



# Proposed Public Pontoon At Dangar Island

## Technical Specification - Design and Construct of Gangway and Pontoon

For: Hornsby Shire Council

FEBRUARY 27, 2017

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APPENDIX B – GEOTECHNICAL REPORT

# 1. GENERAL REQUIREMENTS

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## 1.1 Context

### 1.1.1 Specification

This Performance and Technical Specification (“Specification”) including the Principal Supplied Drawings covers the standard of workmanship and quality of materials required for the design, manufacture, delivery, installation, commissioning and certification of a berth facility to be located on Dangar Island. The berth facility shall include a proprietary pontoon system with a proven history of performance in similar applications as that required for this project.

The Contract is a design and construct contract requiring the Contractor to produce the design including drawings of the Works and to construct the Works in accordance with those designs and related documentation. The Contractor’s designs and the constructed works shall comply in all respects with the requirements of Specification set out herein.

In this Specification, design and documentation produced by the Contractor is generally referred to as the “Contractor’s Design”, the “Contractor’s Drawing”, the “Contractor’s Specification”, etc.

### 1.1.2 Drawings

A list of the Principal Supplied Drawings to be read in conjunction with this Specification is provided on Drawing No. 30011999-1001. Copies of the Principal Supplied Drawings current at the date of tendering are included in the Appendices of this Specification.

### 1.1.3 Definitions

In this Specification:

‘Constructional Plant’ means appliances and things used in the execution of the work under the Contract but not forming part of the Works.

‘Consultant’ means SMEC or other person from time to time appointed in writing by the Principal to be the Consultant and notified as such in writing to the Contractor by the Superintendent and, so far as concerns the functions exercisable by a Consultant’s Representative, includes a Consultant’s Representative.

‘Contractor’ means the person bound to execute the work under the contract.

‘Drawings’ means the drawings referred to in the Contract and any modification of such drawings, or the use of which has been permitted by the Client, for the purposes of the Contract. “Drawings” include Principal Supplied Drawings which are the drawings included in this Specification, and also includes Contractor’s Drawings.

‘Completion’ unless defined elsewhere in the Contract, Completion is that stage in the execution of the work under the Contract when-

1. The Works are complete except for minor omissions and minor defects -
  - (i) which do not prevent the Works from being reasonably capable of being used for their intended purpose, and
  - (ii) in relation to which the Superintendent determines that the Contractor has reasonable grounds for not promptly rectifying them, and
  - (iii) rectification of which will not prejudice the convenient use of the works, and



2. Those tests which are required by the Contract to be carried out and passed before the Works reach Completion have been carried out and passed, and
3. Documents and other information required under the Contract which, in the opinion of the Client, are essential for the use, operation and maintenance of the Works have been supplied.

'Principal' has the same meaning as in the General Conditions of Contract.

'Specification' means this Performance and Technical Specification for work to be carried out, as existing at the Date of Acceptance of Tender and any modification of such Specification thereafter directed or the use of which has been permitted by the Superintendent pursuant to powers contained in the Contract. Specification also means a specification prepared by the Contractor (i.e. a "Contractor's Specification") as reviewed and accepted by the Client.

'Standards' has the same meaning as defined in this Specification.

'Temporary Works' unless otherwise defined, means works used in the execution of the work under the Contract but not forming part of the Works.

'work under the Contract' unless otherwise defined, means the work which the Contractor is or may be required to execute under the Contract and includes variations, remedial work, Constructional Plant and Temporary Works.

'Works' unless otherwise defined, means the whole of the work to be executed in accordance with the Contract, including variations provided for by the Contract, which by the Contract is handed over to the Client.

## 1.2 Purpose Of Works

The intended purpose of the Works is to develop a safe and functional berthing and mooring facility as described by the Specification herein including the Principal Supplied Drawings. The berthing facility shall cater for commercial ferry and water taxi operations and provide temporary day mooring facilities for visitors to Dangar Island. Without limiting the generality of that requirement, the design and construction must satisfy the requirements of these documents and any other documents referenced or otherwise supplied by the Client, and in addition be to a standard which would be reasonably expected for the Works.

## 1.3 Description Of Works

This contract is for the construction of a new pontoon at Dangar Island Public Wharf. A conforming layout is provided in the Drawings accompanying this Specification included in Appendix A. The piles in the conforming layout have been sized to account for the loadings in this Specification. If the contractor utilises this layout the piling sizes can be adopted as detailed on the accompanying Drawings. To complete the design for the new pontoon the following four(4) tasks will then be required for (i) the proprietary pontoon system as per Section 3 of this Specification and (ii) the gangway and its wharf connection as per the loadings in Section 2 of the Specification and layout in the Drawings:-

- Complete the design (i) and (ii);
- Certify the design;
- Obtain all necessary approvals;
- Supply, manufacture, deliver, install, commission and certify the construction.

If a non-conforming arrangement is proposed then the contractor shall undertake the above four(4) tasks for the piling in addition to the pontoon and gangway.

The Works to be carried out by the Contractor include the following as a minimum:

- Piles and pile guides;
- Floating pontoon and walkway including all interconnections (such as but not limited to walers, throughbolts, knee brackets, etc), services ducts, fixtures and protective fendering;
- Ramp, handrails and non-slip tactile indicators;
- Aluminium shelter structure, acrylic window panels and aluminium seating;
- Modifications to the existing timber jetty to allow mounting of the new gangway;
- Aluminium gangway and connections to existing wharf including transition plates;
- Services including provision of ducts within the pontoons, mooring cleats, lighting including navigation lights, electrical connection to distribution board and any required modifications for the connections, etc;
- Demolition of the existing jetty stairs and make good the affected connection points to the structure;
- Cut off redundant timber fender piles at sea bed level, remove and dispose;
- Contractor shall be responsible for maintaining access for Dangar Island Commuter ferry throughout the construction phase. Temporary works required to achieve this shall be allowed for in the tender price.

Minor variations to the overall dimensions shall be acceptable to allow use of standard components.

All components shall be designed with adequate robustness for the environmental conditions of the facility location.

## **1.4 Standards And Guidelines**

### **1.4.1 Standards**

Adopt Standards for this Contract which are Australian Standards and Codes of Practice or approved equivalent British or American Codes where Australian Standards are not available. If a Standard does not exist, establish the design and construction parameters to be used and submit to the Superintendent for review. The Contractor shall also refer to recognised design guidelines such as that published by the NSW Maritime, Department of Transport and Department of Public Works.

As a minimum, all design, materials, workmanship and testing shall comply with, but not be limited to, the latest issue (including amendments) of the standards and guidelines listed in this clause, to the extent that it is not overridden by this Specification.

AS 1012	Methods of Testing Concrete
AS 1101	Graphical Symbols for General Engineering
AS 1101.3	Welding and Non-Destructive Examination
AS 1111	ISO Metric Hexagon Commercial Bolts and Screws
AS 1112	ISO Metric Hexagon Nuts including Thin Nuts, Slotted Nuts and Castle Nuts
AS 1141	Methods for Sampling and Testing Aggregates
AS 1163	Structural Steel Hollow Sections

AS 1167 Welding and Brazing - Filler Metals  
AS 1167.2 Filler Metal for Welding  
AS/NZS 1170.0 Structural design actions – General principles  
AS/NZS 1170.1 Structural design actions - Permanent, imposed and other actions  
AS/NZS 1170.2 Structural design actions - Wind actions  
AS 1171 Methods for Magnetic Particle Testing of Ferromagnetic Products and Components  
AS 1214 Hot-Dip Galvanised Coatings on Threaded Fasteners  
AS 1221 Fire Hose Reels  
AS 1237 Plain washers for metric bolts, screws and nuts for general purposes  
AS 1252 High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering  
AS 1302 Steel Reinforcing Bars for Concrete  
AS 1379 The Specification and Supply of Concrete  
AS 1391 Methods for Tensile Testing of Metals  
AS/NZS 1393 Coach screws  
AS 1428.1 Design for access and mobility – Part 1: General requirements for access - New building work  
AS 1428.2 Design for access and mobility – Part 2: Enhanced and additional requirements - Buildings and facilities  
AS 1428.3 Design for access and mobility – Part 3: Requirements for children and adolescents with physical disabilities  
AS 1428.4 Design for access and mobility – Part 4: Tactile ground surface indicators for orientation of people with vision impairment  
AS 1444 Wrought Alloy Steels - Standard and Hardenability Series  
AS 1449 Wrought Alloy Steels - Stainless and Heat Resisting Steel Plate, Sheet and Strip  
AS 1478 Chemical Admixtures for Concrete  
AS 1553 Covered Electrodes for Welding  
AS 1554 Structural Steel Welding  
AS 1579 Arc Welded Steel Pipes and Fittings for Water and Waste Water  
AS 1588 Filler Rods for Welding  
AS/NZS 1604 Timber – Preservative treated – Sawn and round  
AS 1627 Metal Finishing - Preparation and Pretreatment of Surfaces  
AS 1627.4 Abrasive Blast Cleaning  
AS 1627.5 Pickling, Descaling and Oxide Removal  
AS 1650 Hot-Dipped Galvanised Coating on Ferrous Articles  
AS 1657 Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation  
AS/NZS 1664 Aluminium structures  
AS 1665 Welding of aluminium structures

- AS 1674 Safety in Welding and Allied Processes
- AS 1684 National Timber Framing Code
- AS 1710 Non-Destructive Testing of Carbon and Low Alloy Steel Plate - Test Methods and Quality Classification
- AS 1720 SAA Timber Structures Code
- AS 1720.1 Timber structures - Part 1: Design methods
- AS 1734 Aluminium and Aluminium Alloys - Flat Sheet, Coil Sheet and plate
- AS 1796 Certification of Welders and Welding Supervisors
- AS 1815 Metallic Materials - Rockwell Hardness Test
- AS 1816 Metallic Materials - Brinell Hardness Test
- AS 1866 Aluminium and Aluminium Alloy - Extruded rod, bar, solid and Halcon Shapes
- AS 2053 Conduits and Fittings for Electrical Installations
- AS 2082 Visually Stress-Graded Hardwood for Structural Purposes
- AS 2159 Piling - Design and Installation
- AS 2177 Non-destructive Testing - Radiography of Welded Butt Joints in Metals
- AS 2177.1 Non Destructive Testing - radiography of welded butt joints in metal 1994
- AS 2207 Non Destructive Testing - ultrasonic testing of fusion welded joints in carbon and low alloy steel 1994
- AS 2209 Timber – Poles for overhead lines
- AS 2214 Certification of Welding Supervisors - Structural Steel Welding
- AS 2239 Galvanic (sacrificial) anodes for cathodic protection
- AS/NZS 2312 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
- AS 2334 Steel nails – Metric series
- AS 2350 Methods of Test for Portland and Blended Cement
- AS 2441 Installation of Fire Hose Reels
- AS 2758.1 Aggregates and Rock for Engineering Purposes – Concrete Aggregates
- AS/NZS 2878 Timber – Classification into strength groups
- AS/NZS 3000 Electrical installations  
(Known as the Australian/New Zealand Wiring Rules)
- AS/NZS 3004 Electrical Installations - Facility and pleasure craft at low voltage
- AS 3519 Timber – Machine proof-grading
- AS 3566 Screws – Self drilling – For the building and construction industries
- AS 3600 Concrete Structures
- AS 3610 Formwork for Concrete
- AS 3660 Protection of buildings from subterranean termites.
- AS 3678 Structural Steel - Hot Rolled Plates, Floorplates and Slabs
- AS 3679 Structural Steel

AS 3679.1	Hot Rolled Bars and Sections
AS 3679.2	Welded Sections
AS 3750	Paints for steel structures
AS 3799	Liquid Membrane-forming Curing Compounds for Concrete
AS 3962	Guidelines for Design of Marinas
AS 3972	Portland and Blended Cements
AS 4100	Steel Structures
AS/NZS 4130	Polyethylene Pipe for Pressure Applications
AS 4671	Steel Reinforcing Materials
AS/NZS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
AS/NZS 4792	Hot-dip galvanised (zinc) coatings on ferrous hollow sections
AS4997	Guidelines for the Design of Maritime Structures
AS Z5	Glossary of Metal Welding Terms and Definitions
AWRA-AISC-	AWI Technical Notes, 6, 8 and 11
	AWI
BS 539	Covered Electrodes for Metal Arc Welding of Medium, High Tensile Structural Steel

#### 1.4.2 Guidelines

- NSW Maritime Authority “Engineering Standards and Guidelines for Maritime Structures” 2005.
- Former Public Works Department of NSW "Marinas Guidelines" 1987.
- Former Public Works Department of NSW “Design Guidelines for Wharves and Jetties”, August 1990.
- Coastal Council of NSW “Coastal Design Guidelines for NSW”.
- Management of Water and Waterside Lands Regulations - NSW.
- Navigation Act - NSW.
- “Shore Protection Manual, Volumes I and II” prepared by the Coastal Engineering Research Centre of the US Army Corps of Engineers 1984.
- Marine Pollution Regulation 2001.
- Ultimo/Pymont Public Domain Technical Manual.

#### 1.5 Site Information

Site information collated by the Principal is available for reference by the Contractor, including the following:

- Proposed Pontoon and Mooring/Berthing Facility at Dangar Island Public Wharf, Geotechnical Site Investigation Factual Report” prepared by SMEC in August 2012 provided in Appendix B.

- Contours shown on the drawings were determined using GPS located depth soundings and are indicative. The tolerance of the contours shown on the drawings is estimated to be +/- 0.3 m approximately. Details of this survey are available from the Principal.

Information made available by the Principal does not completely show the existing site conditions. The Principal is not responsible for any interpretation, deductions and conclusions made by the Contractor from the information made available and the Contractor shall accept full responsibility for any such interpretations, deductions or conclusions.

## 1.6 Principal Documentation

The Contractor shall not have any claim against the Principal in relation to the resolution of any ambiguity, lack of clarity or discrepancy contained in the Specification including the Principal Supplied Drawings or any performance criteria however specified.

## 1.7 Site Investigations

The Contractor shall undertake investigations of the site if required to obtain sufficient additional information for design and construction of the Works. The extent and nature of these investigations are at the discretion of the Contractor and could comprise any of, or more than, the following:

- survey of the seabed or of topography at the site: e.g. to better define levels and existing features;
- condition surveys and inspections: e.g. in order to be able to assess the impact of new works or the load carrying capacity of existing structures.

Where the findings of such investigations impact on the design or construction of the Works, it will be deemed that the Tender included adequate allowance for the findings of such investigations.

## 1.8 Programme

Within 2 weeks of entering into a contract with the Client, the Contractor shall submit a design and construction programme that is consistent with the Services and shall incorporate and be modified from time to time to incorporate:

- issues of "For Construction" documentation and revisions thereto;
- issue of design certification and revisions thereto;
- issues of shop drawings and revisions thereto;
- construction of the Works;
- issue of construction certification;
- issue of "As-Record" documentation;
- issue of operations and maintenance manuals;
- issue of the specification for ongoing maintenance and sign-off.

Prior to undertaking design tasks and during the course of design, the Contractor shall submit for approval, a Quality Assurance Plan in accordance with the ISO 9000 series, with design verification schedules approved by the Client. Design shall be carried out in accordance with the approved Quality Assurance Plan.

The Contractor shall give the Superintendent the opportunity to comment on and monitor the design and construction performance. The Contractor is responsible for development and completion of design including the Contractor's Drawings and Contractor's Specifications (including calculations) for the Project in accordance with this Specification.

## **1.9 Maintenance Manuals**

### **1.9.1 Operation And Maintenance Manual**

Prior to Completion, the Contractor shall provide a comprehensive operation and maintenance manual covering all aspects of the Works.

The manual shall include but not be limited to periodic inspection schedules, details of routine repairs and maintenance, details and specifications for regular replacement items. The manufacturer's manuals shall be included for proprietary items such as pontoon systems.

A draft copy of the operation and maintenance manual shall be submitted to the Superintendent for review and comment prior to the final submission.

### **1.9.2 Specification For Ongoing Maintenance And Engineer's Sign-Off**

The Contractor shall provide a specification for ongoing maintenance of the berth facilities to be constructed under this Contract. This specification shall include a description of the scope of structures and items to be inspected and shall also provide a regime of regular inspection and structural engineer's sign off on all regular maintenance works for a period of 7 years from Completion of the Project.

## **1.10 Contractor's Experience To Be Utilised**

The Contractor shall provide experienced personnel for design and for construction related tasks, who have undertaken similar projects involving design and construction of berthing facilities.

The Contractor shall carefully integrate previous experience on similar projects in establishing the appropriate structural makeup to suit constructability, form, function and aesthetics.

## 2 DESIGN AND DESIGN DOCUMENTATION

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### 2.1 Design Intent

#### 2.1.1 Purpose

It is recognised that different pontoon systems may have varying performance capabilities which may require variations to the spacing or location of piles, differences in gangway bracket details or other component details. The purpose of the Contractor's Design is to ensure that the Works, when constructed in accordance with the layout comply with the requirements of this Specification and the Drawings giving consideration to the unique features and capacity of the proposed pontoon system.

The Contractor must verify the design shown on the Principal Supplied Drawings, document the design and construct the work under the contract. The Principal is relying on the Contractor's knowledge, skill and judgement in carrying out the design and construction tasks.

The layout of the facility is shown on the Principal Supplied Drawings.

#### 2.1.2 Quality Of Workmanship And Finishes

The design and construction of the facility is to be carried out to a very high standard of quality with respect to appearance, heritage, minimisation of ongoing maintenance and consideration of residents (e.g. noise transmission). All materials, finishes and quality of workmanship shall be of superior standard. Finishes shall maintain their original appearance with only minimal maintenance. Fixtures shall be of an appropriate grade and finish of stainless steel or other corrosion resistant material such as aluminium.

#### 2.1.3 Noise Emissions

The design shall ensure that the completed installation will not generate intrusive noise likely to result in complaints from local residents such that:

- the sound level at any point on the adjoining boardwalk is not greater than the background levels specified in AS 1055;
- "offensive noise" as defined in the Noise Control Act is not generated.

The Contractor shall provide conclusive evidence that the completed installation will comply with these requirements.

#### 2.1.4 Service Life

The Contractor shall design the Works in accordance with the requirements of this Specification to achieve the service life tendered by the Contractor, or where no service life is tendered, a period of 25 years.

Service life shall be interpreted as the period of time during which the Works, when constructed in accordance with the design, shall perform safely and without significant deterioration but with fair wear and tear, assuming minor routine periodic maintenance will be carried out. Items in the Contractor's Design that are not capable of performing to this requirement or which would require significant maintenance at regular periods shall have been clearly indicated in the tender documentation. Any items not so identified shall be designed for a service life of 25 years.



## 2.2 Tender Submission By Contractor

As part of the tender submission of the Contractor, details shall have been provided as follows:

- a description of the pontoon system to be provided and evidence of proven satisfactory performance;
- layout and preliminary sizing of all structural elements except as follows:
  - (i) Piling layout and preliminary sizing only required if as set out in Section 1.3, a non-conforming pile layout is proposed.
  - (ii) Gangway – Layout and preliminary sizing of structural elements if the structural proposal is significantly different from the conforming layout on the drawings.
- routine inspection and maintenance for all components of the facility in the form of a Life Cycle Cost Plan, identifying and describing all expected maintenance activities and the cost of these activities over the design life of the facility.

The Contractor's Design documentation shall embody a design based expressly on that submitted in the Tender or as otherwise approved or accepted by the Client. The Contractor shall demonstrate that future maintenance requirements accord with the tender submission and also satisfy all requirements in this Specification. An updated Life Cycle Cost Plan shall be submitted prior to the design being completed.

It will be deemed that the Contractor undertook sufficient design calculations during the Tender phase to ensure that the facility proposed with his Tender is adequate to satisfy the requirements of this Specification. Acceptance of the Tender shall not be construed as the Principal having agreed with, or approved, the Tender design calculations. There shall be no increase in the amount to be paid to the Contractor as a result of subsequent changes made to the Tender Design.

## 2.3 Design Criteria

The design criteria used by the Contractor shall include all design criteria listed in the Specification and all other necessary design criteria to ensure that the Works comply with the objectives and intent of the project as described in this Specification. The Contractor's Design shall be carried out in accordance with this Specification.

## 2.4 Design Issues

### 2.4.1 Dead Loads

Dead load for the floating facility shall include all framing, decking, connection, flotation units, and all permanently attached equipment such as pipes, services modules, and gangways.

### 2.4.2 Vertical Live Loads

The minimum design vertical live load for the pontoons shall be 3.0 kPa for flotation requirements and 2.0 kPa for stability requirements.

The minimum design vertical load for the gangway shall be 3 kPa

All elements of the facility shall be designed for a concentrated load of 4.5 kN. In addition, the walkway pontoon shall be designed for the dead and live loads from the gangway roller support.

All elements of the facility shall be capable of withstanding a minimum horizontal load applied at deck level of at least 2.5% of the total maximum permanent and imposed loads.

### **2.4.3 Design Vessels**

The vessels berthing on the northern face are expected to be commercial ferry vessels typical operating on the Hawkesbury River. These vessels could be up to 20m long and 100 tonne.

The vessels using the temporary public day berthing facilities are expected to be small low profile vessels up to 6m in length.

### **2.4.4 Horizontal Live Load – 50 Year Return Interval Wind Load**

Wind loads are applied directly to the facility and indirectly to the facility through the action of wind on moored craft and pontoons. The windage areas, drag coefficient and wind speeds for calculation of wind loads on the design craft shall be as nominated in AS 3962 for the design vessel sizes specified. The design 10 minute average wind speed for 50 year recurrence interval from the West was estimated to be 27 m/s reducing to 22m/s for the North and East directions. The corresponding 1 year recurrence interval wind speeds were estimated to be 18 m/s and 14.5 m/s.

### **2.4.5 Horizontal Live Load – Wave Loading**

The facility shall be designed for wave loads due to boat wash and wind generated waves. The design shall consider the combination of boat wash and wind waves as generated in a 1 year return interval, and as calculated for waves generated in a 50 year return interval storm (no boat wash).

The site is considered to have a severe wave climate for the critical westerly fetch based on hind cast modelling method. The 1 yr recurrence wave height is estimated to be 0.6 m with a period of 3.3s. The 50 yr recurrence wave height is estimated to be 0.9m with a period of 3.9s. These values are likely to be extremely conservative.

### **2.4.6 Horizontal Live Load – Normal Berthing Impact**

The facility shall be designed to withstand the loads applied due to berthing impacts of the design vessels. The normal berthing velocities shall be taken as 0.3m/s. For the specified normal design berthing velocity, a  $C_e$  factor of 1.0 shall be adopted. In any event, a berthing force of not less than 10 kN per metre of berth face shall be allowed for in the design for the north face commercial vessel berthing. For the temporary public day berthing the berthing force shall not be less than 2 kN per metre of berth face.

### **2.4.7 Horizontal Live Load – Accidental Berthing Impact**

The facility shall be designed to withstand the loads applied during berthing impacts from design vessels having an accidental design berthing velocity being 50% greater than the normal as specified and  $C_e$  of 1.0. In this case, the acceptable degree of stressing may be increased above that used for normal berthing impact, but the facility must not deflect excessively.

### **2.4.8 Bollards**

Bollards shall be located so as to provide a satisfactory layout to restrain vessels under the design conditions.

### **2.4.9 Dynamic Effects**

The structure shall be designed to withstand dynamic effects. These effects shall include pontoon motion caused by the most critical wave conditions.

The design shall consider the response of the pontoon under load as well as the action of the pontoon system under wave action. The pontoons shall be proportioned and weighted such that persons walking along the pontoons should not feel uncomfortable or alarmed about loss of balance when the facility is subject to prevailing vessel wash or wave action. Furthermore, the motion of pontoons during service under design loads including wave effects shall be limited to ensure safe conditions for vessels, users and structures (including gangways) and shall be such that the peak horizontal acceleration or deceleration is not greater than 0.1g.

### **2.4.10 Tide Effects**

The design shall be suitable for tides ranging between Highest Astronomical Tide and Lowest Astronomical Tide. Tidal ranges are as specified on the Principal Supplied Drawings.

The site is subject to strong tidal flow and flood conditions.

### **2.4.11 Design Load Combinations**

Possible combinations of dead load, vertical live load and horizontal live load shall be considered in the design in accordance with AS 3962. It is not required to design for full vertical design live load during a 50 year return interval design storm condition.

### **2.4.12 Load Factors And Factors Of Safety**

Where considerations relating to factors of safety have been assessed with reference to a particular Standard or Code of Practice, follow the recommendations contained in that or related Standard or Code of Practice issued by the same organisation throughout in computing the attendant factors of safety. Design documentation shall state which Standard/Code of Practice is being followed in the design.

If no standards exist for factors of safety, establish the appropriate factors of safety to be used and submit for review. In establishing the factors of safety, the Contractor's Designer shall also refer to recognised design guidelines such as those published by the NSW Department of Transport - Roads and Maritime Services and Department of Public Works.

### **2.4.13 Freeboard, Draft And Stability Of pontoons**

Deck freeboard (height of deck above water level) of the pontoons under dead load only shall be as shown on the Principal Supplied Drawings. Draft of the pontoons under dead load only shall be sufficient to prevent excessive movements due to wave actions. pontoons shall float level under dead load. Additional flotation may need to be provided at ends of fingers to support the pile guides as well as at the start of the walkway to support the gangway.

When the design vertical live load is applied to the deck area of the pontoons and gangways, the freeboard shall not be less than 50mm. The opposite chine shall remain submerged under these conditions. The criteria regarding freeboard and chine immersion shall be satisfied under the most disadvantageous arrangement of live loading on any or all points of the pontoons and/or on the gangway.

The pontoons shall be stable under every load combination.

#### **2.4.14 Thermal Effects**

The design shall include, as appropriate, loadings and movements resulting from thermal effects as outlined in AS 1170.1 and Austroads Bridge Code – Section 2.9, considering both uniform temperature variations and differential temperature gradients.

### **2.5 Design**

#### **2.5.1 General**

The Contractor shall produce all designs and design documentation including:

- all necessary design, sketch and design development documents including design calculations;
- all necessary drawings, specifications, information and instructions necessary for the proper construction of the Works; and

#### **2.5.2 Design Resources**

Use persons professionally qualified in the relevant disciplines when completing the design. Notwithstanding that the Contractor is to use persons professionally qualified, whether Selected Subcontractors or not, the Principal relies upon the Contractor for the design and documentation to produce a finished product that is suitable for its intended purpose. The use of persons professionally qualified shall not relieve the Contractor of liability and the Contractor shall accept responsibility for their errors and omissions.

The Contractor shall have and maintain sufficient design resources (including personnel) to maintain sufficient expedition in the production of necessary Contractor's Designs and Drawings such that the Contractor shall not delay the Works.

Design documentation produced shall be consistent with the findings and outcomes contained within the calculations.

#### **2.5.3 Submissions Of Design Documents**

The Contractor shall submit design documents progressively to the Superintendent and relevant Authorities in sufficient time to enable the Client, and where appropriate, Authorities, to review and/or approve such documents by the dates or within the periods stated in the Contract.

#### **2.5.4 Design Calculations**

The Contractor shall provide a numbered, indexed and bound set of design calculations on completion, or if so requested by the Superintendent at any time before overall completion, for a given component of work. Calculations shall be complete with a description of the design philosophy, a description or checklist demonstrating compliance with the requirements of this Specification as a minimum, and contain all assumptions and references.

Calculations shall be in English, legible, easy to follow, free of arithmetical errors and be of a concise nature. Where computer programs are being used, a printout of the input data and results must be submitted together with a brief write-up on the theoretical background of the program utilised.

### **2.5.5 Design Drawings And As Built Drawings**

All Contractor's Drawings shall be of a standard consistent with normal engineering and construction practice. The Works shall be detailed on layout drawings to appropriate scales. Details of specific areas and sections shall be drawn to scales of either 1:50 or 1:20 as may be applicable. A suitable title block indicating the names of the Client, the Contractor and the Contractor's Consultant shall be agreed with the Superintendent and used thereafter on all drawings.

The Contractor's Drawings shall be "A1" in size and shall be produced on a computer aided drafting (CAD) system. Drawing digital files shall be provided to the Superintendent at appropriate stages of the design.

All drawing changes are to be clouded and changes appropriately recorded on each amendment issued.

The Contractor shall provide six (6) prints of Contractor's "As Record" Drawings which shall accurately reflect the as-built works.

Contractor's Drawings shall, in addition to the hard copies, be submitted in digital format in CD Rom in dwg (AUTOCAD) format and pdf format.

### **2.5.6 Specifications And As Built Record**

The materials and workmanship to be used in the Works shall be suitably described by the Contractor's Specifications prepared by the Contractor's design engineer and shall comply with the requirements of this Specification. Materials shall be specified according to available Australian Standards and their use shall be strictly governed by the stipulations contained in such Standards. Workmanship shall be in accordance with the various Australian Standards or Codes of Practice or according to accepted industry practices where no Australian Standards or Codes of Practice exist as such. However, where specific criteria are specified in this Specification those criteria shall be adhered to.

Requirements for testing shall be specified.

The Contractor shall provide six (6) prints and one electronic copy and disk of all Contractor's "As Record" Specifications which shall accurately reflect the as-built works.

### **2.5.7 Design Warranty**

The Contractor shall, in causing the Works to be designed, supervised, co-ordinated, controlled and executed, itself exercise such due skill and judgement in the performance of its obligations under this Contract as shall be necessary or requisite for those purposes and in particular the Contractor warrants to the Principal that:

- all designs for the Works and all Contractor's Plans, Drawings and Specifications for the Works and the construction methods, techniques, materials and workmanship employed in and about the construction of the Works in each case shall be suitable and adequate for their respective functions and purposes;
- the Works comply with and perform in accordance with this Specification;

## 2.6 Design Development

The Contractor shall not have any claim against the Principal in relation to:

- the resolution of any ambiguity, lack of clarity or discrepancy contained in the Specification or any performance criteria however specified;
- the development of initial design concepts which shall be evaluated and tested by relevant consultants on behalf of the Principal and the adjustment, redesign, re-evaluation as may be required by the Principal so as to provide the most suitable and adequate technical design of the Works as shall satisfy the design intent of this Specification;

all of which activities the Contractor shall be deemed to have fully allowed for in the Contract Sum. The only exception to the limitations contained in this sub-clause shall be where the Principal or the Superintendent shall require by notice in writing to the Contractor that a substantive change be made to the scope of the works contemplated by this Contract and in which case alone such change in scope shall be treated as a variation to this Contract and priced accordingly.

In completing the design, the Contractor shall participate in the processes described herein to the extent required by the Client.

## 2.7 Design Verification

The Contractor shall demonstrate and certify that all designs, computations, drawings and other design documentation has been verified and that the completed design and documentation fulfils all requirements of the law, including all relevant regulations.

The Contractor shall submit copies of all design checks and technical review records with calculations to signify that the requirements of the Specification have been satisfied. All design checks, verifications and technical reviews shall be in accordance with AS/NZS ISO 9001.

## 2.8 Review Of Design

The Contractor acknowledges that the Principal may engage specialist consultants to advise the Principal and report on the Contractor's design of the Works and whether the Contractor's design complies with the requirements of this Specification. The Contractor shall as part of its design obligations, provide all necessary documents and attendance on those consultants to enable the Contractor's design, documentation and construction to be checked, assessed and inspected for conformity to this Specification at all appropriate stages and as those consultants shall consider necessary. Should the Principal decide to carry out such review work itself then the provisions of this clause shall still apply. Time taken to inspect these items shall conform to an agreed procedure to meet the programme current at the time and not delay the Works or affect the progress of documents.

## 2.9 Responsibility For Design Documentation

No approval, consent, acquiescence or required amendment at any time made, given or required by the Client, or by any of its employees, agents or consultants shall at any time release, discharge or limit the obligations or responsibilities of the Contractor under this Contract.

## 2.10 Construction Phase Services

The Contractor shall ensure that the responsible Design Engineer continues to be involved throughout the construction phase of the Project to:

- verify that documents used by the Contractor and Subcontractors are appropriate and adequately define the quality standards to be met;
- ensure accordance with the design intent through periodic inspection and attending, where appropriate, meetings with construction subcontractors and suppliers.

## 2.11 Design For Durability

### 2.11.1 General

The Contractor must ensure adequate durability for all elements of the Works. Durability must be addressed by the Contractor in the design, specification, construction, operation and maintenance of all elements of the Works and must be included in the Quality Plan.

### 2.11.2 Specific Durability Requirements

Durability standards and guideline for the various materials and components used in all permanent structures must be in accordance with the relevant Australian Standards and the following additional requirements:

- Dense, durable high strength concrete must be used throughout. The minimum strength concrete shall be as specified herein and on the Principal Supplied Drawings. Concrete shall be properly cured to achieve the design requirements.
- Concrete mixes and cover to steel reinforcement shall be designed to ensure that the design life is achieved. Concrete mix design shall include the design for the curing regime, placement needs, finishing needs and prevention of deleterious effects of alkali aggregate reaction, carbonation, erosion, wear, delayed ettringite formation and sulphate attack. As a minimum the concrete mix shall meet the requirements as specified herein and on the Principal Supplied Drawings.
- Except where stainless steel or aluminium of a suitable grade is used, high performance coatings must be used on all exposed steel work except that to be galvanised.
- Attention must be given to deterioration of elements which cannot be easily accessed for maintenance or repair. The design must ensure that the durability of any such element is attained without maintenance.
- Special measures must be taken to minimise the possible deleterious effects of heat of hydration stresses in thick concrete sections, e.g. by the use of selected secondary cementitious materials or special curing or insulating regimes or both.
- In addition to the protective coatings the piles shall include the following corrosion allowances:
  - Top of pile to 1m below LAT            - 6 mm
  - 1m below LAT to sea bed                - 4 mm
- Epoxy coated reinforcement must not be used.

## **3 PROPRIETARY PONTOON SYSTEM**

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### **3.1 General**

This Specification including the Principal Supplied Drawings covers the standard of workmanship and quality of materials required for the design, manufacture, delivery, installation, commissioning and certification of the proprietary pontoon system.

The proprietary pontoon system shall have a proven history of performance in similar applications as that required for this project.

### **3.2 Positive Buoyancy**

The flotation units shall be of such a design as to remain positively buoyant following any damage, such as puncturing, to the shell or protective surface(s).

If hollow pontoon units are used, they shall be compartmentalised, such that puncturing of any compartment below the water line will not lead to (a) successive filling of other compartments; and (b) instability of the pontoon structure under dead load conditions. (That is, the minimum freeboard requirement is maintained with one breached compartment.)

### **3.3 Deck Finish For Pontoon and Gangway Landing**

The pontoon shall have a broomed concrete deck finish. The transition at the end of the gangway shall comprise aluminium tread plates with an appropriate non-slip finish. Details shall be provided for the Client's approval.

### **3.4 Mooring Bollards/Cleats**

Adequately sized bollards/cleats shall be provided to resist without failure the mooring line forces resulting from the action of wind, waves and currents on the design vessels and berthing forces. Bollards/cleats are to be marine grade aluminium.

### **3.5 Load Distribution**

Where the pontoon is made up of separate pontoons, load distribution throughout the facility shall be provided by designing a continuous system where pontoons are connected via a fully engineered and appropriately certified design. Where walers are used, they shall have splices capable of developing the full strength of the waler material. Alternate load distribution systems will be considered providing the system has a proven record of performance in similar locations and published testing by a recognised authority is available that verifies design assumptions and anticipated performance. Elastomeric hinged pontoon systems will not be accepted.

Loads shall be carried from the pontoons system through pile guides into the piles.

### **3.6 Pile Guides**

Pile guides shall be provided which adequately transfer the forces arising from the action of wind, waves and currents on the floating structure and the design vessels and of vessels berthing at the facility. The pile guides shall be designed to prevent the generation of noise and to avoid removal of protective coatings or excessive wear.



Consideration shall be given in the design of pile guides to possible torsional effects due to rotation of the pontoon under live load or wave action.

The gap between pile guide wearing pads and pile shall be as small as practical to minimise the effects of sudden movements of the pontoon.

The relative hardness between the wearing pad and the pile protective coating (if required) shall be such that the wearing pad wears in lieu of the pile protection.

### **3.7 Piles**

The facility shall be held in position by steel piles. Piles shall be placed in accordance with AS2159 and within the tolerances shown on the contract drawings. The piles shall be protected by a HDPE coating. Piles shall have bird resistant caps.

### **3.8 Fendering Strip**

Continuous moulded fendering shall be provided to the faces of all pontoons for chafing and abrasion protection of berthed vessels and pontoon edges. The fendering strip shall be D Rubber fender type MDS#373 or equivalent. Samples of alternative fender materials shall be provided to the Principal for review and shall not be used without approval.

### **3.9 Gangway**

The gangway shall be constructed from aluminium and be provided with a non-slip surface finish in accordance with AS4586. The gangway shall have a hinged pivot with stainless steel pins at the jetty end and be provided with a roller support on the pontoon. The gangway shall have hinged transition plates at each end with non-slip surface finish. The gangway shall be fitted with handrails and toe boards.

### **3.10 Materials**

#### **3.10.1 Materials Generally**

Materials used in construction shall resist the corrosive effects of the salt water environment and attack by marine organisms to ensure low maintenance and effective performance of the structures.

#### **3.10.2 Metalwork**

Metalwork shall be corrosion resistant or shall receive adequate corrosion protection.

Stainless steel shall be grade 316 or superior for the marine environment. Surface finish of stainless steel components shall be specified to ensure surface corrosion (tea staining) does not occur.

Aluminium shall be 6061-T6, 6063-T5 or 5083 -H321 grades. Dissimilar metals shall be isolated to prevent electrolytic corrosion.

#### **3.10.3 Fasteners**

All fasteners shall be corrosion resistant. Fasteners resisting stresses shall be stainless steel (minimum grade 316) or other non-corrosive material. Pontoon through bolts shall be galvanised or stainless steel (minimum grade 316), installed with a marine grade lanolin grease.

### **3.10.4 Timber**

Timber shall be a hardwood species suitable for use in a marine environment, such as blackbutt, tallowwood or turpentine (turpentine only in cases of immersion). Timber shall be treated for termites prior to installation.

## **3.11 Manufacture**

### **3.11.1 Extent Of Work**

The Contractor shall manufacture, or arrange manufacture by others as appropriate, the items listed below in accordance with this section:

- floating pontoons including all interconnections and fixtures;
- piles, sleeves and caps;
- pile guides and pile restraints;
- aluminium gangway including all interconnections;
- mooring bollards/cleats;
- services including modules and reticulation;
- durability systems (i.e. pile sleeves, galvanised steel, galvanised reinforcement, etc);

### **3.11.2 Standards**

Construction shall comply with the details shown on the Drawings, all appropriate Australian Standards and the requirements of all relevant authorities including, but not limited to, the NSW Roads and Maritime Services, Board of Fire Commissioners, Sydney Water, Hornsby Shire Council, WorkCover and the NSW Office of Environment and Heritage.

### **3.11.3 Working Drawings**

Fully dimensioned working drawings showing clear and complete details of each assembly, component and connection, together with all information relative to their fabrication and handling shall be prepared for all items.

## **3.12 Delivery**

Provide five working days notice to the Principal of delivery of goods.

Store and transport the goods in a manner which does not overstress, deform or otherwise damage the goods.

Unload the goods in an area of the site, approved by the Client, during normal working hours.

Make good any damage to items arising from storage, loading, transportation and unloading, at no cost to the Client.

## **3.13 Installation**

### **3.13.1 Standards**

The Contractor shall comply with the details shown on the approved drawings and specifications including this Specification. Installation shall comply with the detailed method

statement for installation of the facility to be supplied by the Contractor and approved by the Client, all appropriate codes, and the requirements of relevant authorities.

### **3.14 Services**

#### **3.14.1 General**

The facility shall be provided with the following services:

- electrical supply (single phase) for lighting.
- water supply

Suitable services modules shall be provided and located as specified in the Principal Supplied Drawings

#### **3.14.2 Services Module**

A services module shall be mounted on the public pontoon of a type as supplied by Marine Technologies or approved equivalent. The service module shall have a 240 volt power outlet. Provision for future services, ducts and pull wires are to be included. Future requirements include power and water supply for two additional service modules.

#### **3.14.3 Concealment Of Service Lines**

Service lines shall be concealed from general view by the use of cast in conduits or services trenches within the pontoon. Services shall not be attached to the underside of walers.

The services conduits shall extend to the middle of the western face of the pontoon to allow for future extension of the services.

#### **3.14.4 Water Supply**

The water supply to the service module shall be connected to an existing mains supply.

The Contractor shall carry out all necessary liaison with relevant authorities.

Water reticulation piping shall be high density polyethylene pipe with flexible hoses at gangways and elsewhere as required.

At the service module one-20 mm standard hose cock shall be provided. Hose cocks shall be chrome finish. Gate valves to isolate hose cocks shall be provided at each service module, located for access from the opening panel provided within the service module.

Reduced Pressure Zone Devices (RPZD) shall be installed.

Installation shall be in accordance with the water supply authority requirements and the system shall be tested by the Contractor prior to Completion.

#### **3.14.5 Electrical Supply**

The Contractor shall be responsible for the design and installation of electrical supply and reticulation to the pontoon from the onshore power board. Design and installation shall be in accordance with AS 3000 and AS 3004 and Supply Authority regulations.

The service module shall be supplied with one general power outlet (with 2.5mm<sup>2</sup> cabling).

All power outlets are to be protected by earth leakage core balance circuit breakers.

The Contractor shall obtain the necessary approvals from the Energy Australia for the electrical system and power supply.

### **3.14.6 Fire Protection**

Fire protection equipment for the pontoon is deemed to be provided by the Rural Fire Service vessel located at the end of the existing public jetty.

### **3.14.7 Lifebuoys**

At least one lifebuoy is to be provided. The lifebuoy is to have a lanyard which enables coverage of the pontoon for a distance of 10metres away from the pontoon. The lifebuoy is to be stored in a suitably marked stainless steel stand.

## 4 CONSTRUCTION PLANNING

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### 4.1 Contractors Responsibilities

The Contractor's responsibilities during the Construction Stage shall be to:

- (a) provide all personnel, plant and other resources necessary for and is to undertake and complete the design and construction of the services;
- (b) attend relevant site meetings, allow the Consultant and Superintendent to undertake regular inspections of the work and respond to and actively assist in the resolution of issued reports and non-conformances with respect to the Services and authority compliance;
- (c) provide a summary report each month of defects or non-compliances, areas of difficulty being experienced with progress of the work, co-ordination of other services, authority approvals. Deficiencies or problems of a serious nature shall be notified to the Superintendent and Consultant immediately in writing;
- (d) review relevant prototypes or samples submitted by the Client;
- (e) prepare documentation as may be reasonably required to co-ordinate and clarify the design during construction as requested by the Client;
- (f) undertake any off-site inspections reasonably required with respect to the Services and pay all associated costs in accordance with disbursement allowances;
- (g) liaise with the Superintendent and Consultant on all relevant project issues including but not limited to response to request for information and site instructions;
- (h) prepare and submit documents, drawings and reports as necessary for all relevant authority approvals and presentation to 3rd parties;
- (i) liaise with all relevant authorities for expeditious approvals and attend all meetings;
- (j) assist the Superintendent with any relevant tests and inspections required by the Contractor and authorities in obtaining all permits, approvals and certificates for the lawful use of the project;
- (k) submit to the Consultant for review and approval prototypes and samples, including site inspections at the various stages of material / plant completion;
- (l) submit reports to validate compliance against the specification;
- (m) maintain up-to-date drawings to reflect modifications to the Services made throughout the design and construction phase and issue these to the Consultant as they are produced;
- (n) provide an "As Record" for the elements of the Services of the Contractor;
- (o) provide assistance to the Superintendent during the defects liability period.

### 4.2 Construction Loads

The Contractor shall ensure that no excessive loads are placed on any part of the existing structure or the proposed Works during construction.

### **4.3 Construction Progress Warranty**

The Contractor's Designer shall make regular inspections of the Works throughout the construction period (no more infrequent than a weekly basis) and shall ensure that the Works are proceeding in accordance with the design intent and all the requirements of the design documentation.

### **4.4 Compliance With Statutory Requirements**

The Contractor shall observe and comply with all Acts, regulations, ordinances, by laws, orders and rules for the time being applicable to the Contractor in relation to the execution of the work under the Contract and with all directions and requirements of any Governmental or Local Government Semi-Governmental Authority lawfully applicable to the Contractor for the execution of the work.

### **4.5 Shop Drawings**

The Contractor shall provide to the Superintendent for review and approval all shop drawings, specifications, prototypes, samples and the like. The Contractor shall submit these to the Superintendent in time with and to an agreed procedure to meet the programme current at that time and not delay the works. Following review by the Client, the Contractor shall undertake all agreed amendments.

### **4.6 Submission Of Construction Documents**

The Contractor shall submit copies of the Contractor's Construction Documents progressively to the Client, by the dates or within the periods as established by the programming of work. The Contractor's Construction Documents shall embody a design for the Works based expressly on the Concept Design submitted in the Tender or as otherwise approved or accepted by the Client.

Construction work shall comply with the requirements of the design documentation.

### **4.7 Contractor's Floating Plant**

#### **4.7.1 General**

The Contractor shall be deemed to have considered the normal activities and vessel movements at the site and movements required to allow progressive completion of the Works at the site, and to have satisfied himself as to the effect of these upon operations in connection with the work under the Contract and to have allowed, in the Contract Sum for any possible interference to their operations from this source.

#### **4.7.2 Regulations**

Where the Contractor employs any type of floating plant for the work under the Contract, it shall be the Contractor's responsibility to comply with the provisions of all Acts and Regulations administered by the Superintendent in respect of all such plant which shall be surveyed and licensed under the Management of Water and Waterside Lands Regulations, NSW or the Navigation Act, NSW.

#### **4.7.3 Charges**

All charges levied by the Australian and State Governments and other Authorities arising out of the transfer of the Contractor's plant to and from the harbour, or from the presence

of the said plant in the harbour or adjacent waters shall be the responsibility of the Contractor. Such charges shall include all harbour charges levied by authorities and all customs duties where such charges are applicable and shall be included in and covered by the relevant item in the Schedule of Prices. No variation to the Contract Sum shall be made due to any duty of other payments which the Contractor shall be required to make in accordance with his responsibilities under this sub-clause.

#### **4.7.4 Buoys/Moorings**

The Contractor shall be responsible for providing and maintaining such buoys, moorings and fastenings, as may be necessary to secure his floating plant and also such marking buoys, piles, markers and lights as may be deemed necessary by the Superintendent to warn vessels of the existence of the Works, Temporary Works and Constructional Plant. The provision, installation, maintenance and removal of buoys, moorings, piles, markers and fastenings shall be at the sole risk of the Contractor and the Contractor shall be responsible for any accidents arising there from or damage caused thereby or thereto or which may arise through the failure of the moorings or fastenings, the breaking adrift of the buoys or their absence from their specified positions. The Contractor shall remove and clear away all such buoys, lights, piles, markers, moorings and fastenings when they are no longer required or when instructed by the Client.

## 5 CONSTRUCTION MATERIALS

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### 5.1 General

Materials to be selected for the Works shall be materials that have a proven history of durability and suitability for use on similar applications in a marine environment. If requested, the Contractor shall provide conclusive evidence that the materials nominated for use comply with all relevant clauses of this Specification. Materials used shall take into consideration the prevailing Australian Standards that govern such usage and the specific requirements contained in this Specification, in particular service life.

### 5.2 Concrete

#### 5.2.1 General

The Contractor shall submit this concrete Specification to the concrete supply subcontractor. Details of the mix designs for each specified class of concrete shall be provided by the Contractor for the Client's review not less than two (2) weeks prior to commencement of concreting operations. The details submitted shall include but not necessarily be limited to:

- (a) name of the concrete supplier and the proposed methods and degree of quality control;
- (b) class of concrete and verification that the Specification has been received and that the proposed mix meets the requirements of the specification;
- (c) proportions by mass of various materials comprising the mix, including chemical admixtures;
- (d) target strength;
- (e) target slump;
- (f) method of shrinkage control of precast elements;
- (g) other target parameters such as shrinkage, chloride ion penetration, crack width, etc.

Where ready-mixed concrete is supplied, copies of the manufacturer's certificate for each truck load of concrete shall be forwarded to the Superintendent immediately the certificate(s) becomes available.

#### 5.2.2 Standards

Concrete work shall comply with the current issue of the following Standards except where noted otherwise:

AS 1012	Methods of Testing Concrete
AS 1141	Methods for Sampling and Testing Aggregates
AS 1379	The Specification and Supply of Concrete
AS 1478	Chemical Admixtures for Concrete



AS 2053	Conduits and Fittings for Electrical Installations
AS 2350	Methods of Test for Portland and Blended Cement
AS 2758.1	Aggregates and Rock for Engineering Purposes – Concrete Aggregates
AS 3600	Concrete Structures
AS 3610	Formwork for Concrete
AS 3972	Portland and Blended Cements
AS 4671	Steel Reinforcing Materials
AS 3799	Liquid membrane-forming curing compounds for concrete

### 5.2.3 Particular Requirements

Concrete shall comply with AS 3600, for exposure classification C2, and shall comply with the following requirements unless otherwise accepted by the Client:

- minimum characteristic strength ( $f'c$ ) of 50 MPa;
- minimum clear cover to any reinforcement shall be 60mm for precast concrete with intense compaction – cover shall apply to dry drip groove apex or other such indentations, to ligature steel and to steel embedments.

The binder shall be composed of Type GP ordinary portland cement (conforming to AS 3972), and Fine Grade Fly Ash (conforming to AS 3982.1). A minimum binder content of 460 kg/m<sup>3</sup> shall be used. The minimum portland cement content in the binder shall be 420 kg/m<sup>3</sup> with up to an additional maximum of 40 kg of fly ash. The concrete shall have a maximum water:binder ratio of 0.35.

The concrete shall be sufficiently fluid to ensure ease of placement. Use of water reducing and superplasticiser admixtures to provide an initial slump (no superplasticiser) of 40 mm ± 10 mm and a final slump (with superplasticiser) of 120 ± 30 mm may be used.

Drying shrinkage values at 56 days shall be a maximum of 600 microstrain achieved in the field and to AS 1012.

Concrete shall be of low permeability to chloride ion penetration to reduce the risk of corrosion of embedded reinforcement. The concrete shall be designed to provide protection of embedded reinforcement against corrosion initiation for a period of 50 years. The Superintendent may require a rapid chloride ion penetration test in accordance with ASTM C1202-1991. Chloride ion penetration shall be less than 1,000 coulomb.

The finished concrete shall be free of cracks in excess of 0.1mm width at the Time of Completion. Any concrete having crack widths in excess of this shall be rectified at the Contractor's expense to the satisfaction of the Client. This requirement will be rigidly enforced.

### 5.2.4 Aggregate

Coarse aggregate shall be clean, hard, durable particles of crushed igneous rock or river gravel with a nominal maximum size of 20 mm. Aggregate shall be selected to achieve the required shrinkage strains.

Fine aggregate shall be dense, naturally occurring sand or rock, crushed, uncrushed or a blend of both. Limit blended crushed and uncrushed material finer than 75 micrometres to 5% maximum, to AS 1141.12.

Fine and coarse aggregate shall comply with AS 2758.1 - severe exposure condition and the sampling and testing of such shall comply with AS 1141. Prior to supplying concrete, furnish test certificates based on samples from the most recent production or from stockpiles for the project, for the properties listed below.

<u>Coarse Aggregate</u>	<u>Test Method</u>	<u>Clause No. AS 2758.1</u>
• Particle size and analysis	AS 1141.11	8.1.2
• Particle Density	AS 1141.6.1 & 2	7.1
• Water Absorption	AS 1141.6.1	7.3
• Particle Shape	AS 1141.14	8.3
• Los Angeles Abrasion Value and/or Sodium sulphate soundness	AS 1141.23	
	AS 1141.24	9.3.3
• Alkali Aggregate Reactivity		10
• Weak/Friable Particles	AS 1141.32	11
• Light Particles	AS 1141.31	12
• Sugar	AS 1141.35	14.2

<u>Fine Aggregate</u>	<u>Test Method</u>	<u>Clause No. AS 2758.1</u>
• Particle size and analysis	AS 1141.4	8.1.3
• Particle Density	AS 1141.5	7.1
• Bulk Density and Water Absorption	AS 1141.4	
	AS 1141.5	7.2 & 7.3
	AS 1141.6.1 or	
	AS 1141.6.2	
• Organic Impurities	AS 1141.34	14.1
• Sodium Sulphate Soundness	AS 1141.24	9.3.3
• Light Particles	AS 1141.31	12
• Sugar	AS 1141.35	14.2
• Soluble Salts	AS 1012.20	14.3

### 5.2.5 Water

Mixing water shall be fresh, clear, potable water.

### 5.2.6 Reinforcement

All reinforcement shall be hot dipped galvanised. Such reinforcement shall be cut and bent prior to galvanising. Galvanising shall be such as to provide at least 600g of zinc per square metre surface area. Where galvanised reinforcement is used in a part of the works, all steel reinforcement in that part of the works shall be galvanised, including ligatures, ties, tie-wire and bar-chairs. The galvanised reinforcement shall have no contact with any exposed metal fittings or bolts etc.

Reinforcement shall be provided as shown on the Drawings and shall comply with AS 3600.

Bar reinforcement shall comply with AS 1302. Fabric reinforcement shall comply with AS 1304.

Splices in reinforcement shall be made only in positions shown on the Drawings or otherwise approved in writing by the Client. Splicing of bars shall be staggered where possible.

Laps for splices in reinforcement where necessary shall comply with AS 3600 Section 13, but in no case shall laps be less than 25 times bar diameter (db).

Welding of reinforcement is not permitted except where shown otherwise on the approved structural drawings. Spot welding shall not be permitted.

Joggles to bars in column/pile splices shall be 1 times db over a length of 12 times db.

Fabric shall be lapped 2 transverse wires plus 50 mm in each direction.

Where transverse tie bars are not shown on the Drawings, provide a minimum of N12 at 400mm centres, spliced where necessary, and lap with main bars 400 mm unless noted otherwise on the Drawings.

All reinforcement shall be firmly supported and the specified cover achieved to all formed surfaces through the use of spacers.

Contact between reinforcement and metalwork which projects beyond the concrete surface shall be avoided. Where such contact cannot be avoided reinforcement shall be insulated with an approved tape.

A bar bending schedule shall be prepared by the Contractor and submitted to the Superintendent for his information and review, not later than two (2) weeks prior to the placement of any reinforcement.

### **5.2.7 Protection of Reinforcement from Corrosion**

All reinforced concrete to be constructed in a marine environment shall be treated to protect the steel reinforcement from attack by chlorine ions. Where specified or shown on the Drawings, carry out the following:

- install special reinforcement (e.g. stainless steel, galvanised, etc);
- treat the concrete by an admixture of corrosion inhibiting chemicals or organic pore-blocking chemicals or other substance;
- apply to the concrete surface purpose-manufactured chemicals such as silane.

#### Surface Protection

Unless specified otherwise, ALL concrete works other than plain (unreinforced) concrete in this contract shall be protected by the application of two flood coats of silane using Drytreat 100N or approved equivalent. All finished and exposed surfaces shall be treated.

### **5.2.8 Performance Testing**

A project assessment of concrete shall be undertaken by the Contractor in accordance with the requirements of Section 20 of AS 3600. The Contractor shall arrange for an Approved registered NATA Testing Laboratory to carry out concrete testing in accordance with the requirements of AS 3600 Section 20 and AS 1379. The cost of all such tests shall be borne by the Contractor. Test reports shall be supplied to the Superintendent within two (2) working days of testing.

Concrete shall be slump tested at site prior to the addition of superplasticiser. Slump testing shall be carried out in accordance with AS 1012.3 Method 1. Concrete from each ready mix truck delivery of concrete to the site shall be tested. The slump shall be deemed to be acceptable if it is within the permissible tolerance in AS 1379 for the nominal slump specified in Clause 5.2.3.

Sample, test and assess concrete for compliance with the specified compressive strength to AS 1379 Section 5 and Appendix B. Sampling shall be carried out to AS 1012.8 and 1012.9 using rubber capping when testing 100 mm cylinders. Prepare a minimum of two cylinder specimens for each sample. Each sample represents all the particular mix supplied since the previous sample. The following minimum sampling and testing frequency applies in addition to those in AS 1379 clauses B7.2 (b) and B7.3 (b).

No of batches per day	No of samples
1	1
2 to 5	2
6 to 10	3
11 to 20	4

### 5.2.9 Formwork

Formwork shall comply with AS 3610 and AS 3600.

The responsibility for the sufficiency of the whole of the formwork, including design certification, construction and performance, shall rest entirely with the Contractor.

Where coatings are to be applied to the finished concrete (e.g. silane), formwork de-bonding agents shall be compatible with the proposed coatings.

Unless otherwise approved, following concrete placement, formwork shall not be stripped until the minimum times indicated in AS 3610 Table 5.4.1 have elapsed.

Special care shall be taken to ensure that all salt contamination and debris is completely removed from the formwork immediately before placing the concrete.

### 5.2.10 Joints

Concrete work shall be carried out with the minimum number of construction joints necessary for the reasonable ease of placement of concrete.

Construction joints where not shown on the Drawings shall only be located to the approval of the Client.

If a construction joint is constructed in a non-approved location, due to unforeseen circumstances (e.g., equipment breakdown, interruption to concrete supply, etc), and the location of the cold joint is not in a suitable location structurally or aesthetically, the Superintendent will order the Contractor to remove concrete (green or hardened) back to a suitable location for a construction joint.

Construction joints shall be prepared in accordance with AS 3600, Rule 19.4. The hardened concrete from the previous pour shall be cleaned of all cement laitance and suitably prepared to expose coarse aggregate.

### **5.2.11 Embedments and Penetrations**

The Contractor shall be responsible for co-ordinating the embedment and penetration requirements of all trades.

Conduits, pipes etc shall only be located in the middle one third of slab depth and spaced at not less than 3 diameters or else as agreed by the Superintendent.

Embedments in and penetrations through the concrete shall be secured and supported (temporarily or permanently) so as to prevent movement during concreting. All such support in reinforced concrete shall comply with the requirements for minimum cover.

### **5.2.12 Cast in Sockets**

All sockets cast in concrete, to be subsequently used to attach other items, shall be stainless steel sockets similar to Rawplug "Schroeder P24". Likewise all holding down bolts cast in concrete, to be subsequently used to attach other items, shall be stainless steel, or as otherwise specified.

### **5.2.13 Metalwork**

All metalwork required to be attached to or built in concrete shall be fixed accurately to the required lines and levels and firmly and solidly attached or built in.

### **5.2.14 Inspections**

The Contractor shall make a thorough inspection of completed formwork, reinforcement embedments and penetrations to ensure that the works comply with the details shown on the Drawings. The Contractor shall make a detailed record of the inspection and provide a copy of this record to the Superintendent at least 24 hours prior to concreting. The Superintendent may make an inspection. No concrete shall be delivered until formwork, reinforcement, embedments and penetrations as fixed in place have been approved.

### **5.2.15 Mixing**

Concrete mixing shall comply with AS 3600, Section 19. When ready-mixed concrete is used, all equipment used for batching, mixing, agitating and transporting the concrete shall be in accordance with AS 1379.

### **5.2.16 Placing and Compaction**

Concrete placing shall comply with AS 3600, Section 19.

No concrete shall be placed during periods of heavy rain or high winds.

Concrete shall not be placed on days where the temperature is likely to exceed 32°C. When the ambient temperature exceeds 25°C for freshly placed concrete, shelters shall be erected to prevent sunlight landing on the concrete.

The finished concrete shall be a dense homogeneous mass, completely filling the formwork, thoroughly embedding the reinforcement and free of stone pockets and honeycombing. Concrete shall be compacted with immersion mechanical vibrators.

### **5.2.17 Finish**

Where concrete is to be retained by formwork the struck concrete shall have a class 3 finish to AS3610.

Unformed concrete surfaces shall have a wood float finish, except those areas which will be subject to traffic, including foot-traffic, which shall have a stiff broom finish.

### **5.2.18 Curing**

Concrete curing shall comply with AS 3600 Rule 19.1.5 except where varied by this clause of the Specification.

Curing of insitu concrete is to be achieved by keeping surfaces continuously wet for a period of 7 days and prevention of loss of moisture for a total of 14 days, followed by a gradual drying out.

Sprayed on curing compounds shall not be used where the concrete will receive subsequent concrete, or where floor finishes are proposed, or where the concrete surface will subsequently be treated to prevent ingress of salt water (e.g. with silane or similar).

Polythene sheeting or wet hessian may be used where it is protected from wind and traffic.

### **5.2.19 Ready Mixed Concrete**

The use of ready mixed concrete will be permitted from an approved plant only. Advice of the plant to be used shall be furnished to the Superintendent at least two (2) weeks prior to the proposed date of supply.

### **5.2.20 Precast Units**

#### **5.2.20.1 General**

Precast units comprise all concrete elements manufactured in other than their final position as shown on the Drawings.

Each precast unit shall be identified by marks which shall:

- remain legible until after the unit has been fixed in place;
- not be visible in the complete structure;
- show the date of casting;
- show the correct orientation of the unit.

Precast units shall comply with the safety requirements of AS 3850.1.

#### **5.2.20.2 Precast Concrete Specification**

The precast concrete specification shall comply with this concrete specification.

#### **5.2.20.3 Handling Precast Units**

Precast units shall not be lifted or supported at points other than those specified by the manufacturer, unless approved by the Client. The handling methods used shall be such that they do not overstress, warp or damage the units.

Each lifting device on the precast unit shall be designed for a working load not less than 1.65 times the maximum calculated static load at that point and an ultimate load not less than 4 times the maximum static load.

Lifting attachments, holes and other temporary fixings for handling purposes shall not be placed on visible faces without prior approval of the Client. For recess lifting attachments such as ferrules, or other types of cast-in fixings, an approved plug for sealing shall be provided. Temporary attachments shall be removed after erection. Any residual recesses shall be sealed or otherwise made good.

The Contractor's proposals for lifting of all precast units shall be submitted to the Superintendent for review at least five (5) days prior to lifting.

#### **5.2.20.4      *Installing Precast Units***

Precast units shall be fixed securely in their final positions within the specified tolerances. The Contractor shall supply the necessary components and materials for installation, including fixings, braces, shims, jointing strips, sealant, flashings, grout, mortar and the like.

#### **5.2.20.5      *Transporting Precast Units***

The Contractor shall transport members in a manner which does not damage the members.

If members are required to be supported on a delivery vehicle in a manner other than stated in the drawings or specification, the Contractor shall, prior to transport, submit to the Superintendent a certificate from an Engineer eligible for Corporate Membership of the Institution of Engineers, Australia, stating that the proposed method will not overstress the member.

No member shall be transported to site until at least seven days after casting and until the concrete has reached adequate strength.

The Contractor shall submit to the Superintendent a transport and handling plan two (2) weeks prior to commencement of fabrication of the precast elements.

#### **5.2.20.6      *Formwork of Precast Units***

Formwork shall comply with the requirements of this Specification. The formwork shall be assembled and checked before each major production run or after any major modifications, and a dimensional check made to verify the size of the members.

#### **5.2.20.7      *Certification of Precast Units by the Contractor***

Prior to members being incorporated in position in the Works, the Contractor shall submit to the Superintendent a certificate for each member which states that it conforms to the Specification and that all non-conformances have been rectified. The certificate shall be accompanied by a checklist for each member, verifying conformance.

### **5.3 Steelwork**

#### **5.3.1 General**

The Contractor shall provide steelwork to the requirements specified herein and as shown on the Drawings.

### 5.3.2 Standards

Unless otherwise specified herein all steelworks shall comply with the current editions of the following Australian Standards, Codes and Specifications as appropriate.

#### Steel

AS 1163	Structural Steel Hollow Sections
AS 1444	Wrought Alloy Steels - Standard and Hardenability Series
AS 1449	Wrought Alloy Steels - Stainless and Heat Resisting Steel Plate, Sheet and Strip
AS 1657	Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation
AS 1664	SAA Aluminium Structures Code
AS 3678	Structural Steel - Hot Rolled Plates, Floorplates and Slabs
AS 3679	Structural Steel
AS 3679.1	Hot Rolled Bars and Sections
AS 3679.2	Welded Sections

#### Electrodes

AS 1167	Welding and Brazing - Filler Metals
AS 1167.2	Filler Metal for Welding
AS 1553	Covered Electrodes for Welding
AS 1553.1	Low Carbon Steel Covered Electrodes for Manual Metal-Arc Welding of Carbon and Carbon-Manganese Steels
AS 1553.2	Low and Intermediate Alloy Steel Covered Electrodes for Manual Metal-Arc Welding of Carbon Steels and Low and Intermediate Alloy Steels

#### Mild Steel Bolts, Nuts and Washers

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
AS 1252	High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering



## Workmanship

- AS 1101 Graphical Symbols for General Engineering
- AS 1101.3 Welding and Non-Destructive Examination
- AS 1554 SAA Structural Steel Welding Code
- AS 1674 Safety in Welding and Allied Processes
- AS 1796 Certification of Welders and Welding Supervisors
- AS 2214 Certification of Welding Supervisors - Structural Steel Welding
- AS 4100 Steel Structures
- AS Z5 Glossary of Metal Welding Terms and Definitions
- AWRA-AISC- AWI Technical Notes, 6, 8 and 11

### AWI

- BS 539 Covered Electrodes for Metal Arc Welding of Medium, High Tensile Structural Steel

## Surface Preparation

- AS 1627 Metal Finishing - Preparation and Pretreatment of Surfaces
- AS 1627.4 Abrasive Blast Cleaning
- AS 1627.5 Pickling, Descaling and Oxide Removal

## Hot Dip Galvanising

- AS 1214 Hot-Dip Galvanised Coatings on Threaded Fasteners
- AS 1650 Hot-Dipped Galvanised Coating on Ferrous Articles

## Testing

- AS 1171 Methods for Magnetic Particle Testing of Ferromagnetic Products and Components
- AS 1391 Methods for Tensile Testing of Metals
- AS 1710 Non-Destructive Testing of Carbon and Low Alloy Steel Plate - Test Methods and Quality Classification
- AS 1815 Metallic Materials - Rockwell Hardness Test

AS 1816 Metallic Materials - Brinell Hardness Test

AS 2177 Non-destructive Testing - Radiography of Welded Butt Joints in Metals

AS 2207 Non-destructive Testing - Ultrasonic Testing of Fusion Welded Joints in Carbon and Low alloy Steel

### **5.3.3 Stainless Steel Components**

Stainless steel shall conform to AS 1444-1986 and AS 1449-1994. All stainless steel components shall be passivated as specified herein.

The Contractor shall provide all labour, tools, plant materials and everything necessary for the passivation of stainless steel items or welded areas on stainless steel.

Cleaning and passivation shall be carried out before installation to ensure that the protective chromium oxide film is fully effective.

Bolts, nuts and washers and other small items should be cleaned and passivated by an overnight soak in 15% dilute nitric acid followed by a thorough washing in fresh water.

Welded areas on fabricated stainless steel items shall be passivated by treating with "SANDVIK" Pickling Paste or approved equivalent used strictly in accordance with the manufacturer's printed directions.

Items too large to be treated using the method outlined above should be treated using "SANDVIK" Pickling Paste or approved equivalent used strictly in accordance with the manufacturer's printed directions.

Passivation should take place outdoors or in a well ventilated room because of the risk of gas emission.

Persons working with nitric acid or pickling paste should be equipped with rubber gloves, rubber boots, rubber apron and a guard protecting the face.

### **5.3.4 Hot Dip Galvanising**

All mild steel bolts, nuts, washers, nails and other fixings, mooring cleats and bollards and bracing rods shall be hot-dip galvanised unless otherwise specified or agreed with the Client. Hot-dip galvanising of fasteners such as bolts, nuts and washers shall be in accordance with AS 1214.

Prior to galvanising, the surfaces shall be cleaned of all dirt, weld spatter, grease, slag, oil, paint or other materials deleterious to the zinc coating.

Steel surfaces shall be abrasive blast cleaned in accordance with the provisions of AS 1627.4 to provide a standard of surface preparation of Class 3 as defined in AS 1627.4 or, alternatively, shall be chemically descaled in accordance with the provisions of AS 1627.5.

The zinc coating shall consist of a uniform layer of commercially pure zinc free from abrasions, cracks, blisters, chemical spots or other imperfections, and the coating shall adhere firmly to surface of the steel. The quality of galvanising shall be in accordance with the provisions of AS 1650.

Any damage to surface treatment shall be repaired to provide a coating consistent with the original surface preparation and treatment.

### **5.3.5 Welding**

All electrodes, welding techniques, procedures and personnel shall comply with the requirements of AS 1553 and AS 1554.

All welding shall be in accordance with AS 1554 Part 1.

Welding electrodes shall be series E48XX in accordance with AS 1553 and approved prior to commencement of fabrication.

All welds shall be continuous type SP in accordance with AS 1554.

A weld once started shall be completed without any interruption or delay. Structural protection shall be provided against adverse weather conditions and draughts during welding operations.

Particular care is to be taken to avoid distortion of welded sections and the cracking of welds where the geometry of the joint as well as the metal thickness may affect the cooling rate and tend to produce distortion.

Where any field welding is to be carried out care shall be taken to accurately align and handle the sections prior to and during welding.

Any welds which are defective or unsound shall be removed, replaced or otherwise corrected in accordance with Clause 5.8 of AS 1554 Part 1.

Weld testing may be carried out using radiographic, ultrasonic or other means.

The first test on each weld will be carried out at the Contractor's expense. Any further testing required as a result of the discovery of a defective weld shall be carried out at the Contractor's expense.

Radiographic testing of welds shall comply with AS 2177 Part 1, "Radiography of Welded Butt Joints in Metal - Methods of Test". Ultrasonic testing of welds shall comply with AS 2207, "Methods for the Ultrasonic Testing of Fusion Welded Joints in Steels".

All welds to be tested (100%) by radiographic ultrasonic means. Weld testing records have to be kept and copies submitted to the Client.

### **5.3.6 Fixings**

#### **5.3.6.1 General**

"Fixings" shall be deemed to include bolts, nuts, washers, screws, nails and the like for the securing of members. All mild steel fixings shall be hot-dip galvanised.

#### **5.3.6.2 Standards**

Bolts shall be in accordance with AS 1111 or AS 1252 as appropriate.

Threaded rods shall be in accordance with AS 1111 where applicable.

Nuts shall be in accordance with AS 1112 or AS 1252 as appropriate.

Washers shall be in accordance with AS 1237 or AS 1252 as appropriate, unless noted otherwise.

### 5.3.6.3 Materials and Workmanship

Where lengths of bolts, threaded rods and coach screws are given on the Drawings, it shall remain the responsibility of the Contractor to ensure that the lengths are adequate, due regard being given to all dimensional tolerance.

The length of each bolt shall be such that the threaded portion will project through the nut by at least one and one half complete threads.

All fixings cast in concrete shall be stainless steel unless otherwise specified or noted on the Drawings.

Single washers shall be used against timber (without timber packing) behind all nuts and bolt heads. The tops of all bolt heads shall be recessed to approximately 6 mm below the timber surface.

The sizes of washers shall be in accordance with the dimensions given below:

Nominal Bolt Diameter	Width Across Edges mm	Thickness mm	Hole Diameter mm
M16	60	6	18
M20	65	6	22
M24	75	8	26
M30	100	10	32

### 5.3.6.4 Tightening and Protection of Bolts and Nuts

At the end of the construction period and again within four weeks prior to the end of the defects liability period, the Contractor shall ensure that all bolts securing timber members and all other fixings are tight. The Superintendent shall be advised in writing 2 weeks prior to this work being carried out by the Contractor.

Following the testing of torque on bolts, at the end of the construction period, the nuts and the bolt-ends protruding beyond the nuts, shall be painted with two coats of an approved aluminised protective mastic coating such as "Butaramel HB Silver" by Bituminous Productions Pty Ltd. After the final tightening of the bolts prior to the end of the defects liability period, the nuts and bolt-ends shall be repainted with two coats of "Butaramel HB Silver" and then coated with knife grade "Pabco Hydroseal".

## 5.4 Aluminium Work

### 5.4.1 General

The work shall comprise the supply, fabrication and erection of all structural aluminium shown on the drawings including surface treatment and storage, deliver to the site, connections and their fastenings. The work shall be carried out in strict accordance with the approved Drawings and Specifications.

### 5.4.2 Standards

Comply with the following standards:

AS 1428      Parts 1, 2, 3 and 4

AS 1664	SAA Aluminium Structures Code
AS 1665	SAA Aluminium Welding Code
AS 1588	Filler Rods for Welding
AS 1734	Aluminium and Aluminium Alloys - Flat Sheet, Coil Sheet and plate
AS1866	Aluminium and Aluminium Alloy - Extruded rod, bar, solid and Halcon Shapes
AS 2177.1	Non destructive testing - radiography of welded butt joints in metal 1994
AS 2207	Non destructive testing - ultrasonic testing of fusion welded joints in carbon and low alloy steel 1994

### **5.4.3 Materials**

Structural aluminium sections are to be suitable for the intended purpose and shall be Grade 6061-T6 or better. Aluminium plates are to be Grade 5083-H321 or better.

### **5.4.4 Inspection**

Give 3 working days notice so that inspection may be made at the following stages:

- aluminium work in the workshop prior to completion of fabrication;
- aluminium work on site prior to erection;
- completion of erection.

### **5.4.5 Shop Drawings**

Prepare shop drawings showing clear and complete details of each assembly, component and connection, together with all information relative to their fabrication, surface treatment and erection. Submit 3 copies copy of each drawing to the Superintendent 5 working days before the proposed date for commencement of fabrication and obtain permission to fabricate. Conform to AS 1428 Parts 1, 2, 3 and 4 for handrails.

### **5.4.6 Fabrication**

Fabricate as shown on the Drawings and as described in AS 1664 and AS 1665. Carry out and complete fabrication in the workshop. site operation where necessary shall be placed in positions of easy access and shall only be carried out with the approval of the Client.

### **5.4.7 Welding**

All electrodes, welding techniques, procedures and personnel shall comply with the requirements of the following:

- AS 1665 Aluminium Welding Code

All welding shall be carried out using MIG or TIG processes. All weld spatter shall be removed.

The filler rods to be used shall be as follows:

- (i) Alloy 5356 where extrusions in alloy 6061 are welded to plates in alloy 5083;
- (ii) Alloy 4043 where two sections in extrusion alloy are welded together.

A weld once started shall be completed without any interruption or delay. Structural protection shall be provided against adverse weather conditions and draughts during welding operations. Cutting of sections and plates by an approved means will be allowed. After all such cuts rough edges shall be cleaned off and chipped or ground flush in accord with good workshop practice.

Particular care is to be taken to avoid distortion of welded sections and the cracking of welds where the geometry of the joint as well as the metal thickness may affect the cooling rate and tend to produce distortion. All welds shall be continuous and all hollow sections shall be effectively sealed by welding to prevent ingress of moisture.

Any welds which are defective or unsound shall be removed, replaced or otherwise corrected in accordance with AS 1665.

Field welding will not be permitted without the approval of the Client.

### **5.4.8 Testing**

Provide a representative sample of not less than 10% of weld test results.

Testing of welds by radiographic ultrasonic or other means may be carried out at the discretion of the Client.

If the Superintendent advises the Contractor that a weld is to be tested the Contractor shall give the Superintendent forty-eight (48) hours notice in writing as to when the weld will be completed and ready for testing.

The testing of welds is to be carried out at the Contractor's expense. Any further testing required as a result of the discovery of a defective weld shall be carried out at the Contractor's expense. Any waiting time due to carryout out the above tests shall be at the Contractor's expense.

Radiographic testing of welds shall comply with AS 2177.1.

Ultrasonic testing of welds shall comply with AS 2207.

Weld testing records have to be kept and copies submitted to the Client.

## **5.5 Timber Work**

### **5.5.1 Scope**

This section of the Specification covers the quality of materials, the standards of workmanship and the methods of testing to be used in the supply and installation of timberwork.

### **5.5.2 Standards**

Materials, workmanship and testing shall comply with the requirements of the latest editions of the following Standards including any amendments thereto to the extent that they are relevant and are not overridden by this Specification.

Australian Standards:

AS 1080	Methods of Testing Timber
AS 1111	ISO metric hexagon commercial bolts and screws
AS 1143	High Temperature Creosote for the Preservation of Timber
AS/NZS 1393	Coach screws
AS/NZS 1604	Timber – Preservative treated – Sawn and round
AS 1684	National Timber Framing Code
AS 1720	SAA Timber Structures Code
AS 2082	Visually Stress-Graded Hardwood for Structural Purposes
AS 2159	SAA Piling Code
AS 2209	Timber – Poles for overhead lines
AS 2334	Steel nails – Metric series
AS 2543	Nomenclature of Australian Timbers
AS/NZS 2878	Timber – Classification into strength groups
AS 3519	Timber – Machine proof-grading
AS 3566	Screws – Self drilling – For the building and construction industries
AS 3660	Protection of buildings from subterranean termites.
ASO 1	Glossary of Terms used in Timber Standards
SAA INT 365	Piles (Eastern Australian Hardwoods)

### **5.5.3 Inspection**

All timber shall be inspected by an officer of State Forests before delivery at the Contractor's expense. Inspection Certificates certifying compliance of the timber with the Specification shall be submitted to the Superintendent prior to incorporation of the timber in the work.

Officers of the State Forests may, on application by the Contractor, inspect timber before it is consigned from railway stations or wharves. This inspection and approval of timber however will not relieve the Contractor of his responsibility to deliver it in sound condition nor of any other obligation imposed by the Subcontract. Should the Superintendent find that any portion of the timber has become damaged or rendered unfit during delivery it will be rejected and replaced by the Contractor at the Contractor's expense.

### **5.5.4 Timber Species and Stress Grade**

Timber shall be selected from the following species:

- Decking - grey gum, white mahogany, tallowwood, grey box or blackbutt.

- All other timbers - grey ironbark, grey gum, white mahogany, tallowwood, grey box, yellow stringybark, white stringybark, woollybutt, forest red gum or blackbutt.

Except timbers with some part permanently fixed below mean high water mark which shall be turpentine.

Unless shown otherwise on the Drawings, all sawn timbers shall be of stress grade F17 in accordance with AS 1720 and AS 2082. Log timbers shall be stress grade F22.

### **5.5.5 Quality of Deck Timber and Timber with Least Dimension Less Than 150mm**

Sawn timber with least dimension less than 150mm shall be straight, with ends cut square. It shall be free from impairing grub holes, live insects, termite galleries, decay, knots other than sound intergrown knots, knot holes, splits, transverse or right shakes, impairing gum pockets, sapwood, wane or want, excessive gum veins which are exposed on the face of the piece and will permit lifting of the adjacent surface and any other defects liable to impair the utility of the piece. Unless otherwise specified, timber shall be free from heart and sapwood.

#### Defects in Timber

Limited defects will be permitted as follows at the time of grading for the bottom and sides of deck timber and for other timbers:

- borer holes not exceeding 3 mm in diameter, or other holes measuring from 3 mm to 6 mm diameter, not to exceed one per 0.06 square metres;
- grub holes situated not more than 450 mm from the ends of the piece;
- loose gum vein up to 3 mm width, provided that they do not permit shelling of the corners or appear on the exposed face of deck timber;
- gum pockets, provided that they occur on the lower two-thirds (2/3) of the edges, or on the lower side, and that there are not more than one in any 1.8, linear metres;
- sound intergrown knots, not exceeding one-quarter of the width of the surface on which they occur except on the face side of deck planks where only one knot, up to 30 mm wide over a 1,500 mm length of plank is permitted;
- cross grain, provided it does not exceed 1 in 15.

The upper (sawn) face of deck timbers shall be free of the following defects:

- loose and unsound knots;
- shakes;
- loose gum veins;
- knot holes;
- termite galleries;
- wane, wane & bark;
- checks wider than 1 mm;



- (h) end splits wider than 1 mm;
- (i) included bark;
- (j) borer holes larger than 3 mm;
- (k) additionally permitted defects shall not cover more than 15% of the top face.

#### Dimension Tolerances on Timber (Other than Deck Timbers)

Size and shape of timbers other than deck planks and the like, shall conform to the following requirements:

- (a) material shall be uniformly sawn full to the dimensions specified with the following maximum tolerances:

Width + 6 mm - 3 mm

Thickness + 1.5 mm - 1.5 mm provided that not more than 50% of the timber will be below the full size specified, and that the maximum variation in width of any one piece shall not exceed 6 mm except for decking timbers (refer Fixing of Timber);

- (b) spring - shall conform with AS 2082, sub-clause 1.9.2;
- (c) bow - shall conform with AS 2082, sub-clause 1.9.2;
- (d) twist - shall conform with AS 2082, sub-clause 1.9.3.

#### Dimension Tolerances on Deck Timbers

Timber planks used for decking subject to pedestrian traffic shall be sawn on the upper wear face and machined on the other three sides to the following requirements:

Deck plank material shall be machined to tolerances:

Width + 1 mm - 1 mm

Thickness + 0.5 mm - 0.5 mm.

The top edges shall have a 3 mm arris to reduce splintering.

### **5.5.6 Handling and Stacking of Timber**

All timber shall be stacked on site, after delivery, clear of the ground by using adequate supports and all necessary precautions shall be taken to ensure that the timber does not deteriorate or suffer any damage. The handling and stacking of timber shall at all times be such as to avoid surface and edge damage.

All timber products shall be kept covered at all times to prevent damage from the rain.

### **5.5.7 Fixing of Timber**

All timber members shall be fixed by the Contractor in accordance with the Drawings. Butting or splicing, other than shown on the Drawings, will not be permitted without prior permission from the Client.

Deck timbers shall be fixed with stainless steel screws at each support carried out in a regular pattern or to match existing installation where decking is an extension of the existing. Detailing of fixings shall minimise the chances of timber splitting.

Timberwork shall be executed using normal techniques of bridge and wharf carpentry. Deck planks to be fixed shall be cramped against the previous fixed planks before fixing. All joints shall be neatly made in order to obtain a tight fit; wedging or packing shall not be permitted. Unless otherwise specified or shown on the Drawings each piece of timber used shall be continuous throughout its length, and the ends of the timber shall be sawn square and wrought true at all contacting surfaces.

Decking timbers shall be sorted so that variations in height between adjacent deck planks are no greater than 1.0 mm. If variations in surface level occur between adjacent planks which are greater than 1.0 mm, the thicker plank shall be planed over one-third of its width to reduce the height difference.

Ensure that all timber decking members are placed heartwood downwards to prevent premature deterioration due to ponding of water upon drying shrinkage.

The Contractor shall construct a representative sample of the timber deck having an area of at least 4.0 metres square. The sample is to be prepared for the Client's inspection and approval before proceeding with construction of the timber decking. The approved timber decking sample may be incorporated within the works. The Contractor is advised that the timber deck will be used by pedestrians and cyclists and therefore the standard of surface finish must comply with the specified tolerances.

### **5.5.8 Protection of Cuts, Recesses and Interfaces**

The exposed ends of all timbers and all cut or trimmed surfaces exposing end grain and all bolt holes and bolt recesses shall be protected with a liberal coating of copper naphthenate emulsion.

Any part of the timber which is cut or trimmed shall have the cut surface spread liberally with boron based preservative coating to fill all surface irregularities before bringing the mating surfaces together. Both the mating surfaces shall receive the coating. Adequate amount of coating shall be applied to ensure that it completely seals the mating surfaces when the fasteners are tightened.

All bolt holes in timber shall be filled with adequate quantity of injectible boron based timber preservative to ensure that when the bolt is inserted in the hole, the clearance space between the bolt and the hole is completely taken up and preservative oozes out of the other end of the hole.

Prior to inserting bolts, all recesses for bolt heads in timber shall be filled with preservative.

All horizontal contact surfaces between timbers shall be coated with preservative prior to laying of 2 ply malthoid. A continuous layer of 2 ply malthoid shall also be laid on the top of the girder members supporting the decking timbers after two flood coats of boron based preservative. The malthoid shall extend a minimum of 20 mm beyond the contact surface and shall be turned down, and tacked if necessary, to shed water.

The top surface of all headstocks shall be given two flood coats of boron based timber preservative.

For timber kerbing, the underside of the kerb and packers in contact with another surface shall be coated with preservative, in accordance with the manufacturer's recommendations.

Bolts in the top of horizontal members where recessed are to have the depressions filled with “Porion Exterior Flexible Filler” (Timbermate Products) or approved equivalent after the bolts have been tightened.

Exposed bolts and nuts shall be protected after the bolt has been finally tightened as follows. The nuts and the bolt-ends protruding beyond the nuts, shall be painted with two coats of an aluminised protective mastic coating. After the final tightening of the bolts prior to the end of the defects liability period, the nuts and bolt-ends shall be repainted with two coats of the aluminised protective mastic coating.

## **6 INSTALLATION OF PILES**

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### **6.1 General**

Except as modified herein the installation of piles shall be in accordance with the provisions of Section 4 of AS 2159-1995. The Contractor shall maintain a copy of AS 2159 on site at all times during the contract period and shall make the copy available to the Superintendent if requested to do so by the Superintendent.

### **6.2 Standards**

All materials, workmanship and testing shall comply with the requirements of the latest issue of the following documents, including amendments, to the extent that they are not overridden by the Specification.

#### **6.2.1 Australian Standards:**

##### **Timber**

- AS 1720 Timber structures – Part 1: Design methods
- AS 2159 Piling – Design and installation

##### **Concrete**

- AS 3600 Concrete Structures

##### **Steel**

- AS 1163 Structural steel hollow sections
- AS 1553 Covered electrodes for welding
- AS/NZS 1554 Structural steel welding
- AS 1674 Safety in welding and allied processes
- AS 1796 Certification of welders and welding supervisors
- AS 2214 Certification of welding supervisors - Structural steel welding
- AS/NZS 3678 Structural steel – Hot rolled plates, floor plates and slabs
- AS/NZS 3679 Structural steel

## 6.2.2 British Standards

BS 539 Covered Electrodes for Metal Arc Welding of Medium, High Tensile Structural Steel

## 6.3 Site Investigation by Contractor at Pile Locations

Prior to installation of piles, the Contractor shall probe the proposed pile locations in order to determine the nature of seabed material including the depth of overburden, and to aid in the selection of the most appropriate method of pile installation: displacement piles or non-displacement piles (i.e. driven piles or potted piles). The results of the probing shall be submitted to the Superintendent upon completion (prior to installation of piles).

## 6.4 Handling and Stacking of Piles

Piles shall be transported, offloaded, stacked and picked up from the on-site storage area or the on-site barge by the Contractor. The Contractor shall take precautions when handling and storing to avoid damage to the piles.

Material for slings should be selected for lifting piles so as to avoid damaging the corrosion protection systems on steel piles, or the surfaces of concrete piles, or the surfaces of double treated timber piles or the bark on turpentine timber piles. Where steel slings are required to be used, adequate measures (wrapping the pile, or similar) shall be undertaken to prevent the steel sling damaging the surface of the pile.

Piles which suffer surface damage or other damage during handling and/or stacking will be rejected by the Superintendent, and repair or replacement of the pile will be required, at no cost to the Principal.

## 6.5 Protective Treatment to Piles

### 6.5.1 Tubular Steel Piles

Tubular steel piles shall be manufactured in accordance with the section on Manufacture and Supply of Tubular Steel Piles.

## 6.6 Preparation of Piles

### 6.6.1 Steel Tubular Piles

Pile toes and heads shall be cut square to the pile axis.

If hard driving is expected, the head of the pile should also be fitted with a steel driving shoe as shown on the Drawings, or if not so indicated, the driving shoe to be annular construction having the same outside diameter as the pile shaft and a wall thickness equal to at least twice the thickness of the pile wall thickness. The length of the driving shoe shall be 300mm. The driving shoe shall be full penetration butt welded to the pile shaft.

A closely-fitted metal helmet and a hardwood dolly together with appropriate packing above the helmet shall be used for driving steel piles.

## 6.7 Piling plant and Equipment

The Contractor shall be deemed to have made his own assessment of the piling plant and equipment required to install the piles to the required levels and pile safe working loads and ultimate loads and bending moments. The Contractor may find it necessary to use land-based plant and/or floating plant for installation of piles.

If the piling hammer and equipment proposed by the Contractor proves to be inadequate for the proper installation of the piles then such additional or alternative plant as may be necessary shall be procured by the Contractor to permit successful installation of the piles, at no extra cost to the Principal.

For driven piles, the weight of the hammer or ram shall be selected to advance the pile steadily without causing damage to the pile. The minimum weight of the drop hammer or ram shall be at least 75% of the weight of the pile. The maximum height of drop of the hammer shall be 1.5 metres.

The pile driving plant and equipment shall be maintained in good condition to ensure safe operation and effective performance.

## 6.8 Pile Installation

Pile hammering or other noisy operations shall be restricted to between 8.00am to 4.30pm Monday to Friday and 8.00am to 1.00 pm on Saturday.

The method and sequence of driving the piles shall be submitted to the Superintendent before operations are commenced.

The Contractor shall have made allowance in his Tender for the possibility of encountering hard layers and boulders and include this under the appropriate item for pile installation and in his lump sum of tender generally.

The Contractor shall be responsible for obtaining detailed information regarding the possible presence of objects on or below the surface, not necessarily detailed on the Drawings. (See requirements for probing prior to piling, specified above). The site may have been used before for a variety of port related or construction or other uses. The Contractor shall be deemed to have allowed in his tender for encountering obstacles on and below the seabed commensurate with any former uses of the site. The Superintendent will not consider any claims for extra payments or for direct or indirect costs due to the effect caused by the presence of any objects on or below the surface which relate to former uses of the site.

The Contractor shall ensure that his construction method does not overstress any element of the Works, and in determining his proposed construction method during the tender period, he shall have given due consideration to the effects of noise and vibration on the surrounding environment.

The piles shall be installed in the positions shown on the Drawings and within the tolerances specified herein.

All piles shall be installed under periodic inspection of the Superintendent. The Contractor shall give one working day's notice of his intention to install piles so that the Superintendent can arrange for attendance.

The Contractor shall immediately notify the Superintendent if in the Contractor's opinion, ground conditions vary from those indicated by the report(s) of any relevant geotechnical investigations. Work should however proceed in accordance with the Contractor's approved

method for installation of the pile through the ground. The start and finish depths of the variable ground conditions shall be recorded on the pile records.

Piles shall be driven into the bed such that the ultimate axial capacity and penetrations specified on the Drawings are achieved. If for any pile the set has not been achieved after driving to the contract toe level, then the Contractor shall continue to drive the pile until the required set is achieved but shall not drive the top of the pile beyond the cut-off level without the prior approval of the Superintendent.

Driving concrete piles in soft ground should be undertaken with care to avoid reflected tension cracking.

Jetting of piles may, with the written permission of the Superintendent, be undertaken to achieve the minimum penetrations specified. The Contractor shall not be paid additional moneys for driving the piles beyond the specified embedment level if such extra driving was required as a result of the piles being jetted.

Jetting of piles by water shall be carried out in such a manner as not to impair any of the following:

- the bearing capacity of piles already in place;
- the stability of the soil; and
- the safety of adjoining structures.

If the Contractor wishes to install piles by jetting, advice from an experienced geotechnical engineer shall be obtained stating that jetting of piles will not impair (a), (b), or (c) above.

Where piles are installed with the use of jetting, the piles may only be jetted to achieve 90% of the specified penetration. The piles shall then be driven for the remaining specified penetration using a percussion hammer (drop hammer, diesel hammer, or similar) to achieve the specified ultimate resistance.

The Contractor shall give adequate notice and shall provide all facilities to enable the Superintendent to observe driving resistance. The final set shall be taken only in the presence of the Superintendent unless otherwise approved.

Where driving is interrupted for more than thirty (30) minutes before the toe has reached the final level, the records of set shall not be resumed after the resumption of driving until at least twenty (20) blows of the hammer have been given.

After the commencement of driving each pile shall be driven continuously until the specified set and depth has been reached, except that the Superintendent may permit the suspension of driving if he is satisfied that the rate of penetration prior to the cessation of driving will be substantially re-established on its resumption, or if he is satisfied that the suspension of driving is beyond the control of the Contractor.

When a final set is being measured, the following requirements shall be met:

- the exposed part of the pile shall be in good condition without damage or distortion;
- the dolly and packing, if any, shall be in sound condition;
- the hammer blow shall be in line with the pile axis and the impact surfaces shall be flat and at the right angles to the pile and hammer axis;
- the hammer shall be in good condition and operating correctly; and
- the temporary compression of the pile shall be recorded to confirm calculated sets.

## 6.9 Piling Records

The Contractor shall maintain records for all piles showing the following information in addition to that required under the provisions of Clause 7.6 of AS 2159 - 1995:

- the date and time of installation;
- the level of the ground surface at the commencement of operations;
- the pile number or location;
- the type and size of the piling hammer/auger;
- for driven piles, the type and condition of the piling helmet and packing;
- details of any variations in the penetration resistance;
- details of any special circumstances notified by the Superintendent;
- the length of the complete pitched pile;
- toe level of the pile before and after installation including, where applicable, jetting and/or driving;
- the distance jetted and/or driven;
- the level of the top and bottom of stone layer(s);
- for driven piles the set at 0.5 m intervals over the last 5 m of driving the final set (averaged over the last 10 blows);
- details of any interruption to installation;
- details of any re-driving;
- any other relevant information.

The Contractor shall provide the piling records to the Superintendent. The cost of compiling and copying these records shall be included in the Contractor's price for piling. Failure to provide piling records for any pile may result in rejection of that pile by the Superintendent and its removal and replacement with a new pile for which records are provided.

## 6.10 Levels and Sets

Piles shall be installed to the minimum embedment shown on the Drawings. In addition piles requiring an ultimate load capacity as shown on the Drawings, shall be driven to a final set, corresponding to the design capacity indicated on the drawings, or in any event not less than 100 kN safe working load (ultimate capacity of 300 kN).

Where working loads are provided on the Drawings the ultimate axial capacity  $R_u$  of the piles shall be based on a minimum load factor of 3.0.

The final set shall be determined by the Contractor based on the Contractor's piling equipment using a recognised dynamic piling formula such as the Hiley or Janbu formula. The Contractor shall submit calculations for the final pile set to the Superintendent, a minimum of 5 working days prior to commencement of pile driving operations. These calculations shall be prepared and certified for their adequacy by an engineer who is registered on the National Professional Engineers Register as a Structural or Civil Engineer.

## 6.11 Tolerances

Piles shall be driven such that the pile axis is within 50 mm of the specified plan position indicated on the Drawings measured at the pile head conditional on the works not being detrimentally affected. Variation from verticality or the rake specified shall not exceed 1 in 75. Variation from the specified elevation of top of piles shall be within 10 mm and the pile head shall be cut horizontal, unless shown otherwise on the Drawings.

Care should be taken to ensure that loads imposed by the Contractor during subsequent construction do not cause any pile to deviate from the specified position and tolerances.

## 6.12 Rectification of Non-Conforming Piles

If the results of any pile testing carried out under the provisions of the Contract indicate that piles which have been installed have not achieved the required embedment or load capacity, or if any pile which is outside the specified tolerances, the Superintendent will nominate one of the following courses of action:

- extending and further driving of the pile;
- the driving of additional piles in designated positions;
- the extraction and replacement of the pile;
- the adoption of any other appropriate action.

All costs associated with the above work including the cost of delays and any structural amendment that may be made shall be borne by the Contractor.

Piles shall not be bent or sprung into place during or after driving unless specifically approved by the Superintendent. They shall be effectively guided and held in true lateral position during driving. Piles which in the opinion of the Superintendent have not been so driven or are twisted, broken, bent or otherwise damaged, or do not conform to the tolerances specified herein, shall be withdrawn and re-driven or shall be replaced with another pile.

Jetting for the purpose of correcting pile driving errors in location or rake will not be permitted.

## 6.13 Risen Piles

If a pile has risen as a result of adjacent piles being driven, the Contractor shall submit to the Superintendent his proposals for correcting this and for the avoidance of it in subsequent work.

## 6.14 Potting of Piles

Potting of piles shall be carried out in accordance with the method described below.

### 6.14.1 Laterally Loaded Piles

This category of piles includes piles which have essentially only lateral loads and very small compression or tension loads, such as fender piles or piles used for restraining floating marinas and pontoons.



Holes shall be bored into sound rock to receive the piles. The diameter of the holes shall be not greater than 50 mm larger than the diameter of the pile. Boring shall be carried out through a sleeve which shall be well driven down to provide a seal against ingress of silts and mud into the bore and to retain the over-burden. All loose material inside the bore sleeve and the bore shall be removed prior to placement of the pile. The length of the rock socket shall be as indicated on the drawings, but in any case shall be not less than four (4) times the diameter of the pile, measured from the surface of sound rock, down to the toe of the pile. (Piles to be potted should not have a tapered driving shoe.)

The pile shall then be installed into the rock socket. The annulus between the pile and the rock shall be filled with suitable clean granular material prior to withdrawing the sleeve. The piles should then be driven with a drop hammer or similar to assist in consolidation of the annular material and to confirm the pile's compression load capacity.

#### **6.14.2 Compression / Tension Piles**

This category of piles is for piles carrying predominantly vertical compression loads, but may under short term action act as tension piles. (As shown on the drawings, piles under permanent tension loads will be anchored using ground anchors.)

Holes shall be bored into sound rock to receive the piles. The diameter of the holes shall be not greater than 50 mm larger than the diameter of the pile. Boring shall be carried out through a sleeve which shall be driven into the surface of the rock to provide a seal against ingress of silts and mud into the bore and to retain the over-burden. All loose material inside the bore sleeve and the bore shall be removed prior to placement of the pile. The length of the rock socket shall be as indicated on the drawings, but in any case shall be not less than six (6) times the diameter of the pile if the pile will be in short term tension, or two (2) times the diameter of the pile if the pile will only be in compression, measured from the surface of sound rock, down to the toe of the pile.

Compression / tension piles are to be potted with concrete embedment as indicated on the Drawings. Concrete shall be placed continuously around the pile by the Tremie method until the finished concrete level is no lower than the top of the rock. During this operation and until the concrete has hardened for at least 48 hours, the pile shall be held firmly in position.

Concrete shall be Grade 20 with 10 mm maximum coarse aggregate, in accordance with AS 3600 Concrete Structures. Concrete placed under water shall contain admixtures to reduce segregation and loss of cement slurry to the water column. Slump of the concrete to be placed by the Tremie method is to be a minimum of 125 mm and a maximum of 180 mm.

#### **6.15 Lengthening of Steel Piles**

If the required set and/or embedment of a steel pile cannot be achieved with the available length of pile, then the pile shall be extended and re-driven.

The pile shall be spliced as shown on the Drawings, or if this is not shown, as specified herein. Pile splicing shall be effected with the aid of steel backing strips, at least 4mm thick and 100 wide, positioned centrally across the splice by tack welding. On completion of the alignment of the two parts of the pile, the splice shall be made with a full penetration, full strength butt weld in accordance with AS 1554 (Type SP).

All welds shall be performed by qualified welders. This requirement regarding personnel shall be rigidly enforced. Welders Certificates shall be made available to the Superintendent on request. Safety provisions shall comply with AS 1674.

All electrodes, welding techniques, procedures and personnel shall comply with the requirements of the following Australian Standards: AS 1553 and AS 1554. Electrodes shall be E48 class. Welds shall be continuous type SP.

The weld, once started, shall be completed without stoppage. The Contractor shall ensure that the sections of pile maintain their alignment to the satisfaction of the Superintendent.

Pile driving for unpainted piles shall not be recommenced until at least half an hour has elapsed from the time of completion of the welded joint.

If piles are painted, the pile protective coating specified for the remainder of the pile shall also be applied at the splice in accordance with the Specification. This may require sand blasting and painting which will cause driving to be suspended for a period of days.

## **6.16 Cutting and Trimming of Piles**

Once the piles have been installed and approved, they shall be cut off at the levels shown on the Drawings. The tolerance for cutting off piles shall be  $\pm 10$  mm unless noted otherwise on the Drawings. Unless shown otherwise all piles shall be cut off horizontally.

### Steel Piles

Steel piles shall be cut with an oxy-acetylene torch at the level shown on the drawings. Where embedded in concrete structures, the steel pile embedment shall equal the specified concrete cover.

Anchorage of tubular steel piles into concrete structures shall be effected by concrete filling the top of the tubular pile and extending steel reinforcement from this pile concrete into the pile-cap concrete. The length of concrete filling shall extend at least three (3) pile diameters below the soffit of the pile-cap. Reinforcement shall be bonded at least 32 bar diameters into both the pile concrete and the pile cap concrete.

## **6.17 Pile Caps**

Where shown on the Drawings, steel or concrete piles shall be fitted with an approved conical fibreglass bird capping.

The bird capping shall be fabricated from fibreglass or high molecular weight plastic and finished in white or a colour as noted on the Drawings. The capping shall have a lip which extends a minimum of 75 millimetres along the pile. The capping shall slope upwards to a point. The angle of slope shall be not less than 30 degrees to the horizontal. The point shall be rounded to a radius 25mm.

The bird capping shall be bonded to the steel or concrete pile with an approved glue or epoxy. Any glue or epoxy shall be compatible with the steel or concrete pile and the fibreglass bird capping. The bond shall be complete and shall exclude air from entering the pile shaft. The protective coating system shall be abraded in the area of the bird capping bond.

# APPENDIX A – PRINCIPAL SUPPLIED DRAWINGS

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# APPENDIX B – GEOTECHNICAL REPORT

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