopt.

Reinforcement shall comply with Section 6 of AS 3600. Note that reinforcement shall be supported by accepted concrete, metal, or other chairs, spacers or ties and shall be maintained in position within the permissible tolerance until the concrete has hardened.

Reinforcement shall be secured against displacement by tying at intersections with associated tie wires. The Contractor shall ensure that ends of wires do not infringe concrete cover.

Purpose made bar chairs and supports shall be used to support reinforcement in the correct position. Plastic supports or protective coating to ferrous supports suitable for the exposure conditions shall be provided under the concrete cover.

Metal bar chairs shall not be used in structures where concrete surfaces will be in contact with sewage or earth.

4.12. Production and placing of concrete

The production and placing of concrete shall comply with Section 19 of AS 3600.

Particular care shall be taken to ensure that concrete is properly placed and compacted in the vicinity of waterstops.

Drains/pipes that pass through concrete slabs are to be wrapped/lagged with closed cell foam, which does not absorb moisture so as to allow movement between the pipe and slab. Particular care and vigilance is required to ensure that the lagging is arranged to ensure that concrete, as it is being poured, cannot creep around the ends of the lagged section and thereby form a close fitting collar around the pipe which defeats the purpose of the lagging.

Where concrete slabs abut existing/new structures, they shall be separated by use of closed cell foam.

4.13. Caisson construction

Works including caisson construction shall conform to the following specifications.

The cutting edge shall be constructed to the details shown on the Drawings. Sinking the cutting edge shall not be commenced within 7 days of casting unless otherwise accepted in writing by the Superintendent.

The top edge of the walls shall be finished with 12 x 12 fillet strip.

The excavation for the sinking of the caisson may be undertaken either as construction of the caisson proceeds or following construction of the whole caisson to the underside of any attached chamber floor. Following the satisfactory-sinking of the caisson, the void on the outside of the caisson which results from the cutting edge diameter being greater than the remainder shall be filled with mass concrete, flooded and vibrated into place.

When the caisson has been sunk, the maximum out-of-vertical permitted shall be 100mm over the full depth of the wall. The Contractor shall align the caisson, if necessary, after the caisson has been sunk to remain within this tolerance. The Contractor shall not pour the top section of wall until the caisson has been sunk to its final level and aligned. The top of the well shall be finished horizontal.

Following sinking, the floor of the caisson shall be trimmed to the required level and all loose material shall be removed. Any over excavation shall be filled with concrete when the plug is cast. The Contractor shall not stockpile excavated material within 10 metres of the caisson during sinking operation.

Following approval of the floor of the caisson by the Superintendent, the Class N32 concrete plug shall be placed. During placing, dewatering of the area around the caisson shall be continued to prevent it from lifting. After placing the concrete, the plug shall be cured for fourteen days and if required the joint between the caisson and the plug shall then be grouted or otherwise sealed to block-off any seepage. The cost of grouting or sealing if necessary shall be deemed to be included in the Contract Sum.

The Contractor shall supply and install a continuous circular water-stop in the bottom of the recess in the wall for the floor slab. The Contractor shall take all measures necessary to ensure that concrete is placed and properly compacted behind the water-stop to the requirements detailed elsewhere in this Specification. A hydrophilic sealing strip will not be considered as an alternative in this location.

Wall construction joints shall be scabbled, except where the hydrophilic sealing strip is to be placed as per the manufacturer's recommendations.

Existing concrete shall be dampened prior to placing fresh concrete.

All excavation under any chambers attached to the caisson shall be backfilled with mass concrete at a minimum 15MPa.

4.14. Joints and embedded items

4.14.1 Construction joints

Construction joints shall be so made and located as accepted by the Superintendent or where indicated on the drawings. In general, they shall be located near the middle of the spans of slabs.

All reinforcement shall be continued across joints.

Construction joints shall unless otherwise detailed or directed, be truly horizontal or vertical and made with a small formed rebate or other accepted means of ensuring that a straight clean line appears at the joint on completion.

On structures required to retain or exclude water, as a minimum, unless another product is required by the Contract, or agreed by the Superintendent, Hydrotite CJ-0725-3K or accepted equivalent is to be provided at each construction joint to provide a watertight seal, installed to the manufacturer's recommendations.

The Contractor shall obtain from the Superintendent which of the following methods of bond shall be permitted:

- The use of an accepted adhesive;
- The use of an accepted chemical retarder which delays but does not prevent setting of the surface mortar. Retarded mortar shall be removed within 24 hours after placing, to produce a clean exposed aggregate bonding surface;

- Roughening the surface of the concrete in an accepted manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed prior to placing adjoining concrete.

4.14.2 Embedded items

All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

Any exposed threads shall be taped to prevent concrete or mortar adhering to the thread prior to concrete being placed.

Pipes, conduits, etc. embedded in concrete shall comply with Section 14 of AS 3600.

4.15. Pipe penetrations within concrete structures

Pipe work required to penetrate concrete structures shall be provided complete with factory fitted weep flanges and hydrophilic waterstops. Pipework shall be cast integrally within the concrete construction sequence unless otherwise accepted by the Superintendent or noted on the Contract documentation.

Where accepted by the Superintendent or noted on the Contract documentation, blockouts may be incorporated within the concrete construction sequence for later installation of pipework.

Blockouts shall be scabbled, primed with an accepted bonding agent and reinstated in accordance with the project drawings and specifications.

4.16. Hydrophilic waterstops

Hydrophilic waterstops shall be Hydrotite CJ-0725-3K supplied by Parchem or accepted equivalent is to be provided at each construction joint to provide a watertight seal, installed in accordance with manufacturers recommendations.

Hydrophilic waterstops shall be either set in a groove or fixed in its position so that they remain in the correct position during concreting.

Hydrophilic waterstops shall be bonded to concrete with Leakmaster supplied by Parchem.

4.17. Supercast PVC waterstops – expansion and contraction joints

In addition to joint sealant all joints in liquid retaining structures shall have a waterstop of a type as specified on the drawings. The installation and jointing of waterstops shall be strictly in accordance with manufacturer's Specification with the additional requirement that jointing of PVC waterstops and repairs to damaged PVC waterstops shall only be carried out by using heat welding.

PVC water stop, Expandite Supercast Hydrofoil (min 200 mm width) or equal, is to be provided either centrally or externally placed at each expansion or contraction joint to provide a watertight seal, installed to the manufacturer's recommendations.

The waterstops shall be located in the middle except for the externally placed PVC waterstops in floor slabs. A minimum clearance of 30 mm shall be maintained from the nearest face of reinforcement.

The PVC waterstops shall be of sufficient stiffness and be secured in its place firmly so that they remain in the correct position during concreting.

4.18. Hydrostatic testing of liquid retaining structures

Hydrostatic testing shall only commence following confirmation that all structural elements have reached their required design strength and receipt of approval by the Superintendent.

All liquid retaining structures, including portions of the structures shall be tested individually with all adjacent tanks, channels and galleries empty.

All liquid retaining structures containing epoxy protection systems shall be tested prior to application of the system. Following successful completion of testing, epoxy protection systems shall be applied in accordance with the manufacturer's requirements and Section 6.9 – Corrosion Protection.

Testing shall take place and shall be successfully completed prior to placing of backfill around each structure and prior to placing concrete benching, mortar toppings and tiling.

Prior to carrying out the hydrostatic tests, all debris shall be removed from within the structures. Temporary blank flanges, plugs or caps on pipework shall be installed where pipework is cast through concrete walls. All temporary covers and any openings in the concrete below top water level shall be inspected to generally ensure that each structure is watertight and ready for testing.

The test method to follow shall be as per AS 3735 clause 7.3. The structure shall be filled with water to the Top Water Level of the structure as indicated in the contract drawings, at a rate not greater than 2 m in 24 hours.

Upon completion of filling, the structure shall be kept full for a period of seven (7) days to allow for absorption and autogenic healing. During this time water level readings shall be taken daily, together with a record of local rainfall and evaporation rates, measured on site.

Following the above establishment procedure, testing shall proceed until there is no visible leakage, and the drop in water level over a consecutive 7 day period, after allowing for evaporation and rainfall is not greater than 1/500th of the average depth of the tank or 10 mm (whichever is less).

Any leaks including visible wet patches or defects which may cause leakage, shall be rectified to the satisfaction of the Superintendent and the structures shall be retested until they meet the requirements of this Clause.

No backfilling around the structure shall take place until these requirements are all met. Repairs shall be carried out from the liquid face of the structure unless otherwise approved by the Superintendent. The durability of all repairs over the design life of the structure shall be warranted.

Upon completion of testing the structure shall be emptied and the water disposed of to either the next structure or to the head of the Works or other location as directed by the Superintendent

A copy of the hydrostatic test results shall be submitted to the Superintendent.

Blockouts and Pipework Cast into Concrete:

- The Contractor shall provide blockouts as shown on the Drawings plus any other penetrations required for the various trades;
- Where blockouts are to be concreted up after installation of pipes and ducts etc., the surfaces shall be scabbled, with reinforcing exposed;
- Concrete used shall be Grade N40;
- Where horizontal pipework is to be concreted into vertical walls, the grout shall be placed under pressure with a minimum 'pressure head' of 300 mm above the top of the blockout. After completion of the concreting, excess concrete shall be removed and surface finish provided in accordance with details specified elsewhere.

Holes:

- The Contractor shall cast into the walls or floors as required on the Drawings, holes for motor cables, pipe connections, level controls etc., and it shall be his responsibility to obtain the correct position for the services before casting concrete.
- Where core holes and service lines and fittings are not shown on the drawings, they shall be to the approval of the Superintendent and Clause 19.4.2 of AS3600. No cutting of the reinforcement shall be allowed and cores shall not be cut after the concrete has been placed without the approval of the Superintendent.

4.19. Repair of surface defects

Surface defects, including tie holes, shall be repaired immediately after form removal.

4.20. Repair of defective areas

All honeycombed and other defective concrete shall be removed down to sound concrete. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. No feathered edges will be permitted.

The area shall be patched with an accepted patching mortar. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface.

4.21. Crack Repair

Cracks which appear in concrete in water retaining structures shall be repaired by injecting an accepted chemical grout.

The repaired crack shall show no signs of water leakage when the structure is subsequently filled with water.

Tie Holes:

- After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.

Proprietary Materials:

- If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used. Such compounds shall be used in accordance with the manufacturer's recommendations and shall be accepted by the Superintendent.

4.22. Repair of existing structural concrete

4.22.1 Concrete repair systems

For the purpose of this specification, structural concrete repair systems can be described as either “Mortar Repair System” or “Fluid Repair System”. The Superintendent may accept alternative concrete repair systems.

a) Mortar Repair System can be used for the repair of large or small areas of reinforced concrete structures where low permeability and low shrinkage are required, and where high compressive strength is required. Ideal for ease of application under a range of in-service conditions (i.e. horizontal, vertical, soffit etc), trowelled or hand applied repair system.

b) Fluid Repair System can be used for repair of large or small areas of reinforced concrete structures using free flowing grouts or fluid micro-concretes where access for the application of hand or trowel applied mortars is not practicable.

4.22.2 Qualifications of personnel

Personnel, sub-contractors and suppliers utilised in cementitious patch repair shall have minimum of three (3) years’ experience in rehabilitation of similar reinforced concrete structures and demonstrated competency for preparation and application of the repair material to be applied.

The concrete repair supervisor shall be trained and qualified in all aspects of application techniques and shall be present at all times during the repair work. Application personnel shall be trained and skilled in the application procedures of the repair material to be applied.

Documented evidence shall be made available to the Superintendent to demonstrate experience, qualifications, skills and training of personnel, sub-contractors and suppliers.

4.22.3 Breakout and removal of deteriorated concrete

Breakout of existing failed concrete shall be undertaken as follows:

a) Saw cut the perimeter of each repair as a series of straight lines at 3-degree angles to the surface (i.e. dovetail) to a nominal depth of 20mm to prevent feathering of edges. Reinforcement shall not be damaged during this process.

b) Feathered edges will not be accepted and where necessary, fresh saw cuts are to be made to eliminate feathered edges at the completion of the breakout.

c) Remove all defective, delaminated and drummy concrete through the use of a portable jack hammer or equivalent, to expose the sound concrete substrate. If necessary, the repair area shall be enlarged to ensure the extent of defective concrete is removed.

d) Where reinforcement is reached the breakout shall extend 25mm beyond the depth of the reinforcement.

e) The repair area perimeter shall extend until a minimum 100mm length of sound reinforcement (i.e. no-section loss) is achieved, or greater if required for lapping of reinforcement.

4.22.4 Cleaning of exposed reinforcement

Exposed reinforcement shall be cleaned prior to the application of the reinforcement primer as detailed below:

a) Clean reinforcement to remove any loose scale and/or corrosion products to achieve a surface finish equivalent to Class St 2, or Sa 2 of AS1627.2 and AS1627.4 respectively.

b) Abrasive blasting or the use of power tools will be required to achieve this class of finish.

4.22.5 Reinstatement of corroded reinforcement

Reinstatement of corroded reinforcement shall be undertaken as follows:

a) Where greater than 30% loss of cross-sectional area of reinforcement is identified, an equivalent bar diameter in accordance with AS/NZS4671 shall be lap welded to the existing sound bar. Welds shall be in accordance with Appendix F, Table F4 of AS/NZS 1554.3.

b) Reinforcing steel shall conform with the requirements of AS/NZS 4671.

c) The additional reinforcement shall be lapped in a manner such that the depth of cover is not reduced from the existing value.

d) Welding of additional reinforcement shall be performed by experienced personnel with qualifications in accordance with AS1554.

4.22.6 Concrete substrate preparation

Concrete substrate preparation shall be undertaken as follows:

a) The substrate shall be lightly scabbled with a hand-held power tool (such as a pneumatic hammer drill or jack hammer) to ensure mechanical adhesion with the repair system.

b) Subsequent to scabbling, thoroughly wash the substrate surface with clean potable water to ensure the substrate is free from dust, loose particles and other contaminants.

c) For larger sized repairs, the mechanical key of the repair area shall be improved with the use of stainless-steel pins, such as “Helifix PatchPins” Grade 316 Stainless Steel or accepted equivalent.

d) Pins are to be installed minimum 50mm from the edge of the patched area and intermediate pins at 150mm crs. Minimum two pins per patch shall be installed.

4.22.7 Reinforcement priming

To inhibit further corrosion, the cleaned and prepared exposed reinforcement shall be primed prior to the application of repair mortar as detailed below:

a) New reinforcement does not require priming.

b) Reinforcement shall be primed with a cementitious priming agent or neat cement slurry recommended by the repair mortar manufacturer.

c) Zinc or epoxy-based primers shall not be used in potable water applications.

d) Application of the priming agent shall be strictly in accordance with manufacturer's recommendations.

4.22.8 Concrete substrate priming (mortar repair system)

Prior to the application of the priming agent, the repair area concrete substrate shall be primed as detailed below:

a) Thoroughly soaked with clean potable water.

b) After achieving concrete surface saturation, the entirety of the concrete substrate should be primed with one layer of Fosroc Nitobond HAR or accepted similar, with the use of a brush, ensuring the agent is adequately scrubbed into the surface.

4.22.9 Concrete substrate priming (fluid repair system)

Several hours prior to placing fluid repair system, the prepared concrete substrates shall be primed as detailed below:

a) Saturated by filling the prepared formwork with clean potable water.

b) Immediately prior to the application of the fluid repair system, this water should be removed from the formwork, via the drainage outlets.

4.22.10 Formwork preparation (fluid repair system)

The unrestrained surface area of the repair must be kept to a minimum.

The formwork should be rigid and tight to prevent loss of material and have properly sealed faces to ensure that no water is absorbed into the repair material.

The formwork should include drainage outlets for pre-soaking.

Provision must also be made for suitable access points to pour or pump the material into place and allow air to escape.

4.22.11 Mixing

Mixing of mortar repair system, Fosroc Renderoc HB40 or fluid repair system, Fosroc Renderoc LA55 or accepted equivalents shall be undertaken as follows:

a) Mixing of the repair mortar shall be undertaken in accordance with the manufacturer's recommendations. Hand mixing shall not be used.

b) Whole bags of dry component material shall be used. Split bags shall not be used. Materials that have deteriorated in any way, or exceeded used by dates, shall not be used.

c) Potable water only shall be used during mixing.

d) The volume of mix ingredients shall be measured and added in accordance with the mix proportions and procedures recommended by the manufacturer.

4.22.12 Placement (mortar repair system)

Placement of the repair mortar shall be undertaken as follows:

a) Placement of material on the prepared and primed substrate shall be either by gloved hand or trowel application in accordance with manufacturers recommendations.

b) The repair mortar shall be thoroughly compacted onto the primed substrate and carefully packed around reinforcement to ensure there are no voids.

c) Reinstatement shall be in accordance with the manufacturer's recommendations unless otherwise specified.

d) The mortar shall be reinstated to the original profile of the concrete. Apply repair mortar in layers to achieve the manufacturer's recommended minimum and maximum thickness of application. Each previous layer shall be scratched to provide a mechanical key to subsequent layers.

e) Minimum and maximum application layer thickness for vertical and horizontal applications shall be strictly in accordance with the manufacturer's requirements.

f) In addition to providing a scratched mechanical key, a suitable bonding agent such as Nitobond HAR or accepted equivalent should also be applied between each layer. Allow the priming agent to achieve a tacky surface finish.

g) Ensure that repair material does not contaminate surrounding by providing adequate containment to the work area. Materials that fall from the works shall be trapped and disposed off-site in accordance with statutory authority regulations.

h) The surface of the repair mortar shall be flush with the surrounding concrete within a tolerance of +/- 2mm. This can be achieved by trowel finish, or alternatively the repair mortar can be built-up above the surrounding concrete surface and after curing, ground flush with the use of a grinder with a Cupstone disc attachment.

4.22.13 Placement (fluid repair system)

Placement of the fluid repair system shall be undertaken as follows:

a) The mixed material should be placed within 30 minutes of mixing in order to gain the full benefit of fluidity and of the expansion process.

b) If placing by pump, standard concrete pumping practice should be followed. The pump and pipeline must be 'primed' with a rich cement slurry or mortar, discharging the primer mix as waste. Pumping should be commenced immediately after 'priming' in this way.

c) Renderoc LASS or accepted equivalent when used for reinstatement of horizontal areas, must be suitably restrained by formwork.

d) Ensure that repair material does not contaminate surrounding structures by providing adequate containment to the work area. Materials that fall from the works shall be trapped and disposed off-site in accordance with statutory authority regulations.

4.22.14 Curing (mortar repair system)

Curing shall be undertaken by applying a curing compound immediately after mortar reinstatement as follows:

a) Repair areas are to be cured using a compatible proprietary curing compound that complies with AS3799 and AS4020 (such as Fosroc Concure WB30) and applied in accordance with the manufacturer's recommendations.

b) Following the application of the curing compound, it is recommended that the surface of the repair mortar is protected with the use of wet hessian with polythene sheeting taped over, to mitigate the effect of UV & heat.

4.22.15 Curing (fluid repair system)

Curing shall be undertaken as follows:

a) It is recommended that the formwork be left in place for as long as practically possible to provide the best curing conditions. Renderoc LASS or accepted equivalent must be cured immediately after the formwork is stripped in accordance with good concrete practice.

b) Immediately after striking the formwork, all exposed faces of the repair should be thoroughly soaked with clean water and then sprayed with a compatible proprietary curing compound that complies with AS3799 and AS4020 (such as Fosroc Concure WB30) and applied in accordance with the manufacturer's recommendations.

c) Following the application of the curing compound, it is recommended that the surface of the repair mortar is protected with the use of wet hessian with polythene sheeting taped over, to mitigate the effect of UV & heat.

d) The excess repair mortar present at the formwork spout shall be removed by grinding flush to the level of the surrounding concrete via the use of a grinder with a cupstone disc attachment. The surface of the repair mortar shall be flush with the surrounding concrete within a tolerance of +/-2mm.

4.22.16 Performance testing

Prior to conducting patch repairs, the Contractor shall submit a set ITP's including hold points to the Superintendent for approval.

Testing the performance of patch repairs, where specified in the accepted ITP's, may require, compressive strength testing of cementitious repair material, and/or testing for adhesion (pull-off) testing.

Mandatory performance testing shall include delamination check for drummy areas and testing for flatness.

a) Compressive strength of the cementitious material shall be undertaken by making three 75mm test cubes taken from the first batch of mixed material, then three 75mm cubes for every 100kg of subsequent material used.
   - The test cubes shall be cured for 7 days under laboratory controlled conditions with two of the cubes tested at 7 days and the third at 28 days to confirm compliance with minimum strength requirements.
   - Test cubes shall be made, cured and tested in accordance with AS 1478.2.
   - Any test batch that fails to meet the specified standards shall be classified as a non-conformance product and all repair work relating to the batch shall be removed and the repairs repeated in accordance with the requirements of this specification.

b) Adhesion testing shall be undertaken on partially cored direct pull-off tests of the fully cured in-situ repair to verify the tensile bond between the repair material and the existing concrete substrate. Adhesion testing shall be conducted 7 days after completion of the repair work.
   - Pull-off testing shall be undertaken in accordance with AS 1012.24:2015: Methods of Testing Concrete - Determination of the tensile bond strength of concrete - Repairs and strengthening systems.

- Test locations shall be jointly determined by the Contractor and the Superintendent.
- Testing frequency shall be three tests per 10m2 at locations that represent the repair area. Final number of tests shall be determined by the Superintendent.
- The mean bond strength at 7 days shall not be less than 0.75 MPa with no individual result less than 0.65MPa. Mean bond strengths less than 0.75MPa shall be classed as a non-conformance.
- Type of failure shall be determined using visual inspection of the test specimens as categorised below:

  Type 1 – Tensile failure within the existing concrete structure

  Type 2 – Tensile failure within the repair material

  Type 3 – Bond fail at the interface between the concrete structure substrate and the repair material

  Type 4 – Bond failure between dolly and repair material

  Type 5 – Partial bond failure at interface between existing concrete structure and the repair material and partial tensile failure within the repair material

  Type 6 – Partial bond failure at the interface between the existing concrete structure and the repair material and partial tensile failure within the existing concrete structure.

- Acceptable types of failure shall be in accordance with Type 1. Failure types 2, 3, 4, 5, 6 shall be classified as a non-conformance.

c) Testing for drummy areas of all concrete repair areas shall be conducted to check for delamination with all defects recorded.
   - The test for drummy areas shall be conducted using a small hammer over the whole surface area of the concrete repair.
   - Testing for drummy areas shall be conducted in the presence of the Superintendent.
   - Delaminated areas are characterised by a drummy or hollow sound. These areas shall be marked for repair.
   - Drummy areas shall be removed and repaired in accordance with this specification.

d) Control of dimensional tolerances (flatness) is important for overall quality control of repairs.
   - Tolerance on edges and surfaces in plan and elevation shall be ±3mm. The maximum allowance for irregularities when measured with a 2m straight edge shall be 3mm.

The Contractor shall submit to the Superintendent for review, a copy of all performance testing including photographic records within one week of undertaking testing.

a) Daily records shall be kept for the following:
   - Stability of the structure;
   - Reinforcement surface finish;
   - Concrete substrate surface finish;

- All materials used – Types, Brand names, batch numbers;
- Mixing details (e.g. water to grout ratio);
- Temperature records;
- Curing time.

4.23. Finishing of formed surfaces

After removal of forms the surfaces of concrete shall be finished as specified below, unless noted otherwise on the Drawings.

All surfaces of concrete which are exposed to view shall have a surface finish of Class 2C in accordance with Section 3 of AS3610. All other surfaces shall have a Class 3 surface finish. The internal surfaces of the pumping station shall have a Class 3 surface finish.

4.24. Slabs

4.24.1 Preparation of subgrade for slabs on ground

The subgrade shall be well drained and of adequate and uniform load bearing nature.

The subgrade shall be prepared by tyning, moistening and proof rolling such that the top 300 mm is compacted to 98% standard compaction according to AS 1289.

The bottom of an undrained granular base course shall not be lower than the adjacent finished grade.

The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

4.24.2 Edge forms and screeds

Edge forms and intermediate screed strips shall be set accurately to produce the designated elevations and contours of the finished surface and shall be sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment.

The concrete surface shall be aligned to the contours of screed strips by the use of strike-off templates or accepted compacting type screeds.

When formwork is cambered, screeds shall be set to a like camber to maintain the proper concrete thicknesses.

4.24.3 Placement

Mixing and placing shall be carefully coordinated with finishing. Concrete shall not be placed on the subgrade or forms more rapidly than it can be spread and screeded. These operations must be performed before bleeding water has an opportunity to collect on the surface.

The size of finishing crews shall be planned with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete. If construction joints become necessary, they shall be constructed as per this Specification.

4.24.4 Jointing

Joints in slabs on ground shall be located and detailed as indicated on the Drawings. If saw-cut joints are required or permitted, cutting shall be timed properly with the set of the concrete; cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and shall be completed before shrinkage stresses become sufficient to produce cracking.

4.24.5 Compaction

Concrete in slabs shall be thoroughly compacted by means of accepted vibration equipment.

4.25. Finish of slab surfaces

4.25.1 Tolerances

The surface of the concrete shall be finished as specified to the tolerances listed below:

- **Class 1** - True planes within 3 mm in 3 m as determined by a 3 m straightedge placed anywhere on the slab in any direction;
- **Class 2** - True planes within 6 mm in 3 m as determined by a 3 m straightedge placed anywhere on the slab in any direction;
- **Class 3** - True planes within 6 mm as determined by a 600 mm straightedge placed anywhere on the slab in any direction.

4.25.2 Types of finish

Slab surfaces in concealed areas and slab surfaces to receive applied toppings and screeds, which are included in other sections of the specification, shall be finished as follows:

- **Type A "Scratched finish":**
  - After concrete has been placed, struck off, consolidated and levelled, to a Class 3 tolerance, the surface shall be roughened with stiff brushes or raked before final set;
- **Type B "Wood floated finish":**
  - After the concrete has been placed, struck off, consolidated and levelled, the concrete shall not be worked further until ready for floating;
  - Floating shall begin when the concrete has stiffened sufficiently to permit the proper operation of a power-driven float;
  - The surface shall then be consolidated with a power-driven float;
  - Hand floating with wood or cork-faced floats shall be used in locations inaccessible to the power drive machine;
  - Trueness of surface shall be re-checked at this stage with a 3 m straightedge applied at not less than two different angles;
  - All high spots shall be cut down and all low spots filled during this procedure to a Class 1 tolerance;
  - The slab shall then be re-floated immediately to a uniform, smooth, granular texture.
- **Type C "Steel trowelled finish":**
  - The surface shall be finished first with power floats, as specified for a Type B finish then with hand trowels;

- Trowelling shall be done by hand after the surface has hardened sufficiently;
- The surface shall be thoroughly consolidated by the hand trowelling operations;
- The finished surface shall be free of any trowel marks, uniform in texture and appearance and shall be planed to a Class 1 tolerance;
- On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor coverings shall be removed by grinding;

- **Type D "Broomed finish":**
  - The surface shall be finished to a Type B finish and then given a coarse transverse scored texture by drawing a broom or hessian belt across the surface;
- **Type E "Non slip finish":**
  - The Type B finish surface shall be given a "dry shake" application of crushed ceramically bonded aluminium oxide or other suitable abrasive particles;
  - The rate of application of such material shall be in accordance with supplier's instructions but not less than 1.25 kg/m2 applied uniformly.

4.25.3 Surface hardeners

Where indicated, surface hardener shall be used. Hardener shall be Master Builders 'Masherplate 200' or accepted equivalent dusted into the surface of the concrete at a rate recommended by the manufacturer and accepted by the Superintendent prior to final trowelling of the concrete.

Material shall be applied and cured strictly in accordance with the manufacturer's recommendations.

4.26. Curing

Concrete shall be moist cured for a minimum of 7 days continuously as required by AS3600 and until the average compressive strength reaches 80 percent of the 28 day characteristic value. The curing period shall be extended to 14 days if fly ash has been used in the concrete.

Resin and PVA based curing compounds are NOT permitted. The use of any curing component is subject to the approval of the Superintendent. The curing efficiency of membrane compounds in accordance with the requirements of AS3735 Supplement 1 shall be 75 percent. Before the application of any membrane compound the Contractor shall provide documentary evidence from the compound manufacturer about methods of obtaining required adhesion of material used in any subsequent repair of surfaces.

4.27. Inspections

The Contractor shall give sufficient notice (minimum 24 hours) so that inspections of concrete works may be carried out at the following stages:

- Completion of excavation or base preparation;
- Completion of fixing of all reinforcement prior to placement of concrete; and
- Commencement of concrete placement.

4.28. Testing of Concrete for Compliance

4.28.1 Slump testing

After completion of mixing, but prior to site handling, testing for consistency of concrete by the slump test, in accordance with AS1012.3, shall be performed on-site on every batch of concrete delivered to the Site.

The target slump for concrete shall be as shown on concrete class table.

The slump tests shall be performed by a person accepted by the Superintendent and competent to perform these tasks in accordance with the Australian Standard method. All costs are the responsibility of the Contractor.

All concrete slump tests shall be recorded in a “Concrete Records Book” kept on site by the Contractor and submitted with the completed Inspection and Testing Plans.

The concrete may be rejected by the Superintendent if the measured slump value is outside the tolerance of the target slump value of the accepted mix design. For target slump <60 mm, tolerance is ± 10 mm, for target slump 60-180, tolerance is ± 15 mm.

4.28.2 Compressive and flexural strength testing

The Contractor shall be responsible for the performance of all tests and shall meet the cost of all testing associated with the concrete work for all classes of concrete specified including normal and special grades. All testing shall be carried out in a NATA accepted laboratory and Test Certificates shall be issued to the Superintendent within two (2) working days after test results have been received from the testing authority. In particular, this refers to the compression testing of concrete specimens.

Testing for compliance shall be in accordance with Appendix B of AS 3600 for Compressive Strength and Flexural Strength.

The frequency of sampling shall be not less than the following:

Table 2 – Concrete Testing Frequency

Size of concrete pour	No. of samples*
0-5 m^3	1
5-10 m^3	2
10-25 m^3	3
greater than 25m^3	3 for the first 25m^3 plus 1 for each additional 25m^3

*Note that two (2) test cylinders are required to be made from each sample

Unless otherwise directed by the Superintendent, all test cylinders produced as a result of the project assessment provisions of Clause 5.3.1 of AS1379 shall be manufactured, handled, cured and tested by the Contractor in accordance with AS1012.1, AS1012.3 and AS1012.8. The cost of manufacture, handling, curing and testing the cylinders shall be borne by the Contractor.

Shrinkage:

- Shrinkage performance verification shall be provided for a controlled grade of concrete (AS1379, Section 6). For associated grades of concrete, sufficient shrinkage testing shall be completed before any such concrete is used in the works to ensure the required value is attained;

- Further shrinkage samples shall be taken on site at monthly intervals and tested to ensure that the performance criterion is being maintained.

All sampling and testing shall be performed by a NATA registered technician.

5. Post-Tensioning works

5.1. Prestressing system and submissions

Prestressing shall be carried out in accordance with AS 3600 Clause 19.3 and this Specification.

Outline of proposed prestressing system and sufficient detail such that all aspects can be clearly identified and readily evaluated shall be submitted to the Superintendent for review not less than 30 days prior to commencement of work. The submittal shall include but not be limited to the following:

Prestressing system:

- Proposed prestressing system, past experience of the system on similar projects and the manufacturer's literature describing the proposed method and procedure in detail;
- Methods, equipment and facilities to be utilized for the production, transport, erection, stressing and grouting;
- Material specifications, kind or size of prestressing tendons, anchoring devices, ducts, grout and all associated materials and accessory items;
- Past experience of the key personnel who will be responsible for inspections, verifications and check list procedures for the carrying out of all post-tensioning work; the submittal includes the name and record of any subcontractor to be employed for the stressing work;
- The quality control program.

The Contractor shall submit a Method Statement for the post tensioning procedure to the Superintendent for review and approval.

Detailed calculations prepared and signed by a qualified RPEQ to substantiate stressing procedures shall be submitted to the Engineer for review and approval. The Submission shall include the following:

- Calculations of effective force after all losses including losses due to anchorage seating, elastic shortening, creep, shrinkage, relaxation, wobble friction;
- Calculations for expected jacking elongation corresponding to jacking force of tendons.
- Calculations of any portion of the work proposed as substitutions, additions, re-arrangement of prestress or reinforcing steel and any proposed modifications of concrete dimensions.

Prestressing information shall be submitted in the following format:

- Tendon Reference No.;
- Stressing length of Tendon;
- Jack force;
- Frictionless extension of tendon at proposed jack force;

- Calculated loss of extension due to friction and curvature of duct;
- Calculated losses other than friction losses;
- Estimated elongation of tendon at proposed jack force (theoretical extension).

Graph plotted for estimated elongation versus load (applied jacking force during stressing) which can be used to compare actual elongation against the estimated elongation.

Any deviation from the Contract Drawings must be reviewed and accepted by the Superintendent prior to commencement of works.

Fabrication and placement details prepared and signed by RPEQ shall be submitted to the Superintendent for review and approval:

- Shop Drawing complete with layout plan, member dimensions, tendon support heights levels and chair sizes;
- Location of tendons and sheathings throughout their length, size, details;
- Location, materials and stress grade (where applicable) for tendons and accessories, including anchorage device details, jack clearances, jacking procedures, stressing sequence, initial tensioning forces, gauge pressures, tendon elongation and other related data;
- Dimensional conflicts and interference between non-prestressed reinforcement and post-tensioning tendons and anchorages investigated during the preparation of the Shop Drawings and, if found, brought to the attention of the Superintendent promptly;
    - The Contractor is responsible for dimensional conflicts not specifically brought to the attention of the Superintendent;
    - Any other problems that may be encountered based on the prestressing contractor's experience shall also be made known to the Superintendent promptly.

Design of special reinforcement required for the performance of the post-tensioning anchorages for resisting compressive, tensile bursting and tensile-spalling stresses shall be detailed on the post-tensioning Shop Drawings and it shall be supplied and installed as a part of the post-tensioning work.

Reviewed and accepted shop drawings and calculations are the only basis of work to be done which must be kept at work location.

Three certified copies of mill test reports, including chemical analysis and physical properties for each heat of the prestressing steel and for each lot of anchorage assemblies as required by applicable Australian Standard AS4672.

Typical stress-strain curves for prestressing steel for each consignment of steel.

Along with test reports, a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of all prestressing steel and anchorage assemblies.

Where mill certificates are not available, an accepted testing laboratory to perform the required tests and chemical analysis to substantiate conformance with this Specification shall be employed and paid by the Contractor.

The following information on prestressing strands shall be submitted to the Superintendent:

- Breaking force;
- Yield strength and elongation;

- Load-strain plot;
- Cross-sectional area of strand;
- 100 hour relaxation loss at 70% and 80% of MBL;
- Source of strand.

During the construction, the Contractor shall maintain such records and perform or arrange to perform such tests as the Superintendent may deem necessary to ensure compliance with the various provisions in this specification.

5.2. Materials

The class and characteristic compressive strength of concrete (f'c) at 28 days shall be S40. The minimum characteristic compressive strength of concrete at transfer shall be 32 MPa. The cement, aggregate, water, chemical admixtures, reinforcement shall comply with the requirements stated in the concrete works specification (refer Section 4).

Minimum cover to reinforcement and tendons shall be as indicated in the drawings.

Strands shall comply with the requirements of AS4672. Prestressed wire or tendon which has been used previously shall not be used for this work.

Each delivery of materials shall be accompanied with documents showing the lot numbers from which each coil is taken, together with the relevant test certificates in accordance with AS4672 and including data on chemical composition and relaxation.

Strands shall be kept free from loose or thick rust, oil, grease, paint, tar, paint, mud or any other deleterious substance but shall not be brought to a smooth polished condition. A slight film of rust will not be regarded as harmful, but the steel shall not be visibly pitted by rust.

Strands that are damaged, kinked or bent shall not be used. Tendons shall not be subjected to excessive temperature, welding sparks or ground currents. Any burning or welding operations shall not be carried out in the vicinity of tendons.

Material for tendons not currently in use shall be stored in a weatherproof environment and supported above the surface of ground in a manner which will prevent any damage to the tendons.

All sheathing shall be of corrugated galvanised steel.

Ducts, sheathing and duct-forming devices shall be mortar-tight and strong enough to transfer the tendon stresses into the body of concrete and to resist damage and deformation during construction.

Duct material left in place shall not cause any electrolytic action.

The inside surface of ducts shall ensure proper bonding of the grout but it shall not have undue frictional resistance.

Ducts shall be free from any matter detrimental to the bond between the sheath and grout. Ducts are to be sized to allow feeding of tendons and grouting.

The number of joints shall be kept to a minimum and each joint shall be adequately sealed. If tendons are to be installed after concreting, temporary stiffening shall be provided with in the sheathing such that the duct shape is maintained during the concreting and the temporary stiffeners shall be removed after concreting before installing the tendons.

All ducts shall be maintained in their correct positions during the placing of concrete by means of steel stirrups and bars. As shown in the Drawing(s), the ducts are tied to the inside face of the exterior vertical reinforcement of the wall.

The permissible tolerance on the vertical profile (level) of the sheathing shall be ± 5mm.

The number of joints in duct sheathing shall be kept to a minimum and each joint shall be adequately sealed.

Anchorages shall comply with the requirements of AS/NZS 1314. No damaged anchorages shall be used. All parts shall be protected from corrosion at all times. All threaded parts shall be protected by greased wrappings and all tapped holes shall be protected by suitable plugs until used. The anchorage components shall be kept free from mortar, loosed rust and any other deleterious coating. Gripping efficiency of the combined anchorages shall be maintained by achieving the required manufacturing tolerances for each component as specified in the manufacturer's requirements.

Anchorages shall be positioned and maintained during concreting so that the centre line of duct shall pass axially through the anchorage assembly.

The grout shall be a mixture of Type GP Portland Cement to AS3972 and water having a water/cement ratio of not more than 0.4 by mass. Cement and water shall conform to the requirements stated in Concrete Works.

Grout shall have high bleeding resistance, low shrinkage and high fluidity. Grouts shall comply with the performance requirements stated in the table below, when tested:

Table 3 – Grout Performance Requirements

Property	Test Method	Criteria	Comments
Bleeding	ASTM C940	Final bleeding < 0.5%	Measured when two successive readings show no further expansion or bleeding
Early Expansion	ASTM C940	< 2% at 3 hours	Temperature tolerances are 20ºC ± 5ºC
Fluidity	ASTM C939	Immediately after mixing : Efflux time < 20s 45 minutes after mixing : Change in efflux time < ± 3s	Contractor's target efflux time for the site conditions shall not vary from nominated value by more than ±2s
Minimum Compressive Strength	AS 1012	32 MPa in 7days	

At least one sample per batch for grout shall be tested. No grouting is to commence until the test results of the initial 7-days test and predictions for the 28-day strength are accepted.

Grout vent tubes and corresponding holes in the sheathing shall have a minimum internal diameter of 20 mm.

Grout inlets and grout vents shall be of plastic or non-ferrous materials. Grout vents shall be at least 0.5 m higher than the grout inlet to ensure effective head of grout.

The grout inlets and vents shall be firmly secured in position. If any grout inlet or vent becomes blocked during concreting the Contractor shall clean them and make good any damages so that they operate in a satisfactory manner.

All grout inlets shall be fitted with a pressure gauge for measuring pressures independent of pressures observed at the grout pump or air compressor.

All grout inlets, outlets and vents shall be fitted with a metal valve which can be closed and opened several times, or other accepted method provided for maintaining pressure during air testing and for controlling the grout flow during grouting.

The pressure rating for inlets, outlets and vents shall be no less than 1.0 MPa.

5.3. Equipment

Both force and extension measurements shall be taken during all tensioning operation. Force measurements shall be recorded to an accuracy of 2% and extension measurements to an accuracy of 1mm.

The force measurements may be made by dynamometers or pressure gauges. Where the latter are used there shall be a minimum of two gauges on each jack selected so as to be used at between 50% and 90% of their full capacity when the final load measurements are taken on any tendon.

The pressure gauges shall comply with AS1349.

Certified calibration by a NATA accepted laboratory will be required for all dynamometers and pressure gauges. Calibrations shall be carried out at intervals not exceeding three months.

Friction losses in prestressing jacks shall be measured and calibrated at least once a year, or after re-sealing.

Details of proposed stressing and grouting equipment, current calibration certificates shall be submitted to the Superintendent for information and record.

The mixing equipment shall be capable of producing a uniform suspension of cement in water. The injection shall be capable of continuous operation with minimum variation of pressure and shall include a system for recirculating the grout whilst grouting is not in progress.

The grout pump shall be capable of delivering grout a rate of 1800 litres per hour at a pressure up to 1.0 MPa.

All piping to the grout pump shall have a minimum number of bends and valves and changes in diameter.

A standby grout pump shall be made available on site for use at all times during grouting operations.

All equipment shall be thoroughly washed by clean water after each series of operation.

5.4. Operations

Assembly of tendons shall not commence until full conformance records are available for all materials proposed for use.

Tendons shall be assembled using methods and equipment which ensure that individual strands are not kinked and that they maintain approximately the same relative position to the other strands in the tendon.

The strands of the assembled tendon shall be bound at regular intervals, in such a manner that twisting of the tendon is minimised and no damage will be done to the tendon when it is installed.

The pre-assembled tendons shall be pulled through the ducts using a form of pulling sock or cable leader so that no damage is done to the sheathing. Adequate attention shall be taken while pulling the tendons through the ducts so that there shall not be any stripping of the sheathing and forming blockages in the duct or interlocking of the strands and developing internal friction points which may differential overstress or even failure during stressing.

The Contractor shall inform the Superintendent not less than one week prior to commencement of tensioning. Prior to starting of the prestressing work, the contractor shall carry out sufficient tests to determine the actual friction and wobble factors which are applicable to the works and which should be used in the calculation of theoretical extensions. Theoretical extensions are used as an indication that tendons have the correct load applied during stressing.

The sequence of stressing of Tendons is indicated in the drawing as stressing schedule. If the Contractor proposes any alternative sequence of stressing, the Contractor shall submit the stressing schedule to the Superintendent not less than two weeks prior to commencement of stressing.

Tensioning shall be carried out only in the presence of the Superintendent or his representative.

Tensioning works shall not be carried out until the concrete has attained the minimum compressive strength (transfer strength) stated in the drawing.

The ducts and grout vents shall be cleaned out by blowing compressed air through them. Anchorages and protruding tendons shall be thoroughly cleaned.

The tendon force shall be raised to the specified maximum value uniformly such that the force is gradually transferred to the concrete. Extension reading shall be commenced after 10% of the load has been applied in order to ensure that datum is set after slack cable has been taken up.

When the specified jacking force in the tendon is reached, the extension of the tendon shall be measured and shall agree with the calculated theoretical extension to within + or – 5%. Otherwise the Superintendent may direct the tendon be released from the jack and restressed, in which case the stress-strain curve applicable to a second stressing shall be used in determining the elongation required.

In the event of any breaks or failures occur during stressing, the cause shall be thoroughly investigated and a formal report shall be presented to the Superintendent. No further stressing shall be undertaken until the proposed corrective action has been accepted by the Superintendent.

Under no circumstances the maximum jacking force shall exceed 80% of the specified minimum ultimate strength of tendons. Tendons shall be anchored off when the specified jack force is reached. The jack pressure shall then be released gradually in such a way that no shock to the anchorages and tendons.

The following information shall be submitted to the Superintendent, after the tensioning operation is completed:

- Tendon reference. No.;
- Stressing length of Tendon;
- Initial force at which the tendons are marked for measurement of elongation;
- Final force and elongation on completion of tensioning;
- Elongation remaining after release of jacks;

- Ramming pressures;
- Not less than six readings of elongations obtained at suitable intervals during tensioning and corresponding force.

No tendons shall be cut off or grouted until the stressing records for the relevant tendons are accepted by the Superintendent.

The tensioning operations shall be performed only by personnel trained for and experienced in this type of work. Safety induction shall be carried out for all site team members and adequate care shall be taken during tensioning to ensure the safety of all personnel engaged on the work and of other persons in the vicinity. Jacks shall be secured such that they will be restrained if any failure of tendon occurs. No person shall be allowed to stand behind the jacks while tensioning in progress. The operation of jacks, the measurement of elongation and other associated operations shall be carried out in such a manner and from such positions that the safety of all concerned is ensured.

Grouting shall be carried out as soon as practical after stressing. The grouting shall be carried out in such a manner that the ducts are completely filled with a dense and uniform grout.

Air testing of ducts shall be carried prior to grouting by trained personnel. Any water in the duct shall be blown out with oil-free air. After sealing the anchorage ends, the duct shall be tested for pressure loss by accepted method.

Before grouting, the volume of grout required for each duct shall be determined for use as basis for volume control and rate of injection of grouting. When the grout reaches the first vent it shall be allowed to flow out until all excess water and air has been expelled from the first portion of sheath. This grout vent shall be sealed off and the procedure is repeated at the remaining grout vents until the sheath is completely filled with grout. After a period of not less than two days the plugs at grout outlets shall be removed. All grout outlet pipes shall be cut off and the recess so formed shall be made good with non-shrink mortar to give smooth surface finish with the concrete.

If serious leak occurs, the grouting shall be stopped and the duct shall then be flushed clean with water. The leakage shall be plugged before proceeding with grouting.

If a blockage occurs, pumping may be transferred quickly to the far end of the duct if there are sufficient vents to ensure that the ducts will be filled with grout. Alternatively the ducts may be flushed with clean water to clear the blockage. The contractor shall be responsible for the complete filling of the ducts with grout. If blockage occurs the grout mix may be rejected and a new mix shall be proposed by the contractor.

The ends of stressed tendons shall be cut off with high speed abrasive disc or wheel so as to give, when the recesses are concreted, a minimum of 25 mm cover over the tendon stubs. Where the ends of the tendons are not to be covered with concrete, a protective coating of epoxy shall be applied in an accepted manner to the exposed parts of anchorage. Cutting of tendons shall be carried out minimum 7 days after grouting. Flame cutting shall not be allowed under any circumstances.

6. Structural aluminium and steelwork

6.1. General

All materials and workmanship shall to the most recent requirements of relevant statutory local, State and Commonwealth requirements and applicable current Australian Standards.

The Contractor shall supply and install fabricated items as specified and shown on the drawings.

Contractor shall submit detailed fabrication drawings of fabricated items. Manufacture of the items shall not commence until the Superintendent has given approval.

6.2. Materials

Mild steel shall be Grade 250 to AS 3678 and AS 3679. Structural steel hollow sections shall be grade 350 to AS 1163. Cold formed purlins, girts and light gauge members shall be grade 450 to AS 1397.

Stainless Steel shall be Grade 316 to AS 4673 and AS 1554 with the exception that where stainless steel bolts and washers are used, nuts are to be Grade 304 to assist in avoidance of binding. Stainless steel shall be passivated before installation (refer to *Pr9693 -Specification for Mechanical Installations* for passivation details).

Galvanised Steel fabricated items shall be insulated from concrete bearing surfaces by painting contact area with two (2) coats of alkali-resistant bituminous paint or by other means accepted by the Superintendent.

Unless otherwise specified aluminium shall be of aluminium alloys suitable, in all respects, for the purpose being used and in accordance with AS 1734 and AS 1866, the Works shall be considered as a marine environment.

For structural application in a marine environment, the minimum aluminium alloy shall be 6061- T6 for extruded members, 5454-H3 for sheets and plates and 5251-F for roof sheeting.

Unless noted otherwise on the drawings or elsewhere in this specification. all aluminium extrusions shall be alloy 6061 tempered to T6, all aluminium sheet thinner than 3 mm shall be alloy 5251 tempered to H34 and all aluminium sheet 3 mm and thicker shall be alloy 5083 tempered to H321.

Aluminium surfaces to be placed in contact with series 300 stainless steel, wood, concrete or masonry construction shall be given two heavy coats of an alkali resistant bituminous paint before installation. The paint shall be applied as it is received from the manufacturer without the addition of any thinner and the surface shall be cleaned according to the manufacturer's instructions.

All aluminium items shall be fabricated in accordance with the provisions of AS1665; SAA Aluminium Welding Code by personnel qualified for and granted Certificate No. 8 as set out in AS1796 SAA Welder Certification Code.

Where aluminium surfaces come in contact with dissimilar metals, except grade 304 or 316 stainless steel, the aluminium surfaces shall be kept from direct contact with that metal by use of PTFE gaskets or high strength phenolic washers or 2 coats of accepted zinc chromate paint.

Aluminium fabricated items shall be insulated from concrete bearing surfaces by painting contact area with a heavy coat of accepted alkali resistant bituminous paint or by other means accepted by the Superintendent. Where aluminium comes in contact with hot dip galvanised mild steel, a neoprene insertion or equivalent accepted method shall be used to separate the materials.

Joint seals shall be used for the contact surfaces of aluminium covers with the concrete walls of pump well, and pits.

Nylon or polyethylene washers, top hat sections and spacers shall be used to separate stainless steel or Monel metal fasteners from aluminium. Under washers and boltheads and on bolt shanks, etc. where the fastener size is too small for the above insulating methods, i.e. less then (3) millimetres diameter, a heavy application of 'Duralac' to the mating surfaces can be substituted.

6.3. Purlins and girts

Purlins shall be erected in accordance with the purlin manufacturer's recommendations and instructions. Purlins shall be fabricated prior to receiving a protective coating. On-site cutting of coated purlins is not permitted.

6.4. Fabrication and erection

The works required includes the provision of all equipment, materials, labour, services and other items necessary to supply, fabricate, provide surface protection and protective coatings, install or construct, finish, test, commission and put into operation, the structural steel, metalwork ad associated works described herein and elsewhere in the contract.

Fabrication, materials and material selection, corrosion protection and erection of steelwork shall comply with the relevant Australian Standards and the WS-SPEC.

Proper allowances shall be made in detailing and fabrication for the correct fit of joints and components, and allowance has been made for proper access of wrenches, sockets, and other tools for erection.

All necessary tools, joists, bracing, shoring, guys, staging, and materials necessary for safe and expeditious erection shall be made available and shall be removed when erection is completed. All erection equipment shall be of adequate strength and comply with all relevant legislation and regulations.

The bracing system, shores, guys, etc. shall be capable of safely resisting all construction and wind loads during construction and erection. All bracing and guys shall remain in position until all steelwork and metalwork has been erected, levelled and plumbed and all connections made to ensure the stability of the structure or part thereof.

Members shall be supplied true and of even manufacture.

Holes shall be drilled or punched only. Methods of forming holes in Aluminium shall be in accordance with the requirements of AS 1664.

6.5. Cutting of steelwork

All edges of plates and members shall be machine cut, or thermal cut in preparation for welding.

Thermal cutting by hand shall only be undertaken where accepted by the Superintendent.

All surfaces to be incorporated in a weld shall meet the requirements of AS4100 and AS1554 for surface roughness. Galvanised or zinc coated steelwork shall not be cut on site.

6.6. Fabrication tolerances

The general, tolerance on all dimensions shall be in accordance with AS4100 for steelwork and any other relevant standard for metalwork.

Holes shall be positioned and aligned such that fasteners can be freely inserted through the member's perpendicular to the contact face.

Bolt holes that cannot be aligned other than by damaging the structure or any component thereof, including corrosion protection, shall be rectified to the satisfaction of the Superintendent.

A structural member shall not deviate from straightness or its intended length by more than that recommended in the relevant sections of AS4100 and MA1.8 Manual on Steel Structures Fabrication.

6.7. Workmanship

Finished steelwork and metalwork shall be true and free from twists, kinks, buckles, open joints or other defects.

Accuracy shall be observed throughout to ensure all parts fit together properly on erection. Chipping, sheaving and drilling shall be done accurately.

Before being marked off, straightening of any members shall be undertaken by methods that will not damage the material or member.

6.8. Welding

Manual welding and semi-automatic or automatic welding shall be in accordance with AS 1554 and AS 1665.

All welds shall be 6 mm continuous fillet welds unless otherwise noted on the drawings.

Stainless steel welds shall be passivated (refer to *Pr9693* - *Specification for Mechanical Installations* for passivation details).

No site welding of structures or any of their components shall be permitted unless the structures/components to be site welded have been nominated in the tender and expressly form part of the contract.

The completed steelwork shall be free from distortions and true to dimensions. All connections shall be welded in a manner such that the finished connections are neat, smooth in appearance and free of sharp edges.

Details of the welding procedure shall be submitted prior to the fabrication of members utilizing the particular procedure.

6.9. Welding personnel

All welding shall be carried out by skilled welders possessing the required qualifications as per AS 2980 and qualified in the particular welding procedure, welding position and steel being used. Welding shall be carried out under the supervision of a competent supervisor possessing the qualifications required by AS1554.

6.10. Welding equipment and safety

All welding machines and equipment must comply with AS 1674 and the safety requirements of the relevant Statutory Authorities. The machines and equipment must be designed, installed, operated and maintained to such a standard that welds complying with the Specification can readily be made by machine operators.

Electrodes used in all manual arc welding shall conform to and be selected in accordance with the classification in AS 1553.

6.11. Weld contour and quality

Welds shall show a good even contour, a good penetration and fusion with the parent metal and weld quality shall meet the requirements of AS 1554 for Category SP welds, except that no undercutting is permitted. The surface of the weld along and across the joint shall be reasonably smooth and free from sharp irregularities, grooves or depressions and shall merge smoothly into the plate surface.

6.12. Weld finish

Where welds do not meet the surface finish requirements of this specification, they shall be ground to a smooth surface free from sharp crests, sharp troughs and pits. Grinding shall be undertaken so as not to reduce the weld below the design size and not to overheat the joint or introduce grinding cracks.

Sharp edges on all steelwork, including shear edges, shall be ground to a radius of curvature of not less than 1 mm. Weld spatter not capable of ready removal by subsequent cleaning or blasting shall be removed by mechanical means.

6.13. Weld inspection and testing

All welds shall be inspected in accordance with AS 1554.

Weld inspection/testing requirements shall be shown on fabrication drawings. As a minimum, the testing of the SP weld shall be at least 100% visual and 10% NDT.

6.14. Weld defects

Defective welds shall be cut out and replaced and reinspected.

6.15. Welding of stainless steel

For stainless steel fabrications all welds shall be in accordance with AS 1554.6

All stainless steel fabricators shall be ASSDA (Australian Stainless Steel Development Association) accredited fabricators.

After welding of stainless steel, welds and the adjacent plate shall be cleaned, pickled and passivated by accepted methods to restore corrosion resistance. All welds in contact with sewage and/or water shall be ground smooth prior to passivating.

6.16. Welding of aluminium

Welding and inspection of aluminium shall comply with the requirements of AS 1664 and AS 1665.

6.17. Stainless steel fabrications

6.17.1 Passivation

All stainless steel fabrications shall be passivated after all welding has been completed to restore corrosion resistance. Passivating of the welded areas preferably shall be carried out in the fabricator's workshop in accordance with ASTM A380 Standard of Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.

Where passivation on site is unavoidable, it shall be carried out in accordance with the product manufacturer's instructions and the manufacturer's Materials Safety Data Sheets.

No waste shall be flushed down the existing drainage system, unless diluted or neutralised satisfactorily.

Small items such as nuts, bolts, washers, screws shall be passivated by immersing them overnight in a plastic bucket containing 15%-20% by volume of nitric acid in water.

The items shall be thoroughly rinsed in fresh water before use. Larger items shall be passivated by coating with a proprietary acid paste such as Sandvik" Betapaste" or suitable equivalent. The articles shall be coated and left overnight then rinsed thoroughly in clean water. As this product is highly corrosive and gives off fumes, it shall be used in a well-ventilated area and personnel shall use rubber gloves. The product manufacturer's safety precautions on the label shall be carefully complied with.

After passivation, fabricated components shall have a clean, matt finish free from scale and discolouration caused by welding or heating.

6.18. Contamination

Appropriate care shall be taken when handling stainless steel before, during and after fabrication to prevent contamination with mild steel materials, dust, shavings, weld splatter and the like. Such care is particularly important after passivation and during transport to site, storage and installation as these small particles rust quickly and discolour the surface of the stainless steel. This can destroy the protective oxide film and render it liable to pitting corrosion.

The following practices shall not be used:

- Cleaning with steel wool, wire brushes, emery paper;
- Cleaning with abrasive compounds containing chlorides;
- Blast cleaning;
- Using muriatic (i.e. hydrochloric) acid in combination with solder fluxes as it contains iron.

6.19. Surface protection

6.19.1 Hot galvanising dip

Hot dip galvanise all steel fabricated components after fabrication in accordance with AUS-SPEC C402 Development Construction Specification.

Quality and thickness of galvanising shall be in accordance with AS 4534, AS 4680 and AS 4792 with a minimum weight of 0.6kg/m2. Carry out tests in accordance with AS 4534, AS 4680 and AS 4792.

6.19.2 Defective galvanised coatings

The following particular requirements shall apply to the rectification of defective or damaged galvanised coatings:

- Quality and thickness of galvanising shall be in accordance with AS 4534, AS 4680 and AS 4792 with a minimum weight of 0.6kg/m2. Carry out tests in accordance with AS 4534, AS 4680 and AS 4792.
- Where the average zinc coating thickness is less than the minimum specified, the galvanised member shall be re-galvanised. For the purpose of this paragraph “average zinc coating thickness” shall be the average of not less than 10 determinations over a test area of 1m2.
- Where zinc coating has been damaged, the damaged surface shall be repaired by the application of a zinc rich epoxy primer or an organic zinc rich paint. Alternatively, repairs may be affected by the use of an accepted low melting point zinc repair applied as recommended by its manufacturer.

6.20. Bolts, nuts, washers and jointing materials

Bolts, nuts and other demountable fastenings for use in normal atmospheric conditions shall be hot dip galvanised in accordance with AS 1214.

All fastenings for use in corrosive atmospheric conditions, shall be min. Grade 316 stainless steel. All nuts and washers shall be of Grade 316 stainless steel with a suitable Nickle-based anti-galling lubricant applied to all threads, as well as the nut to washer surface prior to fabrication.

For dissimilar metals, PTFE washers shall be fitted between metal washers and the materials being fixed or joined.

All exposed bolt heads and nuts shall be hexagonal and the length of all bolts shall be such that when fitted with a nut and tightened down the thread portion shall fill the nut and protrude from the face thereof by not more than one-half diameter. Except for pipework, the maximum protrusion of the bolts shall be 12 mm.

Bolts in bearing shall be of such length that no threaded portion shall be within the thickness of the parts joined. At least one washer shall be placed under the bolt head or nut whichever is to be rotated. Nuts or bolts subject to severe vibration and vertical bolts in tension shall be locked in position by an accepted method.

6.21. Masonry anchors

For all fixings into concrete masonry structures, allowable types of fastenings are as follows:

- Chemical anchors of Grade 316 stainless steel in drilled holes; and
- Cast in-situ bolts of Grade 316 stainless steel provided that the strength of the fastener is equal to or greater than the chemical anchor equivalent.

All nuts and washers shall be of Grade 316 stainless steel with a suitable Nickle-based anti-galling lubricant applied to all threads, as well as the nut to washer surface prior to fabrication.

PTFE washers shall be fitted between metal washers and the materials being fixed or joined where parts are galvanised or of aluminium alloy.

6.22. Bedding and grouting

All permanent packing used to support steelwork on structures shall be either of solid steel or cement mortar blocks of similar strength to the permanent grout. Temporary packing shall be removed before completion of grouting. All grouting shall conform to materials and methods of AS4100.

6.23. Site cutting, drilling and welding

During erection, steel members shall not be cut, burnt, welded or drilled. Drilling may only be used for bringing parts into position, not to match unfair holes, or enlarge holes or distort metal.

6.24. Platforms, walkways, open flooring, stairways and handrails

Unless otherwise agreed in writing by the Superintendent, all platforms, handrails, stairs, ladders and ancillary equipment shall be made of aluminium. Galvanised systems shall not be considered acceptable unless specific instances require its use.

All platforms, walkways, stairways and handrails shall be designed, supplied and installed as required to comply with the requirements of this Specification.

Access platforms, walkways and stairs shall be provided as necessary to provide safe and convenient access to all areas of structures and all equipment, in particular equipment requiring maintenance, lubrication, adjustment, observation or control. In this context, maintenance includes the replacement of all flange gaskets and gland packing, maintenance of valves, cranes and all temperature, pressure and flow sensing elements and other instrument tapping points. Any access platforms that could prevent the removal of adjacent plant shall be of a demountable type.

Platforms, walkways, step-irons, stairs and handrails shall, in addition to the other requirements of this Specification, comply with the requirements of:

- AS 1657 Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation;
- Relevant Statutory Requirements.

All walkways and stairways shall have a minimum inside width of 1,000 mm. Wider walkways and platforms shall be provided where required to facilitate the smooth operation and maintenance of the Works.

Access stair treads shall have a surface pattern that will provide a non-slip grip even when immersed in liquid.

Grating:

- Materials shall be aluminium;
- Grating shall have serrated edge load carrying bars at appropriate spacing;
- Each grating panel shall have edge bars welded across the end of the load bars, notches or penetrations. The edge bar shall be the same section as the load bars;
- Edges shall be trimmed with bars of the same size as the main bars and welded all round;
- Every panel shall be fastened to the supporting structure using the proprietary screws and clamps of the floor grate supplier, except for the step grates;
- Load carrying bars shall travel in the direction between the supporting structure members;
- There shall be no raised projections above the floor levels of the platforms, walkways etc.

Dissimilar metals shall not come into direct contact unless adequate separation is provided. All aluminium surfaces to be placed in contact with steel and concrete shall be painted with two (2) coats of accepted tar epoxy paint over the area of contact.

Cut-outs:

- Cut-outs in the grating to suit valve spindles, etc. and additional kickplates shall be provided where required;
- Cut-outs in the grating shall be approximately 150 mm x 150 mm and the exposed edges shall be fitted with welded trim bars across the longitudinal runners;
- Band bars shall be provided around all cut outs and butt joints between panels except where specified otherwise;
- Both the load bearing and transverse bars in rectangular flooring panels shall be positioned symmetrically around the centre-lines of the panels in both directions so that where the panels are fixed the bars of all panels are in line;
- All grating and open floor panels shall withstand the maximum of the loads specified in AS 1170, AS 1657 or a distributed load of 4kPa;
- Deflections shall not exceed the least of 5mm and maximum deflections specified in the relevant Australian Standard;
- If possibility of injuring persons by objects falling through grating or open flooring exists, a protective mesh shall be provided under such grating and open flooring.

Where it is required to remove grating for access, routine inspections or maintenance, the grating shall be supplied in panels not exceeding 16 kg for manual handling of one person and 32 kg for two persons. Otherwise the maximum weight of each piece of removable grating shall be 45 kg. In the case where security is required, the grating and hatches shall be lockable with key-alike system.

Hand railing shall be Webforge Monowills aluminium tubular system or an equivalent proprietary system and come complete with aluminium kickplates. All dimensions shall be confirmed on site prior to fabrication.

Hand railing, kickplates, platforms and stiles shall be entirely fabricated off-site. Joining together of handrailings and platforms on-site shall be by means such as bolted connections and/or pins, etc.

Site welding or cutting or metallising shall not be permitted.

Joints in the rails shall be inside stanchion knuckles or connection receptacle.

Floor plating:

- Floor plating material shall be aluminium;
- Plating shall be of sufficient thickness to carry the maximum of the loads specified in AS 1170, AS 1657 or a distributed load of 4 kPa without producing deflections exceeding the lesser of 5 mm or maximum deflections specified in the relevant Australian Standard;
- Plates shall not be less than 6 mm thick and shall have a non-slip surface pattern;
- Where it is required to remove floor plating for access, routine inspections or maintenance, the requirements of Clause 0 shall be met.

All stairways, platforms and walkways shall be enclosed by hand railing complete with kickplates on both sides unless there is less than 100 mm between the walkways and an adjacent structure. In such a case, hand railing does not need to be supplied on that side. Kickplates to AS 1657 shall still be required in this case. The hand railing shall be of uniform appearance and manufacture.

A 6 mm thick kickplate projecting 100 mm above floor plates or grating shall be provided on all platforms, floors and walkways. The stanchions shall be set at not more than 2 m centres.

Stairway access openings on platforms and walkways shall be protected with self-closing safety gates/booms. Chains shall not be used.

7. Appendices

Appendix A – Definitions/Acronyms

The following definitions, abbreviations and acronyms are used throughout this specification.

Term	Meaning
Construction	Any work necessary for the installation, testing and commissioning of a pipeline, maintenance hole or house drain. The term includes such operations as taking care of existing assets, clearing, excavation, erosion control, bedding, laying, jointing, backfilling, restoration, forming, concrete placing, vibrating and stripping, pressure testing and quality testing.
Materials	Any raw or manufactured materials or goods. This includes all machinery, equipment and components.
RPEQ	Registered Professional Engineer Queensland
Superintendent	As defined in the General Conditions of Contract called up in the Contract document (such as AS 2124-1992 or AS 4000) – the person appointed by Unitywater (the Principal)

Appendix B – References

General

All work carried out under this specification shall comply in all aspects (i.e. in design, construction, testing and performance) with the latest relevant Australian (AS), British (BS) and IEC Standards and standards in the following sections.

Reference to specific clauses of the various codes is intended to highlight those points and shall not be taken to imply a lesser importance for all other applicable clauses.

All the works shall conform to the Rules and Regulations of the Statutory Authorities having jurisdiction over the Site.

If the requirements of this Specification do not comply with the minimum requirements of the statutory regulations and standards, the latter shall apply. If the requirements of this Specification are more exacting than the minimum requirements of the statutory regulations and standards, the former shall apply.

All Materials, fittings, accessories and equipment supplied by the Contractor shall be new and the best obtainable of their kind and shall comply in all respects with the requirements of the relevant Standards Australia specifications.

All works shall be completed in accordance with this Specification, the Project Specification and stated supplementary specifications.

The Contractor shall undertake his own assessment as to the type of material to be excavated and sub-surface conditions and shall allow for any dewatering, timber shuttering and shoring that may be required.

The Contractor shall be responsible to manage all structural load conditions during the works including managing floatation of structures.

All temporary building/structural works to have RPEQ certified design calculations submitted to the Superintendent for acceptance.

Where the Contract is a lump sum, the price shall cover all classes of excavation and no variation in payment will be made on account of the nature of the excavated material, site conditions or effects of the climatic conditions.

The following legislation, related Regulation and Codes apply to this specification:

- *Work Health and Safety Act 2011* (Qld);
- *Work Health and Safety Regulation 2011* (Qld);
- *Water Supply (Safety and Reliability) Act 2008* (Qld);
- *Environmental Protection Act 1994* (Qld);
- *Electrical Safety Act 2002* (Qld)*;*
- *Electricity Regulation 2006* (Qld)*;*
- *Queensland Building and Construction Commission Act 1991* (Qld);
- *Building Act 1975* (Qld)*;*
- *Building Regulation 2021* (Qld)*;*
- *National Construction Code;*
- *Plumbing and Drainage Act 2018* (Qld)*;*

- *Professional Engineers Act 2002* (Qld);
- Demolition Work Code of Practice 2021, WorkSafe QLD;
- Managing Noise and Preventing Hearing Loss at Work Code of Practice 2021, WorkSafe QLD;
- Scaffolding Code of Practice 2021, WorkSafe QLD;
- South East Queensland Water Supply and Sewerage Design and Construction Code (SEQ WS & S D & C Code);
- Department of Transport and Main Roads Standard Specifications;
- The Queensland Guide to Temporary Traffic Management (QGTTM);
- Erosion and Sediment Control Manual, Sunshine Coast Council; and
- Concrete Pipe Selection and Installation Manual, Concrete Pipe Association of Australia.

Relevant Unitywater documents that relate to this specification

Document No.	Title
Pr9380	Electrical Installations at Network Sites
Pr9902	Specification for Civil and Earth Works
Pr9835	Specification for Electrical Installation at Treatment Plants
Pr9693	Specification for Mechanical Installations for passivation details

International and Australian Standards referenced within this specification

Standard	Title
Quality Systems	
AS 2990	Quality Systems for Engineering and Construction Projects
AS 3901	Quality Systems for Design/Development, Production,
	Installation and Servicing
AS 3902	Quality Systems for Production and Installation
AS 3903	Quality Systems for Final Inspection and Test
Drawings	
AS 1110	Technical Drawings
AS 1101	Graphical Symbols for General Engineering
AS 1102	Graphical Symbols for Electrotechnology
Workmanship and Design	
AS 1074	Steel tubes and tubulars for ordinary service
AS 1163	Structural steel hollow sections
AS 1289	Methods of testing soils for engineering purposes
AS 1302	Steel reinforcing bars for concrete
AS 1379	The specification and manufacture of concrete

Standard	Title
AS 1554.1	Welding of steel structures
AS 1608	Preservative – Treated farm fencing timber
AS 1650	Hot-dipped galvanised coatings on ferrous articles
AS 1725	Galvanised rail-less chainwire security fences and gates
AS 1830	Iron castings – Grey cast iron
AS 2124	General Conditions of Contract
AS 2187	Explosives – Storage, transport and use
AS 2188	Explosives – Relocatable magazines for storage
AS 2423	Galvanised wire fencing products
AS 2758	Aggregates and rock for engineering purposes
AS 2868	Classification of machinery for earthmoving, etc.
AS 3600	Concrete structures
AS 3678	Structural steel – Hot-rolled plates, floor-plates and slabs
AS 3679	Structural steel – Hot-rolled bars and sections
AS 3706	Geotextiles – Methods of test
AS 3725	Loads on buried concrete pipes
AS 3798	Guidelines for earthworks for commercial and residential developments
AS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4139	Fibre-reinforced concrete pipes and fittings
AS 1012	Methods of Testing Concrete
AS 1074	Steel Tubes and Tubulars for ordinary service
AS 1082	Glossary of Formwork Terms
AS 1101	Graphical Symbols for General Engineering Part 3
AS 1110	ISO Metric Precision Hexagon Bolts and Screws
AS 1214	Hot-dip galvanized coatings on threaded fasteners
AS 1275	Metric Screw Threads for Fasteners
AS 1303	Steel reinforcing wire for concrete
AS 1304	Welded wire reinforcing fabric for concrete
AS 1379	The Specification and Manufacture of Concrete
AS 1444	Wrought alloy steels
AS 1478	Chemical admixtures for concrete
AS 1553	Covered Electrodes for Manual Metal-Arc Welding
AS 1594	Hot-rolled Steel Flat Products
AS 1664	Aluminium Structures
AS 1674	Safety in Welding and Allied Processes
AS 1710	Non-destructive testing
AS 1734	Aluminium and aluminium alloys
AS 1769	Welded stainless steel tubes for plumbing applications
AS 1858	Electrodes and Fluxes for submerged-arc welding

Standard	Title
AS 1866	Aluminium and aluminium alloys
AS 2177	Non-destructive testing
AS 2203	Cored Electrodes for Arc-Welding
AS 2207	Non-destructive testing
AS 2214	Structural Steel Welding Supervisors Certification
AS 2837	Wrought alloy steels - Stainless steel bars
AS 3678	Structural Steels – Hot rolled plates, floorplates and slabs
AS 3679	Structural Steel
AS 3735	Concrete Structures Retaining Liquids
AS 3799	Liquid membrane forming curing compounds for concrete
AS 3828	Guidelines for the erection of building steelwork
AS 3990	Mechanical Equipment- Steelwork
AS 4181	Stainless steel clamps for waterworks purposes
AS 4600	Cold-formed Steel Structures
AS 4654	Waterproofing Membranes for External Aboveground Use
BS 8102	Code of Practice for Protection of Below Ground Structures Against Water from the Ground
AS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
ASTM A380	Standard of Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems
ISO 3506	Mechanical properties of corrosion-resistant stainless-steel fasteners
ISO 9001	Quality Systems for Design/Development
ISO 9002	Quality Systems for Production and Installation
SAAMP20	Admixtures for concrete
SAAHB64	Guide to concrete structures
SAAHB67	Concrete practice on building sites
SAAHB71	Concrete Design Handbook
SAASP004	RC Beams, slabs, columns
Coatings	
AS 1192	Electroplated Coatings – Nickel and Chromium
AS 1627	Metal Finishing – Preparation and Pretreatment of Surfaces Part 2 – Power Tool and Cleaning of Steel Surfaces Part 4 – Abrasive Blast Cleaning
AS 1650	Hot-dipped Galvanised Coatings on Ferrous Articles
AS 1789	Electroplated coatings – Zinc on iron or steel
AS 2312	Guide to the Protection of Iron and Steel Against Exterior Atmospheric Corrosion
Concrete	
AS 3600	Concrete Structures
AS 3610	Formwork for concrete

Standard	Title
Electrical	
AS 1680	Interior Workplace Lighting
AS 2293	Emergency Escape Lighting and Exit Signs for Buildings
AS 3000	Electrical Installations – Building, Structures and Premises (SAA Wiring Rules)
AS 3008	Electrical Installations – Selection of Cables Part 1 Cables for Alternating Voltages Up To and including 0.6/1 kV
AS 3021	Electrical Installations – Construction and Demolition Sites
Fire Testing	
AS 1530	Methods for fire tests on building materials components and structures Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release Part 4: Fire resistance tests of elements of building construction
Glazing	
AS 1288	SAA Glass Installation Code Part 1: Selection of Glass Part 2: Glazing Techniques
AS 2047	Aluminium Windows for Buildings
AS 2048	Codes of practice for installation and maintenance of aluminium windows in buildings
Identification	
AS 1319	Safety Signs for the Occupational Environment
AS 1345	Identification of the Contents of Piping, Conduits and Ducts
Loads	
	Building Code of Australia
AS 1170	SAA Loading Code Part 2 Wind Loads
Masonry	
AS 3700	Masonry in Buildings (SAA Masonry Code)
Metalwork	
AS 1657	Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation
AS 1665	Rules for the Welding of Aluminium Structures
AS 1796	Certification of Welders and Welding Supervisors
ISO 8501	Visual assessment of surface cleanliness
Miscellaneous	
AS 1736	Code of Practice for Pliable Roof Sarking
AS 1904	Code of Practice for Installation of Reflective Foil Laminate in Buildings
Pipework	
AS 2032	Code of Practice for Installation of uPVC Pipe Systems
AS 2033	Installation of Polyethylene Pipe Systems

Standard	Title
AS 3500	National Plumbing and Drainage Code
Plastering and Tiling	
AS CA27	Code of recommended practice for internal plastering on solid backgrounds
BS 5492	Internal rendered finishes
BS 5262	External rendered finishes
Roof Plumbing	
AS 1562	Design and installation of metal roofing
AS 2180	Metal rainwater goods – selection and installation
Soils	
AS 1289	Methods of Testing Soils for Engineering Purposes Part E1.1 Soil compaction and density tests – Determination of the dry density/moisture content relation of a soil using standard compaction – Standard Method Part E6.1 Compaction Control Test – Density Index Method for a Cohesionless Material Part E2.1 Soil Compaction and Density Tests – Determination of the Dry/Density Moisture Content Relation of a Soil Using Modified Compaction – Standard Method
Steelwork	
AS 1538	Cold Formed Steel
AS 4100	Steel Structures Code
Timber	
AS 1684	Code of Practice for Construction in Timber Framing
AS 1720	SAA Timber Engineering Code shapes
Materials	
Aluminium Windows	
AS 1231	Anodic oxidation coatings on aluminium for architectural applications
AS 2047	Aluminium Windows for Buildings
Bricks and Concrete Masonry	
AS 1225	Clay building bricks
AS 1226	Methods of sampling and testing clay building bricks
AS 1316	Masonry cement (metric units)
AS 2699	Wall ties for masonry construction (incorporating Amendment 1 1986)
AS 2733	Concrete masonry units
Bolts	
AS 1111	ISO Metric Hexagon Commercial Bolts and Screws
AS 1112	ISO Metric Hexagon Nuts, including Thin Nuts, Slotted Nuts and Castle Nuts
AS 1237	Flat Metal Washers for General Engineering Purposes (metric series)
AS 1252	High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering

Standard	Title
Concrete Constituents	
AS 2758	Aggregates and Rock for Engineering Purposes Part 1 – Concrete Aggregates
AS 3972	Portland and Blended Cements
Copper	
AS 1432	Copper Tubes for Plumbing, Gasfitting and Drainage Applications
Doors	
AS 1905	SAA Fire Door Code
AS 2688	Timber Doors
Glazing	
AS 2208	Safety glazing materials for use in buildings (human impact considerations)
BS 952	Glass for glazing Part 1: Classifications Part 2: Terminology for work on glass
BS 4255	Performed rubber gaskets for weather exclusion from buildings Part 1: Non cellular gaskets Part 2: Cellular gaskets TTS-001543A sealing compound, silicone rubber base (US Federal Interim Specification Standard)
Polyethylene	
AS 4130	Polyethylene Pipe for Pressure Applications
AS 4766	Polyethylene Storage Tanks for Water and Chemicals
Plastering and Tiling	
AS 1672	Building Limes
AS 2592	Gypsum Plaster for Building Purposes
BS 1014	Specification for pigments for Portland cement and Portland cement products
BS 6431	Ceramic floor and wall tiles
Plumbing Fittings	
AS 1172	Water closet pans
AS 1218	Flushing cistern (metric units)
AS 1229	Laundry troughs
AS 1371	Toilet seats of moulded plastic
AS 1432	Copper tubes for plumbing, gasfitting and drainage applications
AS 1572	Copper & copper alloys – seamless tubes for engineering purposes
AS 1589	Copper and copper alloy waste fittings
AS 1718	Copper allow screw-down pattern taps
AS 2129	Flanges for pipes, valves and fittings
AS 1976	Vitreous china for use in sanitary appliances
AS 3688	Copper and copper alloy compression and capillary fittings and threaded end connectors
AS 4087	Metallic flanges for waterworks purposes

Standard	Title
Reinforcement	
AS 1302	Steel Reinforcing Bars for Concrete
AS 4671	Steel Reinforcing Materials
Sealants	
AS 1526	One-part polysulphide based sealing compounds for the building industry
AS 1527	Two-part polysulphide based sealing compounds for the building industry
Security Fences	
AS 1725	Chain link fabric fencing – Security fences and gates – General requirements
Sheet Metal Roofing and Accessories	
AS 1093	Reflective Foil Laminate
AS 1397	Steel sheet and strip-hot-dipped zinc-coated or aluminium/zinc coated
AS 2179	Metal rainwater goods – Specification
AS 2728	Prepainted and organic film/metal laminate products –
Performance requirements for interior/exterior applications in building	
AS 3566	Screws – self drilling for the building and construction industries
Steel	
AS 1163	Structural Steel Hollow Sections
AS 1554	SAA Structural Steel Welding Code
Timber and Joinery	
AS 082	Sawn Eastern Australian Hardwoods
AS 1748	Mechanically Stress-Graded Timber
AS 1859	Flat Pressed Particle Board
AS 1905	Components for the protection of openings in fire-resistant walls Part 1: Fire Resistant Doorsets
AS 1909	Installation of timber doorsets
AS 2082	Visually Stress-Graded Hardwood for Structural Purposes
AS 2131	Adhesives for bonding decorative thermoset laminates (contact adhesives)
AS 2270	Plywood and Blockboard for Interior Use
AS 2271	Plywood and blockboard for exterior use
AS 2458	Hardboard
AS 2459	Organic Fibre Insulating Board
AS 2543	Nomenclature of Australian Timbers
AS 2688	Timber Doors
AS 2689	Timber doorsets
AS 2754	Adhesives for Timber and Timber Products
AS 2796	Timber – Seasoned Hardwood – Milled Products
AS 2924	Decorative thermosetting laminated sheet

Standard	Title
uPVC	
AS 1250	Unplasticised PVC (uPVC) Pipes and Fittings for Storm and Surface Water Applications
AS 1260	Unplasticised PVC (uPVC) Pipes and Fittings for Sewerage Applications
AS 1273	Unplasticised PVC (uPVC) Downpipe and Fittings for Rainwater
AS 1415	Unplasticised PVC (uPVC) Pipes and Fittings for Soil, Waste and Vent Applications
AS 1477	Unplasticised PVC (uPVC) – Pipes and Fittings for Pressure Applications
AS 2977	Unplasticised PVC Pipes for Pressure Applications
Vinyl Floor Coverings	
AS 2055	PVC sheet floor covering unbacked flexible
AS 1884	Floor Coverings – Resilient Sheet and Tiles – Laying & maintenance practices
AS 1169	Minimising of combustion hazards arising from the medical use of flammable anaesthetic agents
AS 3553	Adhesives for floor and wall applications – resilient vinyl, linoleum & rubber sheet & tiles – interior and exterior use
Products in contact with drinking Water	
AS 4020	Testing of products for use in contact with drinking water
Equipment	
Electrical Equipment	
AS 1359	Rotating Electrical machines – General Requirements Part 30 – Duty and Rating Part 32 – Temperature Limits and Measurements of Temperature Part 60 – Tests
AS 1939	Degrees of Protection Provided by Enclosures for Electrical Equipment
AS 3147	Approval and Test Specification – Electric Cables – Thermoplastic Insulated for Working Voltages up to and including 0.6/1kV
Fire Fighting Equipment	
AS 1221	Fire Hose Reels
AS 2441	Installation of Fire Hose Reels
Lifting Equipment	
AS 1418	Cranes (Including Hoists and Winches) Part 1 General Requirements Part 2 Serial Hoists and Winches