

**BETIO POWER HOUSE
STRUCTURE SPECIFICATION
Rev A
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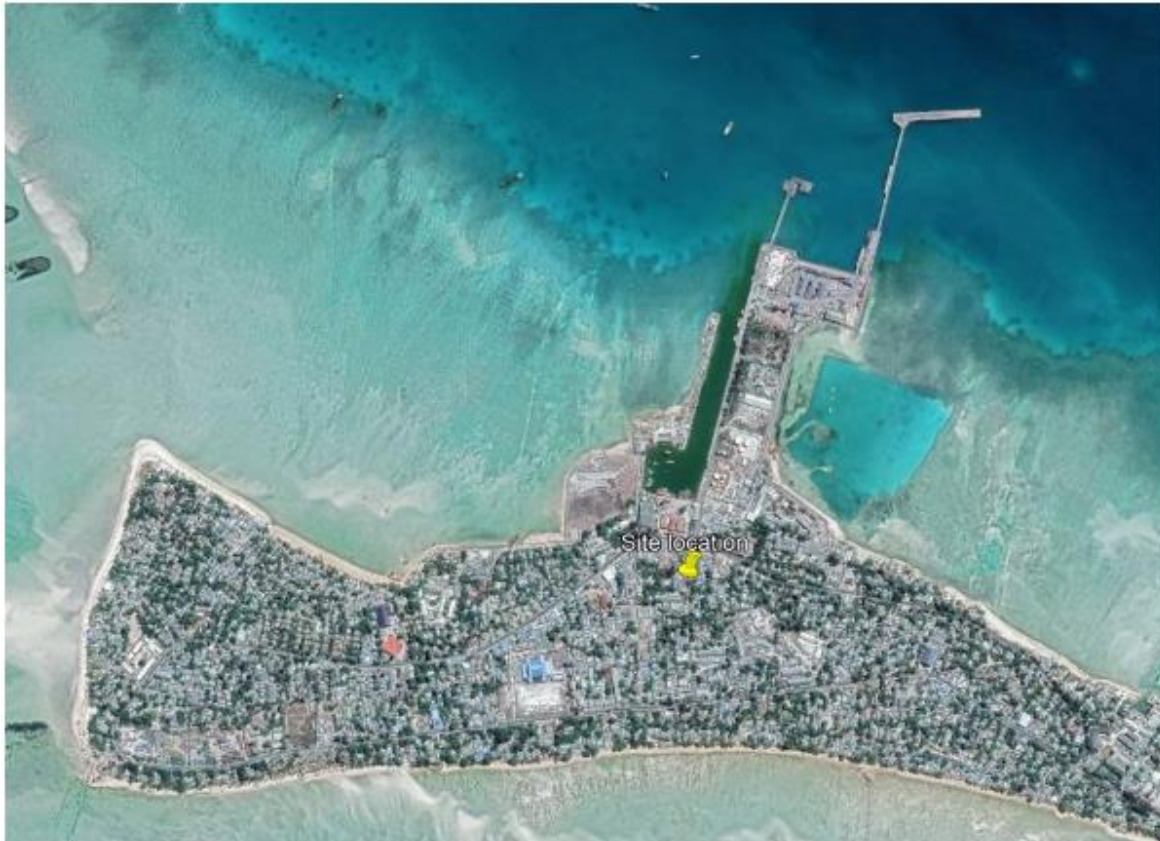
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1 PROJECT DESCRIPTION

1.1 SYSTEM DESCRIPTION

The site for the new diesel generators is outside the PUB Betio PUB is presently demolishing the electrical workshop building to create space in the yard building (footprint 40m x 20m) for the generators and associated equipment. PUB may also consider installing a simple prefabricated steel shed to provide some extra shelter for the new generators.



The building is to be a steel frame structure with a light weight metal roof and façade cladding, and precast slabs-on-ground and footings.

The structural system is proposed to be designed as follows:

Structural Element	Structural System
Foundations	<ul style="list-style-type: none"> 600 mm Thick RC pad footing on ground.
Columns	<ul style="list-style-type: none"> Steel columns to support roof and crane
Ground Floor	<ul style="list-style-type: none"> Steel Precast concrete Slab on ground option being investigated
Roof	<ul style="list-style-type: none"> Braced frame & portal frame steelwork roof supported on steel roof rafters and steel columns.

The design does not consider any construction staging. The main works contractor shall co-

ordinate necessary provisions for construction phasing.

The Engineer is responsible for the delivery of the base building design. The following are not classified as base building elements, or are services to be provided by a specialist contractor and the Main works Contractor shall make all due allowance in their costs:

- All cladding/façade systems and their associated support back to primary structure that is documented by the architectural intent and façade performance specification.
- Gutters and gutter support framing
- Safe access systems (including fall-arrest restraints), platforms, ladders and access stairs not documented.
- Internal and external cladding supports, including window head trimmers, window jambs, closures, door jambs etc.
- Internal and external balustrades, barriers, fascia, upstands.
- Roof support framing to any PV cells or roof mounted systems.
- All doors, windows, roller shutter doors and associated steelwork/fixings supports to suit the base-build structure.
- All proprietary structural systems, e.g. Rondo Stud or equivalent.

2 PROJECT DESIGN BRIEF

2.1 ACTS, CODES AND STANDARDS AND DRAWINGS

The proposed structural services will be designed and installed in accordance with the National Construction Code, and the relevant Australian Standards.

Specifically, the relevant acts, codes and standards include, but are not limited to, the following:

- AS1170 Part 0 Structural Design Actions General Principles
- AS1170 Part 1 Permanent, imposed, and other actions.
- AS1170 Part 2 Structural Design Actions Wind Actions.
- AS1170 Part 4 Earthquake Loads.
- AS1657 Fixed Platforms, Stairways, Walkways and Ladders.
- AS2870 Residential Slabs and Footings.
- AS3600 Concrete Structures.
- AS4100 Steel Structures.
- AS4600 Cold Formed Steel Structures
- AS4678 Earth Retaining Structures
- AS1418 Cranes, hoists and winches

2.1.1 DESIGNING FOR SAFETY

Comply with the relevant state and commonwealth requirements.

3 FOUNDATIONS

3.1 RESPONSIBILITIES

3.1.1 GENERAL

General: Provide installed pad footing which carry the design loads

Safety: The Contractor is responsible for the health and safety of all persons that could potentially be impacted by the works, including the public. The Contractor is responsible for the compliance with all Statutory requirements.

Tenders: Tenders must conform to this specification however alternative designs will not be excluded providing a conforming tender is submitted. Alternatives shall be designed in detail by the Tenderer, and submitted for consideration.

3.1.2 NON-CONFORMANCES & REWORK

General: All costs associated with any non-compliance with the requirements of the documents by the Contractor shall be borne by the Contractor. The requirements of this clause shall also apply to any structure impacted upon by the Contractor. Additional construction costs associated with the following (including impact on subsequent packages):

- Non-compliances with the documents
- Latent conditions for a non-conforming tender resulting in additional works required by the Contractor to meet the performance requirements of this specification.
- Additional testing and rework required following rejection of one or more for a non-conforming tender.
- Amendments to construction methodology or layouts required by the Contractor.

The contractor should be required to provide, as part of its tender, the additional information required to define the proposed system characteristics; and may be invited to submit alternatives to the specified system.

The contractor should be required to provide a certificate from a professional engineer in relation to design adequacy, as well as warranting the materials and workmanship.

3.2 CROSS REFERENCES

General: conform to the drawings and *general requirements* work section.

3.3 STANDARD

General

Design and performance: To AS 2159.

Materials and installation: To AS 2159.

Version

General: The version of all referenced Standards to be adopted is that which is current at the

date of Tender.

3.4 EXISTING SERVICES AND UNDERGROUND INFRASTRUCTURE

Locations: The locations of some existing services within building sites are not known. If any existing services are encountered during excavations, advise immediately for further direction. The Contractor shall be responsible for inspecting the site to ascertain the nature of the ground, exact location of all services, and the working conditions that will be encountered. The Contractor will be responsible for any damage or delays caused directly or indirectly by damaging such services during the works.

Marking: The Contractor shall take all possible steps to clearly mark and safeguard underground and overhead cables and pipe-work before any work is carried out adjacent to their location.

Damage: In the event of damage to any service or underground infrastructure the Contractor is to protect the damaged portion and, in respect of cables, prevent the entry of moisture but is not to carry out any other repair work until such time as the damage has been inspected.

Maintenance areas: Maintenance areas where augers are driven into the platform are to be located away from services, tunnels, foundation locations or any underground infrastructure. Contractor shall provide proposed location for review by the Superintendent in advance.

3.5 SITE ACCESS

General: The Contractor should allow for the cost and programming implications of any site access restrictions. The Contractor shall apply to the Superintendent for access to the site if their proposed working hours conflict with those of the Superintendent.

4 CONCRETE

4.1 EXTENT OF WORK

This section specifies the requirement for the design and construction of all precast concrete works indicated on the Architectural and Structural drawings and/or described in this specification.

This includes the design and construction of all formwork and temporary propping required so that the concrete, when cast will have the dimensions, shape, location and surface finish required by the Contract. The Contractor shall:

- Allow for all loading specified in the documentation, including minimum load allowances specified in the Structural Design. The structural drawings are provided as “reference design” documentation, where noted. They provide intent only with all rates and sizes indicative only.
- Allow to support all structural walls, non-structural walls, screens, façade, precast, partitions, plant, raised floor and other superimposed loading indicated in the documentation in a manner which will adequately support their weight and not cause cracking or any other damage.
- Make due allowance for all construction, temporary isolation and movement joints in the design and co-ordination of joints in all non-structural elements above. The location of all movement joints shall be to the approval of the Superintendent and shall be located within corridor areas where possible. Indicative isolation joints have been illustrated but should be confirmed by the Contractor to suit their design, certification and construction requirements.
- Provide 1:100 structural plans and drawings of appropriate scale showing all details, sections, elevations and schedules necessary for construction and suitable for certification requirements.

4.2 SCHEDULE OF DOCUMENT CONTENT

Refer to the Structural Design Brief, for the schedule summarising the information that is not provided with the Tender First Issue Documents and the Tender Final Issue/Contract Documents and advises the allowances that should be included.

In addition, the information that will not be provided in the Contract Documents is also identified so that the Contractor can make due allowance. Include a provision for all associated works including Contractor design and Contractor certification as required.

4.3 DESIGN CRITERIA

The structural design has been based on the criteria stated in the Engineer's report, Structural Design Brief. All design matters that are the responsibility of the Contractor or Contractor alternatives shall comply with these minimum criteria and the intent shown on the Contract documentation. All of the above is the approval of the Superintendent.

4.3.1 CONCRETE DURABILITY

Structural concrete elements of the built form are to have a design durability that complies with the recommendations of AS3600.

The concrete elements shall be designed for durability using the following exposure classification:

Element	Exposure classification
Pad Footings, pits, retaining wall, slab	A2 (See Note 1)
Interior elements	A1
Exposed concrete elements	B2 (See Note 2)

Note 1 : An environmental assessment has identified contaminated ground conditions that could potentially compromise the integrity of the subsurface elements (structure and services). Further investigation will be required by the Contractor to determine how the design (concrete and soil subgrade) needs to be modified to accommodate the identified contaminants.

This may affect the exposure classification of the structural elements in contact with the ground. With reference to AS 3600 where exposure classifications 'B1', 'B2', 'C1' or 'C2' are encountered the cement type shall be Type SR.

Note 2 : Cover / concrete is to be in accordance with section 4 of AS 3600.

4.3.2 MINIMUM REINFORCEMENT RATIOS AND CRACK CONTROL

Minimum reinforcement ratios should be provided to provide a degree of crack control as shown below:

Area	Degree of crack control
Column / pedestal	Strong
Pad footing / Retaining wall	Strong
Externally exposed slabs	Strong + continuous top reinf

4.3.3 STANDARDS – CONCRETE

Referenced Documents: The following standards are referred to in this Specification.

Concrete Generally

AS 1379 – 2007 Specification and supply of concrete.

AS 1478.1 – 2000 Chemical admixtures for concrete, mortar and grout – Admixtures for concrete

AS 2758.1 – 1998 Aggregates and rock for engineering purposes - Concrete aggregates

AS 3582.1 – 1998 Supplementary cementitious material for use with portland and blended cement - fly ash

AS 3582.3 – 2002 Supplementary cementitious material for use with portland and blended cement – Amorphous Silica

AS 3600 – 2018 Concrete structures

AS 3735 – 2001 Concrete structures retaining liquids

AS 3972 – 2010 Portland and Blended Cements

AS MP20 – 1971 Part 1 - information on permeability - reducing admixtures for concrete. Sampling and Testing

AS 1012.1 – 1993 Methods of testing concrete

AS 1141.3.1-2012 Methods for sampling and testing aggregates

AS 2350.0.1999 Methods of Testing Portland and Blended Cements.

Curing and Protecting

AS 3799 – 1998 Liquid membrane-forming curing compounds for concrete.

Formwork

AS 3610 – 1995 Formwork for concrete

AS 3610 – 1995 Formwork for concrete, supplement 1 and 2

AS3610.1 – 2010 Formwork for concrete – Documentation and surface finish

Reinforcement

AS/NZS4671-2001 Steel reinforcing materials.

AS 1444 – 2007 Wrought alloy steels - standard, hardenability (H) series and hardened and tempered to designated mechanical properties.

AS 1554.3 – 2008 Structural Steel Welding Code - Part 3 - Welding of reinforcing steel.

AS 1627 – 1997 Metal Finishing – preparation and pre-treatment of surfaces.

AS 4534 – 2006 Zinc and zinc/aluminium-alloy coatings on steel wire.

AS 4792 – 2006 Hot dipped galvanised (zinc) coatings on ferrous hollow sections, applied by continuous or a specialised process.

AS 4680 - 2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.

Joints and Jointing

AS 1523-1981 Elastomeric bearings for use in structures.

AS 5100.4-2004 Bridge design – Bearings and deck joints

Other

AS 1170.0 – 2002 Structural Design Actions. Part 0: General principles

AS 1170.1 – 2002 Structural Design Actions. Part 1: Permanent, imposed and other actions

AS 1170.2 - 2011 Structural Design Actions. Part 2: Wind actions

AS 1170.4 - 2007 Structural Design Actions. Part 4: Earthquake actions in Australia

AS 2870 – 2011 Residential Slabs and Footings

ASTM C309 – 2011 Liquid Membrane-Forming Compounds for Curing Concrete

4.3.4 QUALITY

A Quality Assurance System to ISO 9001 to cover all aspects of this specification and ensure all products and services supplied by other parties in the scope of this specification shall be provided under a quality assurance system to ISO 9001.

4.4 SAFETY IN DESIGN

Take all mitigation and actions necessary to ensure that the plant or structure is without risks to health and safety when used for a purpose for which it was designed, including:

- a) Construction methods and techniques that were assumed and form the basis of the design (e.g. erection sequences).
- b) Operating methods and maintenance techniques that were assumed and form the basis of the design.
- c) Consideration of any reasonably foreseeable misuse.
- d) Residual safety hazards and risks relevant to construction, operation, maintenance, decommissioning, demolition and disposal must be clearly recorded and effectively communicated to those who interact with the design. Information regarding residual risks must include information as to how the residual risk is to be managed.

Undertake a safe works procedure that shall identify safety items, and shall include the following:

- a) Propping loads and temporary work/supports required
- b) Assessment of access
- c) Working at height requirements, control access to suspended floor and provision of temporary proprietary clamp on hand rail system.
- d) Provision of safety mesh to all penetrations with a risk of fall.

4.5 COORDINATION OF WORKS

Fully co-ordinate the design, shop drawing and installation making due allowance for all building trade requirements.

4.6 CONCRETE HOBS

All concrete hobs indicated on the documentation shall be poured with the main concrete pours to ensure an integral/monolithic connection. Note all concrete hobs are as per the architectural and building services set-out. Refer to the typical details for their structural requirement.

4.7 CONCRETE QUALITY CONTROL – CONCRETE

4.7.1 LIKELY DEFECTIVE CONCRETE

A quality control system shall be established to ensure that all precast concrete achieves specification and is fit for purpose. The system shall ensure traceability for all concrete supplied and confirm that the concrete for precast panel is in accordance with all design parameters including 28 day compressive strength.

4.7.2 REJECTION

Concrete may be rejected before or after placement, concrete which, does not conform to the design intent or the requirements of this Specification.

Hardened concrete will also be liable to rejection if any of the following defects occur:
It is porous, segregated or honeycombed.

A construction joint has been made at a location or in a manner not in accordance with the documentation.

The construction tolerances have not been met.

The reinforcing steel has been displaced from its correct location.

Waterstops, inserts, and other items embedded in concrete have been displaced from their correct position.

The concrete work is considered to be otherwise non-compliant or defective by the Superintendent

4.8 DESIGN AND CONSTRUCTION CERTIFICATION

The Contractor shall provide structural certification in writing for both their design elements and completed construction, by a corporate member of Engineers Australia, experienced in this form of design, for the design and construction of the works. The Contractor's certified design shall be submitted to the Superintendent for review, and shall be modified as necessary to the satisfaction of the Superintendent prior to work proceeding. Experience of the appointed Contractor's engineer shall be submitted and is subject to satisfaction of the Superintendent and should the Superintendent wish to reject the Contractor's appointment no reason shall be required and the Contractor shall seek a satisfactory alternative.

Acceptance of the certification of adequacy shall in no way reduce the Contractor's responsibility for the design, fabrication and quality of the final product.

4.9 FORMWORK

4.9.1 FORMWORK GENERALLY – CONCRETE

To AS 3610.

The contractor shall be responsible for the design and construction of formwork and all temporary works so that concrete, when cast in the forms, will have the dimensions, shape, location and surface finish required by the Contract.

4.9.2 DIMENSIONAL TOLERANCES – CONCRETE

Construct formwork so that the finished concrete is within the tolerances stated in Table 3.4.2 of AS 3610. In addition, the following tolerances to be achieved if more stringent to AS3610 and AS3600:

Absolute Position: The deviation from the specified position on drawings for concrete elements shall not exceed the following:

- In plan, for a point on the surface of a column or wall at any floor level, 25mm horizontally.

- In plan, slab edges shall not deviate more than 25mm from their absolute position. In elevation, for a point on the top surface of a floor or the soffit of a beam or slab adjacent to a column or wall, 25mm vertically.

4.9.3 DAMP PROOF MEMBRANE AND WATERPROOFING

Provide all ground slab/raft with a Damp Proof Membrane (DPM) for details and extent requirements refer to architect details. Unless shown otherwise as a minimum provide 0.2mm thick polythene vapour barrier to all buried faces of structure shall be provided

4.9.4 DIMENSIONAL TOLERANCES - CAST-IN INSERTS

All cast-in inserts that are to be installed to the surface, soffit or edges of a beam, column or slab shall be within the tolerances stated below with reference to their specified position. The cast-in inserts to comply with the following, with the more stringent tolerance taking precedence:

- $\pm 10\text{mm}$ from slab edge;
- $\pm 3\text{mm}$ from concrete surface;
- $\pm 20\text{mm}$ on plan from absolute position.

4.9.5 FORMED SURFACES – CONCRETE

Generally, to AS 3610, including the recommendations relevant to the construction and use of formwork, and to impermissible blemishes and irregularities.

Unless otherwise shown on the drawings, the minimum standard of finishes to formed concrete surfaces shall be as follows (based on AS 3610 classes and types):

Concrete Element or Surface	Formwork	Colour Control
Normal architectural work, visible painted surfaces & surfaces not otherwise specified.	2	Not applicable
Surfaces to be rendered or hidden by other finishes.	3	Not applicable
Surfaces permanently concealed (e.g. non exposed footings, rear faces of retaining walls).	4	Not applicable

4.9.6 FLOOR SURVEY – CONCRETE

Provide survey to record the top surface at midspan and support locations of all slabs and beams. This shall be done prior to the stripping of formwork and again after removal of all props from the slab soffit.

The survey shall be carried out to an accuracy of 1mm.

An as built survey shall be provided following completion of the works.

4.9.7 FLOOR TOLERANCES – CONCRETE

The floors shall be constructed such that maximum vertical variation from a straight line anywhere on the surface and in any direction, is 6mm in a 3m length when checked with a straight edge. Floor levels shall be measured within 72 hours of placement of concrete to confirm this requirement. Notwithstanding this requirement, the structure shall be constructed so that the member thicknesses comply with the requirements of Clause 17.5.2.3 of AS 3600.

4.10 CONCRETE SUPPLY

4.10.1 MATERIALS – CONCRETE

Concrete Materials Generally.

Comply with AS 3600, Clause 17.1.

Cement

Portland cement: AS 3972, Type SL, unless otherwise specified or required to limit the potential of in-ground contamination.

4.10.2 MIX PROPORTIONS – CONTRACTOR RESPONSIBILITY

The selection of mix materials and proportions shall ensure that the minimum compressive strength and shrinkage is achieved.

4.10.3 RECYCLED AGGREGATE AND CONCRETE CONTENT

A minimum of 20% of aggregate used in concrete must be sourced from recycled aggregate. The aggregate used must be classified as Class 1 Recycled Concrete Aggregates (RCA). In addition, a minimum of 30% of cement for pre-cast concrete shall be replaced with industrial waste product.

Industrial waste products must not be sourced from industrial facilities co-fired with hazardous waste.

The concrete properties specified within this document and on the design drawings must not be compromised with the nominated replacement of aggregate.

4.11 REINFORCEMENT

4.11.1 REINFORCEMENT SUPPLY – CONCRETE

Supply and fix reinforcement, including the necessary tie wires, support chairs, spacers and the like to AS 3600.

Deformed steel reinforcing bars used shall be hot-rolled Grade 500 (D500N) where denoted 'N' on the drawings or equivalent CB500-V

4.11.2 RECYCLED CONTENT OF STEEL

Reinforcing bar and mesh shall have an average post-consumer recycled content greater than 50%

4.11.3 HOLDING DOWN BOLTS – CONCRETE

Inserts and bolts shall be set accurately in the concrete and forms shall be rigidly held during concreting operations.

4.12 PLACING, CURING, PROTECTION AND HONING

4.12.1 PREPARATION AND PLACEMENT

Concrete shall be placed in accordance with the Cement Concrete & Aggregate Australia, Avoiding Early Cracking (June 2005) publication.

The Contractor shall prepare a hot or cold weather concreting plan which they are to utilise throughout the project when the air temperature at the time of pour is expected to be below 5°C or over 33°C. It is expected that the plans will address cooling or warming precautions as applicable in either case. In-conjunction with the above the Contractor shall adopt a procedure to deal with unforeseen weather conditions and plastic shrinkage cracking. Reference should be made to CCAA Data Sheet – Plastic Shrinkage Cracking, for recommended practices.

The Contractor shall provide a compatible Aliphatic Alcohol treatment to all concrete surfaces to ensure the rate of surface drying is reduced. The aliphatic alcohol shall be re-applied after each finishing operation.

“Hot weather” is defined as when surrounding shade outdoor temperature is greater than 32 degrees C or the evaporation rate exceeds 1 kg of water per square metre of concrete per hour (1kg/m²/hr).

To determine the rate of evaporation, refer to “Hot-Weather Concreting (Nov 2004)” Datasheet produced by Cement Concrete & Aggregates Australia. Measurement of temperature should be accurate to the nearest degree C; humidity accurate to the nearest 5% of relative humidity and wind speed accurate to the nearest 1.5km/h to determine the rate of evaporation.

Temperature and humidity shall be measured at approximate table height in the shade.

Wind speed shall be measured at approximately 0.5m off the pour surface and be a mean value over a period not peak/max gust.

The Contractor shall not mix/place precast concrete when the outdoor shade temperature on exceeds 38 degrees C.

The Contractor shall take all necessary precautions to prevent premature stiffening of the fresh mix and to reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

4.12.2 CURING – CONCRETE

To AS 3600-2018 and AS 3799.

The Precast Contractor shall protect fresh concrete from premature drying and excessively hot or cold temperatures. Maintain the concrete at a reasonably constant temperature with minimum moisture loss for the curing period.

The Precast Contractor shall allow for the application of a compatible aliphatic alcohol treatment to all concrete surfaces to ensure the rate of surface drying is reduced. The aliphatic alcohol shall be re-applied after each finishing operation.

The Precast Contractor shall make available when requested their adopted procedure to deal with unforeseen weather conditions and plastic shrinkage cracking. Reference should be made to CCAA Data Sheet – Plastic Shrinkage Cracking publication.

4.12.3 CURING PERIOD

Unless otherwise specified, cure continuously until the cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature in contact with the concrete is above 100C, totals not less than the following:

Concrete made with normal portland cement: days	7
Concrete made with high early strength cement: days	7
Concrete to ground precast slab / pad footing / retaining wall days	14

4.12.4 CURING METHODS

May include the following unless otherwise specified:

Ponding or continuous sprinkling with water

An impermeable membrane

An absorptive cover kept continuously wet

A Contractor approved curing compound.

During hot weather:

- Curing should commence immediately after the slab has been finished.
- Curing should be provided to newly exposed surfaces when forming is removed.

4.12.5 SEALING

Concrete surfaces shall be sealed by a proprietary system. The sealer shall be applied and cured in accordance with the manufacturer's recommendations. The Contractor shall provide a surface maintenance and cleaning schedule required to maintain the applied sealing compound.

4.12.6 DUST INHIBITOR

Provide compatible dust inhibitor to the floors where required, ensuring a compatible system for any mix compounds and architectural finishes.

4.13 JOINTS

4.13.1 JOINTS – CONCRETE

The Contractor shall design all joint requirements, including temporary and permanent.

All joint details and locations shall be approved by the Superintendent prior to any works. The location of all movement joints shall be located within corridor areas where possible.

Provide a suitable joint (e.g. a sliding joint, temporary slab release) to any nominated or Contractor required joint that will allow for temporary and/or permanent movement and remove the need for future remedial works to reseal joints after construction. With the provision of these joints the Contractor shall be deemed to have allowed for all temporary propping, restrictions and programme constraints required to construct the works.

Alternative design solutions can be submitted by the Contractor for approval by the Superintendent if it can be demonstrated (to the satisfaction of the Superintendent) that it will fulfil the design intent.

All construction joints shall be adequately tied to remove the possibility of vertical differential movement between pours.

Install proprietary water stops at all joints (construction and movement) to precast ground slabs and retaining walls, installed in accordance with all manufacturer's recommendations in order to ensure no internal ingress of water and dampness.

The Contractor shall ensure that all termite protection will be adjusted to suit the construction methodology of the works so that the protection provided is not

4.14 REPAIRS TO CONCRETE

4.14.1 GENERAL – CONCRETE

No repairs to concrete shall be made until an agreed method of repair is provided for review.

Extensive patching of honeycombed concrete will not be permitted.

Excessive cracking and cracking beyond hairline cracks (0.3mm width) determined by the Superintendent shall be deemed to be non-compliant and will be rejected by the Superintendent.

All rejected concrete shall be repaired by the Contractor at the Contractor's expense.

4.14.2 TRIAL REPAIRS – CONCRETE

Conduct trial repairs in positions agreed. The cost of all repair work and trials shall be at the Contractor's expense.

4.15 CONCRETE REINFORCEMENT

4.15.1 GENERAL

Responsibilities

Requirement: Provide concrete reinforcement, as documented.

Cross references

General: Conform to the General requirements work section.

Associated work sections

Associated work sections: Conform to the following:

- General Requirements
- Precast concrete
- Tilt-up concrete
- Concrete pavement

Standards

General

Standard: To AS 3600 and AS/NZS 4671.

Version

General: The version of all referenced Standards to be adopted is that which is current at the date of Tender.

Reinforcement and Steel certification

All reinforcement, structural steel and associated components and welding consumables shall be manufactured by companies accredited to AS 9001 which hold a valid certificate of approval issued by the Australian Certification Authority for Reinforcing and Structural Steels (ACRS) or an equivalent third-party product certification system as may be approved in writing by the Superintendent.

General: Provide a certificate for the reinforcement of compliance with AS/NZS 4671 or equivalent

Origin of steel reinforcement: If it is proposed to use steel reinforcement not of Australian origin, submit documentation which demonstrates that the steel complies with Australian Standards with the Tender.

Tolerances

General

Fabrication, including bending and cutting, and fixing: To AS 3600

Reinforcement position: To AS 3600

Submissions

Execution details

Reinforcement: Submit the following:

- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 Section 8.
- Mechanical bar splices: Details and test certificates for each size and type of bar to be spliced.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600.
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Welding of reinforcement is not permitted unless approved by the Superintendent.

Materials

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

Origin of steel reinforcement: If it is proposed to use steel reinforcement not of Australian origin, submit documentation which demonstrates that the steel complies with Australian Standards with the Tender.

Inspection

Notice

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

- Cores and embedment's fixed in place.
- Reinforcement fixed in place, with formwork completed except where such formwork may prevent inspection of installed reinforcement.
- Reinforcement cages fabricated and

Hold points

Minimum notice: 2 working days for each

Checking

Checking: Comprehensively check the work before giving notice. Advise the local Council or Authority to allow them to inspect the work as required prior to concreting. An inspection report shall be provided to the Superintendent or his approved representative, and the local Council or authority, prior to either performing an inspection. If an inspection report is not provided, work shall be deemed to be "unchecked". Work which has not been checked will not be inspected.

Approval: Works which have not been inspected and approved by the Contractor will not be allowed to proceed. All costs due to the non-compliance with the above by the Contractor shall be fully and solely borne by the Contractor. An example is a reinforcement inspection deemed to be unchecked by the Superintendent, causing a delay in a scheduled concrete pour.

The Contractor would be liable for all costs due to his/her non-compliance.

Reporting: During the full period of the inspection, there shall be a suitably experienced person accompanying the Superintendent or his approved representative provided by the Contractor. This person must take neat and concise written notes of all that is required by the engineer and shall ensure these requests are carried out. These written notes will be used as the inspection report and a copy shall be given to the Superintendent at the end of the inspection.

Actions: Each action requested by the Superintendent and written upon the above-mentioned report shall be signed off once the work has been carried out. A copy of this signed inspection report shall be forwarded to the Superintendent prior to any of the works inspected proceeding.

4.15.2 PRODUCTS

Materials

Protective coating

Standard: To AS 3600

General: For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating.

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

- Thickness: 200 μm minimum.

Galvanizing: To AS/NZS 4680:

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

Steel reinforcement

Standard: To AS/NZS 4671.

Ductility grade: Class N unless noted otherwise on the Drawings.

Steel ligature ductility grade: Class N unless noted otherwise on the Drawings.

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

Identification: Ensure that reinforcement is readily identifiable as to grade and origin in accordance with AS 4671 Section 9.

Unenacted reinforcement

General: If 'starter bars' and other items project from cast concrete for future additions and are exposed to the weather they shall be hot dip galvanised or stainless steel, unless specifically approved as otherwise by the Superintendent.

Tie wire

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

External and corrosive applications: Galvanized.

Splicing

General: Unless otherwise shown on the Drawings, lap the reinforcement bars which have to be spliced in accordance with the Lap schedule.

Lap schedule

Type	Grade	Lap length
Plain Round Bar	250R	50 x diameter
Ribbed Wire	500RW	50 x diameter
Grade 500 Hot Rolled Deformed Bars to AS/NZS 4671	500N	50 x diameter (500 mm minimum)
Grade 500 Mesh Welded Wire Mesh to AS/NZS 4671	500L	250 mm minimum, with overlap measured between outermost wires of each sheet and not less than the pitch of the secondary wires + 25 mm. Refer also to details shown on the Drawings.

Stagger: The Contractor shall stagger splices to the approval of the Superintendent and securely tie fabric.

Notification: In the event of the reinforcement of any portion of the work not being adequately shown on the structural drawings or otherwise specified, the Contractor shall notify the Superintendent accordingly.

Requirement

General: Where not shown on the drawings, supply, and fix reinforcement, including the necessary tie wires, support chairs, spacers and the like.

Welding

Requirement: The Contractor shall not weld hot rolled high deformed bars without written approval of the Superintendent unless otherwise detailed on the Drawings. Where welding is permitted, or shown on the drawings, it shall comply with AS 3600, Clauses 13.2 and 17.2.2. All welding where shown shall be undertaken by the Contractor strictly in accordance with the relevant part of AS 1554. Details and prequalification of the proposed welding procedure shall be submitted to the Superintendent for review and approval.

Support

General: Where not shown on the drawings, supply, and fix reinforcement, including the necessary tie wires, support chairs, spacers and the like. The Contractor shall use supports adequate to withstand construction traffic and sufficient in number and spacing to maintain the reinforcement in its correct position. The Contractor shall support all bar reinforcement in slabs by a minimum of N16 bars at not greater than 500 centres. The Contractor shall give

particular care to the support of light gauge reinforcement and of reinforcement in general where the concrete is to be cast against the ground or against fill. In such cases, the Contractor shall provide supports at 500 centres (max).

Protection in Hot Weather

Requirement: Where there is the likelihood of an ambient air temperature greater than 30°C occurring during the placement of the concrete then the Contractor shall adequately shade or spray with water the reinforcement so as to keep its temperature below 30°C. Concrete shall not be poured if reinforcement temperatures exceed 30°C.

4.15.3 EXECUTION

Construction

Dowels

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

Tolerances:

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

Grade: 250 N unless noted otherwise on the Drawings.

Cover

Concrete cover generally: To AS 3600 clause 4.10.

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

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

Supports

General: Provide proprietary concrete, **metal** or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, to AS/NZS 2425 and as follows:

- To be adequate to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.
- For exposure classifications more severe than A1 use only plastic supports of adequate strength and of a shape appropriate to the location.
- Chairs to be securely fastened to the formwork to ensure reinforcement and tendons are not displaced during concrete placement.

Exposed face: For precast elements with faces exposed to the weather, support reinforcement so that no bar chairs are used on the exposed faces. All spacers shall be approved plastic.

Minimum spacing:

- Bars: < 60 diameters.
- Fabric: < 600 mm.

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

Projecting reinforcement

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

Tying

General: Secure the reinforcement against displacement by tying at intersections with either annealed steel wire ties, or by approved clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.

Beams: Tie stirrups ligatures to bars in each corner of each stirrup/ligature. Fix other longitudinal bars to stirrups ligatures at 1 m maximum intervals.

Bundled bars: Tie bundled bars together so that the bars are in closest possible contact. Provide tie wire at least 2.5 mm diameter at centres not more than 24 times the diameter of the smallest bar in the bundle.

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

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections, and at other points as required.

Tolerances: To AS 3600

Welding

General: If welding of reinforcement is proposed, provide details. Do not weld reinforcement which does not comply with AS/NZS 4671. Do not weld reinforcement within 75 mm of a section that has been affected by bending or re-bending.

Provision for concrete placement

General: If spacing or cover of reinforcement does not comply with AS 3600 clauses 8.1.7 and 4.10.2 respectively notify the Superintendent and obtain instructions prior to placing concrete.

Equipotential bonding fixing requirements

General: In certain areas, the reinforcement is to be fixed for equipotential bonding as required under the Electrical Services Contract.

Completion

Exposed reinforcement

General: If ‘starter bars’ and other items project from cast concrete for future additions and are exposed to the weather, provide details of protection.

4.16 PRECAST CONCRETE

4.16.1 GENERAL

Extent of Work

This section of the specification specifies the requirements for the design, certification, manufacture, and installation of all precast concrete units indicated on the Architectural and Structural drawings and/or described in this specification. Generally, the precast is to the slab, pad footing, retaining wall of the building. The structural and architectural drawings are provided as “reference design” documentation.

Include for the design and preparation of shop drawings and the supply of all materials, casting, finishing, curing, stacking, storing, delivery of all units and accessories such as all required inserts, fixings, connections, anchors, bolts, nuts, washers, ferrules, penetrations, brackets, hooks and lifting devices which are required to be either fixed into the structural concrete, secured to the structural steelwork, concrete frame and/or used in the erection of the panels.

Supply and install all grouting for panels including grouting of dowel bars, all lifting lugs etc upon completion of erection.

Supply and install all weather bars and sealants and coordinate with all other external trades to ensure a weatherproof/watertight external building facade.

Schedule of Document Content

Refer to the Structural Design Return Brief, STR drawing for the schedule summarising the information that is not provided with the Tender First Issue Documents and the Tender Final Issue/Contract Documents and advises the allowances that should be included. In addition, the information that will not be provided in the Contract Documents is also identified so that the Contractor can make due allowance. Include a provision for all associated works including design and certification as required.

Design Criteria

The structural design has been based on the criteria stated in ICE’s report, Structural Design Return Brief.

All design or Contractor alternatives shall comply with these criteria and shall be subject to the final approval of the Superintendent.

Any visible external connections are to be low profile and are subject to the Architect’s approval.

Safety in Design

Take all mitigation and actions necessary to ensure that the plant or structure is without risks to health and safety when used for a purpose for which it was designed, including:

- a) Construction methods and techniques that were assumed and form the basis of the design (e.g. erection sequences).
- b) Operating methods and maintenance techniques that were assumed and form the basis of the design.

- c) Consideration of any reasonably foreseeable misuse.
- d) Residual safety hazards and risks relevant to construction, operation, maintenance, decommissioning, demolition, and disposal must be clearly recorded and effectively communicated to those who interact with the design. Information regarding residual risks must include information as to how the residual risk is to be managed.

Undertake a safe works procedure that shall identify safety items and shall include the following:

- a) Propping loads and temporary work/support required
- b) Assessment of access
- c) Working at height requirements, control access to suspended floor and provision of temporary proprietary clamp on handrail system.
- d) Precast removal strategy for the lifetime of the building to allow for future Building Services installation.

Co-ordination of Works

Fully co-ordinate the precast design, shop drawing and installation making do allowance for all building trade requirements.

Prototype Erection / Testing

The Contractor shall allow for all costs associated with the manufacture, delivery, and erection of a multi-panel prototype assembly on site or at the precast factory to confirm details, including weatherproofing, fixings, erection, lifting and future removal process. Multi-panel prototypes to be installed on:

One full bay of façade from ground to roof level

4.16.2 DESIGN

General

The precast units are to be designed for their final permanent location and all temporary loading conditions that will exist throughout the life of the building by the Contractor.

The design shall allow the design and documentation of all precast units and their connections in accordance with the relevant Australian Standards, including adequate allowances for impact effects, during the following operations and criteria:

- a) Stripping from moulds
- b) Factory handling and storage
- c) Turning for finishing
- d) Transport to site
- e) Unloading
- f) Propping and temporary works
- g) Erection and installation
- h) Safe removal and reinstatement of precast panel bays
- i) Verification of works
- j) Review and audit of each panels installation
- k) Review and assessment of de-propping requirements

- 1) Proposed lifting procedure including any necessary reorientation of the units to accommodate this lifting procedure.

Tolerances of Location of Fixings Secured to Building Structure

The design of all fixings shall allow for a minimum tolerance of 25mm in any direction for the location of all bolts, inserts and the like which are required to be secured to the building structures unless a tolerance is nominated on the drawings, or is shown on the approved shop drawings.

The Contractor is solely responsible for the co-ordination of the precast panels and the associated concrete and steel supports.

Certification

The structural adequacy of the design, handling and construction shall be certified in writing by a corporate member of Engineers, experienced in the design of architectural precast concrete elements. Refer to the proposed project lifting plan for removable precast but note that the final method of installation and removal is to be provided by the Contractor. The Contractor's certified design and construction certificates shall be submitted to the Superintendent for review, and shall be modified as necessary to the satisfaction of the Superintendent prior to work proceeding.

Acceptance of the certification of adequacy shall in no way reduce the Contractor's responsibility for the design, fabrication and quality of the final product.

Minimum Requirements

Design items such as the structural thicknesses of units, cover to reinforcement, reinforcement quantities and type, fixing types and concrete mix requirements as nominated on the drawings and in this specification, are the minimum which will be accepted without written approval.

The external profiles and exact dimensions of the precast units shall be shown on the shop drawings submitted for approval.

Refer to acoustic and architectural specification for additional requirements.

Fixings are generally to be provided to the rear of each precast panel. External visible fixings to any precast are subject to the approval by the Superintendent prior to finalisation of design.

Precast Panels

- Standard to AS 3600 - and to other subsections of this section where applicable.
- General - Design panels in accordance with the loading conditions noted.
- Concrete Strength Grades – Minimum 32MPa.
- Precast to be designed for exposure classification B2 to AS3600.
- Size - Dimensions set out on drawings. Refer to appropriate architectural / structural drawings for length and configuration.
- Finishes – Refer to architectural specification and drawings.
- Erected Alignment - Ensure difference between adjacent panels does not exceed 10mm.

Panel Split-up

The precast panels have been indicated by architectural documentation. The Contractor shall review the layout and proposed fixing details during tender and will have deemed to accept the intent with their tender should no comment be raised.

Lifting Units

Lifting and support units of each precast panel shall be provided to suit panel layout, their installation and potential future removal of precast bays.

Samples and Surface Finish

Provide a minimum of two samples (or as advised) to show the surface characteristics, fillet and rebate details of the units to be manufactured.

Color Control

Colour control requirements shall be in accordance with Sections 3.5 and 3.6 of AS3610 and as set out by the architect. All precast elements shall comply with Class 2 finish as set out in Table 3.4.2., AS3610 unless otherwise defined by the architectural specification.

Each precast unit shall be painted as per architectural requirements

Manufacture all precast concrete off site at a recognised precast manufacturers yard or workshop.

Spares

Contractor to allow for the provision of 3 precast panel spares of each size

4.16.3 CODES

The works shall be in accordance with this specification and in conjunction with all relevant Architectural and Structural documentation.

All design, materials and workmanship shall comply with the requirements of all current Australian Standards and with the recommendations outlined in "Recommended Practice - Design and Detailing of Precast Concrete - Institute of Australia September, 1983".

Unless otherwise stated in this specification, all work described as precast concrete shall comply strictly with all requirements for concrete work specified in AS 3600 and all work shall be carried out in conformity with the requirements of any Authority having jurisdiction over the work. In the case of a conflict between the referenced Standard Specification or Code and this Specification, the more stringent provisions shall apply.

Codes relevant to this specification are:

AS 3600 - 2018	Concrete structures
AS 3610 - 1995	Formwork for concrete
AS 3610.1 - 2010	Formwork for concrete.

Part 1: Documentation and surface finish

AS 1379 – 2007	Specification and supply of concrete
AS 1170.0 - 2002	Part 0: General principles
AS 1170.1 - 2002	Part 1: Permanent, imposed and other actions
AS 1170.2 - 2011	Part 2: Wind actions
AS 1170.4 - 2007	Part 4: Earthquake actions in Australia
AS 3972 – 2010	General purpose and blended cement
AS 2758.1 - 1998	Aggregates and rock for engineering purposes - Part 1 - Concrete aggregates
AS 3582.1 - 1998	Supplementary cementitious materials for use with portland and blended cement – Fly ash
AS 3583.1 - 1998	Methods of test for supplementary cementitious materials for use with portland and blended cement – Determination of fineness by the 45 micrometre sieve
AS 3850 – 2003	Tilt-up concrete construction
AS 1478.1 - 2000	Chemical admixtures for concrete, mortar and grout – Admixtures for concrete
AS/NZS 4671 - 2002	Steel reinforcing materials
AS 1554.3 - 2008	Structural steel welding - Welding of reinforcing steel
AS1012.1 - 1993	Methods of testing concrete – Sampling of fresh concrete
AS 1141.3.1 - 2012	Methods for sampling and testing aggregates – Sampling – Aggregates
AS 4100 – 1998	Steel structures
AS/NZS 4284 - 2008	Testing of building facades

All Standards shall include the latest amendments up to the date of tender. Any other Standard mentioned in the body of the preface of the above Standards shall be considered as part of this specification. Materials or operations not covered by the above Standards shall conform to the appropriate Australian Standard or if no such Standard exists, they shall conform to the standards laid down by the American Society for Testing Materials (ASTM).

4.16.4 MATERIALS

Concrete

General

Concrete materials shall generally comply with AS3600-2018, Section 17.

Cement

Cement shall be Type SL to AS3972, unless otherwise specified.

Recycled Aggregate and Concrete Content

A minimum of 20% of aggregate used in concrete must be sourced from recycled aggregate. The aggregate used must be classified as Class 1 Recycled Concrete Aggregates (RCA). In addition, a minimum of 30% of cement in pre-cast concrete shall be replaced with industrial waste product.

Industrial waste products must not be sourced from industrial facilities co-fired with hazardous waste.

The concrete properties specified within this document and on the design drawings must not be compromised with the nominated replacement of aggregate.

Reinforcement

Specifications

All reinforcement shall comply with the following standard:

AS/NZS 4671–2001 Steel Reinforcing Materials.

Reinforcement shall be readily identifiable as to grade and origin.

Reinforcing bar and mesh shall have an average post-consumer recycled content greater than 50%

Accessories

All bar chairs and spacers are to be of non-ferrous material (e.g. plastic).

Metal Attachments

All metal attachments are to be in locations permanently protected from the external environment.

Ferrules

All externally exposed ferrules shall be fabricated from stainless steel.

Bolts, Nuts, Washers and Packing Shims

All bolts and nuts shall be of galvanised mild steel (grade 8.8).

All metal washers and packing shims shall be galvanised mild steel.

After installation coat all exposed steel surfaces with an approved epoxy sealant.

All fixings including bolts, nuts, washers, cover plates etc. that are visible to the external face in the final position of each precast unit shall be treated so that they meet the architectural intent. Allow for stainless steel fixings to the approval of the architect

Fixings

Fixing angles and brackets shall be galvanised unless noted otherwise on the drawings.

Dowels

All dowel pins and bolts shall be of galvanised mild steel, unless noted otherwise in the drawings.

4.16.5 MANUFACTURE

General

All units shall be constructed accurately to the shapes, sizes and profiles indicated on the drawings and all necessary provisions shall be made for handling, hoisting, lifting, holding and precast fixing of the units.

Finish shall be uniform texture throughout, free from pitting and other defects. All finishes are subject to the approval of the Superintendent and shall be of the same standard as the approved sample panels.

Care shall be taken to provide clean, smooth, unpitted surfaces to all areas of units where in contact finally with sealants.

All arises shall be uniform and to the dimensions shown on the approved shop drawings.

All required ferrules and other fixings and hoisting eyes shall be cast in accurately to positions shown or required.

Any panel that is considered by the Superintendent to be non-complaint with the documentation shall be rejected. See Section 7.

4.16.6 REINFORCEMENT

Placement of Reinforcement

Reinforcement shall be accurately positioned and located to maintain position until completion of the pour. Bar chairs shall not be used to support reinforcement off faces where the finish is to be exposed to view.

All reinforcement is to be securely suspended from a suitable support framework. Where bar chairs or spacers are used, they shall be of non-ferrous material (e.g. plastic). The ends of the tie wire shall be turned away from the face of the panel.

Minimum cover to reinforcement shall be as follows, unless agreed otherwise.

Exposed face: 30mm, Internal Face: 20mm

Tolerances: - 0, + 5mm

Units which have any ferrous materials, other than the fixings and inserts shown, closer to the surface than specified will not be accepted.

4.16.7 TOLERANCE

Each precast unit shall be constructed to fall within the tolerances set out in the following table:

Checking for compliance with the specified tolerances will be carried out in accordance with

the recommended procedure given in Appendix C2.2 of "Recommended Practice - Design and Detailing of Precast Concrete - Concrete Institute of Australia, September 1983".

4.16.8 PANEL IDENTIFICATION

All units are to be clearly numbered with the panel identification number, type, date of casting and unique identification number if two or more identical panels are cast on the same day.

DIMENSIONAL TOLERANCES IN PRECAST UNITS

DIMENSIONS	TOLERANCES
Flat Panels	
a) Cross section, overall dimensions: Less than 600mm 600mm to 1500mm Greater than 1500mm	$\pm 3\text{mm}$ $\pm 6\text{mm}$ $+ 10\text{mm}, - 6\text{mm}$
b) Length, critical dimensions of abutting members	$+ 0, - 6\text{mm}$
c) Openings	Length and width $\pm 3\text{mm}$
d) Twist	$+ 3\text{mm}, - 3\text{mm}$ and over total length of individual panel
All Units	
a) Straightness of edges and flatness of surfaces	Length/1000 to a max 6mm
b) Warp: Up to 5m diagonal Over 5m diagonal	6mm 6mm
c) Squareness of corners: Up to 2m on shorter side Over 2m, up to 4m Over 4m	3mm 5mm 6mm
d) Core holes, ducts and the like, diameter or side dimensions	$\pm 3\text{mm}$
e) Grooves, width and depth	$\pm 2\text{mm}$
f) Location of grooves and fastenings for window frames, door frames and the like	$\pm 3\text{mm}$
g) Position of individual connection bolts, bolt holes, projecting metal or other devices in any associated group (e.g. the joint of two precast units).	Within 3mm of their true positions in the group in which they are cast.

4.16.9 DELIVERY AND ERECTION

Factory Inspections

All panels shall undergo factory inspection prior to delivery as part of the Contractor's quality system. All damaged panels shall be rejected prior to leaving the factory. A traceable quality assurance system, including photographic record, shall be provided to ensure compliance.

Provision for Erection

Ferrules and/or other methods of attaching lifting and aligning devices to the panels shall be provided in locations to allow access for erection purposes. The lifting and aligning devices are not to be attached to the ferrules in the panels that are to be used for permanent fixing to the structure.

Inspection and Rejection after Erection

The Contractor shall be wholly responsible for removing any units fixed to the structure which later show latent, visual defects and/or are rejected due to transportation/erection damage, faulty materials or workmanship as determined by the Superintendent or Client.

All costs associated including the removal of any such units, manufacturing and re-erection of new units including scaffolding, removal and reinstatement of work affected by other trades, rigging and craneage, shall be borne by the Contractor at no cost to the Client.

4.16.10 REPAIRS TO CONCRETE

General

Extensive patching of honeycombed concrete will not be permitted. Refer also to AS3610 (Formwork Code) for limitations on the extent of permissible repairs.

Trial Repairs

No repairs to concrete shall be made until an agreed method of repair is provided for review. Extensive patching (as defined solely by the Superintendent) of honeycombed concrete will not be permitted.

Conduct trial repairs in positions nominated. The cost of all repair work shall be at the Contractor's expense.

Approval of the final repair shall be solely by the Superintendent. Rejected repairs will required the replacement of panel. See Section 7.3

Repair Requirements

Repair types, materials and procedures shall be proposed by the Contractor for Superintendent approval.

4.16.11 CONSTRUCTION CERTIFICATION

Provide construction certification such that their panels have been designed and installed in accordance with the shop drawings, contract documentation, including the specification and

design intent drawings. This includes all temporary works required to install each panel and review of each panel prior to removing each prop. Experience of the appointed Contractor's engineer shall be submitted and is subject to satisfaction of the Superintendent and should the Superintendent wish to reject the Contractor's appointment no reason shall be required, and the Contractor shall seek an satisfactory alternative

The Contractor's certified design shall be submitted to the Superintendent for review, and shall be modified as necessary to the satisfaction of the Superintendent. Acceptance of the certification of adequacy shall in no way reduce the Contractor's responsibility for the design, fabrication and quality of their final product.

5 STEEL

5.1 GENERAL

5.1.1 EXTENT OF WORK

This section of the specification specifies the requirements for the design, manufacture and installation of all structural steelwork (primary and secondary steelwork) indicated on the project drawings, required for service installation/reticulation and/or described in the project specifications.

The structural drawings are provided as “reference design” documentation. Certification of the “Final Tender Documentation” which documents the primary steelwork will be provided with sufficient information that will allow the Contractor to develop their remaining construction details and provide their final certification of the works.

The Contractor’s works shall include all primary steelwork nominated including the development of all fabrication details, connections, preparation of shop drawings and the erection of steelwork.

In addition, secondary steelwork not specifically documented for internal and external façade systems, trimmers, louvres, door opening etc. shall be designed, documented and certified by the Contractor to suit the illustrated intent of the current drawings and the specific item and construction sequence adopted by the Contractor.

5.1.2 SCHEDULE OF DOCUMENT CONTENT

Refer to the Structural Design Brief, for the schedule summarising the information that is not provided with the Tender First Issue Documents and the Tender Final Issue/Contract Documents and advises the allowances that should be included.

In addition, there will be no further design information provided following tender. Documentation has identified parts of the design that the Contractor must make due allowance and include a provision for all associated works/costs including design and certification as required to progress finalise the scheme.

5.1.3 DESIGN CRITERIA

The structural design has been based on the criteria stated in ICE’s report, Structural Design. All design or Contractor alternatives shall comply with these minimum criteria and the intent on the Contract documentation to the approval of the Superintendent.

5.1.4 SAFETY IN DESIGN

Take all mitigation and actions necessary to ensure that the plant or structure is without risks to health and safety when used for a purpose for which it was designed, including:

- a) Construction methods and techniques that were assumed and form the basis of the design (e.g. erection sequences).

- b) Operating methods and maintenance techniques that were assumed and form the basis of the design.
- c) Consideration of any reasonably foreseeable misuse.
- d) Residual safety hazards and risks relevant to construction, operation, maintenance, decommissioning, demolition and disposal must be clearly recorded and effectively.

Undertake a safe works procedure that shall identify safety items and shall include the following:

- a) Propping loads and temporary work/support required.
- b) Assessment of access and crane/scissor lift provisions.
- c) Working at height requirements, control access to roof and provision of temporary proprietary clamp on handrail system to roof.

5.1.5 CO-ORDINATION OF WORKS

The Contractor shall fully co-ordinate the design, shop drawing and installation making due allowance for all building trade requirements.

This includes the co-ordination of all penetrations (including roof, louvres, façade etc.) and all additional secondary steel, if necessary for the final scheme, with reference to the typical details provided. Roof purlins shall be adjusted to suit and trimming steel provided subject to the final Services and Steel Shop Drawings.

The Contractor shall also be responsible to co-ordinate the precast, facade and steelwork co-ordination of their final scheme.

5.1.6 CERTIFICATION

The Contractor shall provide design and construction certification such that all steelwork is designed and installed in accordance with the design, specification, drawings, and approved shop drawings. Certification shall be provided from a corporate member of Engineers Australia or Chartered Professional Structural Engineer. The Contractor's certified design shall be submitted to the Superintendent for review, and shall be modified as necessary to the satisfaction of the Superintendent prior to any works proceeding. Experience of the appointed Contractor's engineer shall be submitted and is subject to satisfaction of the Superintendent and should the Superintendent wish to reject the Contractor's appointment no reason shall be required and the Contractor shall seek a satisfactory alternative

5.2 DESIGN

Acceptance of the certification of adequacy shall in no way reduce the Contractor's responsibility for the design, fabrication and quality of their final product. Changes to the documentation will require the documents to be re-certified.

5.2.1 GENERAL

Materials, construction, fabrication and erection: To AS 4100.

5.2.2 CODES

Refer to the relevant Codes referenced in this Specification. Comply with AS 4100, The Use of Steel in Structures. Where relevant, also comply with the latest edition of the Codes as listed below. Reference in this Specification to specific clauses of various codes is not intended to imply a lesser importance for any other applicable clauses.

AS 1101.1 - 2007	Graphical symbols for general engineering
AS 1101.3 – 2005	Welding and non-destructive examination
AS 1111 - 2000	ISO metric hexagon commercial bolts and screws
AS 1112 - 2000	ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts
AS 1163 – 2009	Cold-formed structural steel hollow sections
AS 1171 – 1998	Methods for magnetic particle testing of ferromagnetic products and components
AS 1214 - 1983	Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237.1 - 2002	Plain washers for metric bolts, screws and nuts for general purposes - General plan
AS 1237.2 - 2002	Plain washers for metric bolts, screws and nuts for general purposes – Tolerances
AS 1252 - 1996	High strength steel bolts with associated nuts and washers for structural engineering
AS 1397 - 2011	Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium
AS/NZS 4855:2007	Welding consumables – Covered electrodes for manual metal arc welding
AS 1554 – 2011	Structural Steel Welding Code
AS 1554.1 – 2011	Structural steel welding – Welding of steel structures
AS 1554.2 - 2003	Structural steel welding - Stud Welding (steel studs to steel)
AS 1594 - 2002	Hot rolled steel flat products

AS 1595 - 1998	Cold rolled, unalloyed, low carbon steel sheet and strip
AS 1627 - 1997	Metal finishing - Preparation and pre-treatment of surfaces
AS 1657 - 1992	Fixed platforms, walkways, stairways and ladders - design, construction and installation
AS 1710 - 2007	Non-destructive testing of carbon and low alloy steel plate and universal sections - Test methods and quality classification
AS 1796 - 2001	Certification of welders and welding supervisors
AS 2062 – 1997	Methods for non-destructive penetrant testing of products and components
AS 2074 - 2003	Steel castings
AS 2177 – 2006	Non-destructive testing – radiography of welded butt joints in metal
AS/NZS 2312 - 2002	Guide to the protection of structural steel against atmospheric corrosion using protective coatings
AS 2214 - 2004	Certification of welding supervisors in structural steel welding (known as the SAA Structural Steel Welding Supervisors Code)
AS 3678 - 2011	Structural steel – hot rolled plates, floor plates and slabs
AS 3679.1 - 2010	Hot rolled bars and sections
AS 3679.2 – 2010	Welded I sections
AS 4100 - 1998	Steel Structures
AS 4600 – 2005	Cold formed steel structures
AS/NZS 4680 - 2006	Hot dipped galvanized (zinc) coatings on fabricated ferrous articles

Other Publications:

Design Capacity Tables for Structural Steel: AISC

Standardised Structural Steel Connections: AISC

5.3 QUALITY

5.3.1 INSPECTION AND TESTING

Implement a Quality Assurance System to ISO 9001 to cover all aspects of the structural

steelwork and ensure all products and services supplied by other parties in the scope of this specification are provided under a quality assurance system to ISO 9001.

5.3.2 COMPLIANCE OF STEEL

Structural steel shall comply with all requirements of the relevant Australian Standards. Certified test certificates in line with the appropriate steel product material standards e.g. AS/NZS 1163, AS/NZS 3678, AS/NZS 3679.

Provide valid certificates of approval issued by an acceptable third-party compliance assessment body such as the Australian Certification Authority for Reinforcing Steels (ACRS). The Contractor shall provide details of their proposed third-party compliance assessment body to the Superintendent for approval prior to their appointment.

Evidence of compliance must be submitted as part of the quality assurance process prior to any fabrication works.

All evidence (including certification) must be submitted in English and to the approval of the Superintendent.

5.4 TESTS

5.4.1 NON-DESTRUCTIVE WELD EXAMINATION (NDT)

Standard: To AS/NZS 1554.1.

Radiographic and ultrasonic inspection: Have the examination performed by an independent accredited testing authority.

Repairs: Repair faulty welds revealed by non-destructive examination and repeat the examination.

Minimum Non-destructive weld examination (NDE) table

Type of weld and category	Examination method	Extent (% of total length of weld type)
Shop Fillet welds	Visual inspection	100
All Site welds, SP	Visual inspection	100
	Radiographic or ultrasonic inspection (NDT)	50
All Butt welds, SP	Visual inspection	100
All Butt welds, SP	Radiographic or ultrasonic inspection (NDT)	10

If radiographic or ultrasonic testing shows inconsistency in the welding the extent of NDT testing to ALL welds shall be increased (to a level to be determined) to ensure a level of confidence is achieved for the project at the Contractors expense.

5.5 MATERIALS AND COMPONENTS

5.5.1 STEEL TYPE AND GRADE

Standards

Cold-formed sections: To AS/NZS 4600.

5.5.2 STEEL GRADE TABLE

Steel grades to comply with the following schedule:

Type of steel	Grade
Universal beams and columns, parallel flange channels, large angles to AS/NZS 3679.1	300
Flat, small angles, taper flange beams and columns to AS/NZS 3679.1	300
Welded sections to AS/NZS 3679.2	300
Hot rolled plates, floor plates and slabs to AS/NZS 3678	300
Hollow sections to AS 1163: - typical SHS, RHS and CHS sections UNO	C350
Cold formed purlins and girts to AS 1397	G450 Z350

5.5.3 STEEL GRADE SCHEDULE

Type of steel	Grade
Hot-rolled plate, sheet and strip to AS/NZS1594	300

5.5.4 MEMBERS

Traceability

All steel elements, including bolting, are to be identified and traceable to the manufacturer's material/ mill test certificates.

Third party product certification to be provided for steelwork. Refer to Section 3.

5.5.5 BOLTS

Bolts, Nuts and Washers

All bolts shall be grade 8.8/S (unless noted otherwise). Bolts to be hot-dipped galvanised, corrosion-free coated in oil and in serviceable condition.

Provide accredited laboratory independent compliance certificates confirming compliance to AS/NZS 1252 for all structural bolts or similar. Additionally, bolts and bolt assembly are required to be compliant with the Roads and Maritime Services (RMS) Quality Assurance Specification, B240 - Supply of Bolts, Nuts, Screws and Washers, or similar.

5.5.6 CONNECTIONS

Connection type: Unless noted otherwise, all connections shall have a minimum of 10 mm plate cleats, 6 mm continuous fillet welds and 2 M20 bolts in 8.8/S bolting category.

Requirement: Supply end cleats, brackets and other connections, not specifically detailed on the drawings, to suit the location shown thereon with gauge and edge distances in accordance with AS 4100.

Identification: Supply and deliver all field bolts, washers, etc. to the site in properly labelled bags.

Finish: All non-stainless-steel bolts to be galvanised and then painted as specified.

Certification: If impact wrenches are intended to be used, they must be calibrated and certified and shall not be used as the primary tension measurement method.

Washers: Hardened washers shall be installed under any bolt head or nut for any slotted or oversized hole in accordance with AS 4100.

Reuse: Under no circumstances shall a bolt which has been fully or partially tensioned be reused. If a bolt has been tensioned beyond snug tight and then has to be removed, it shall be marked accordingly and destroyed.

Bolting category 8.8/TF contact surfaces: Clean, as rolled and free from applied finishes.

5.5.7 FOUNDATION BOLTS

General: Provide each foundation bolt with 2 nuts and 2 oversize washers and provide sufficient thread to permit the levelling nut and washer to be set below the base plate.

Galvanizing: Galvanize all components. Minimum coating: 55 pm DFT

Set out: Set out bolt groups accurately in the concrete and forms using templates and ensure they are rigidly held during concreting operations. Ensure the length of anchor bolts and the elevation at which they are set is such that two full threads project above the nut when fully tightened. Use galvanised 'U-bolts throughout of minimum size M20, Grade 4.6/S cast in 400 mm unless noted otherwise on the drawings.

Position anchor bolts within the following tolerances:

Deviation of a bolt within a bolt group (including verticality): +/- 3 mm

Deviation between groups: +/- 6mm

Maximum accumulated deviation between groups: +/- 6mm per 30 m

Centre of bolt group off grid: not greater than 6mm

5.6 EXECUTION

5.6.1 FABRICATION

Fabrication shall comply with AS 4100.

Minimise on site welding and maximise the extent of shop fabrication.

Where site welding is undertaking, it shall be thoroughly cleaned and cold galvanised applied. All work shall be in accordance with AS1554 and to the approval of the Superintendent.

Tolerances for fabrication of structural steelwork shall be as per AS 4100.

Tolerances

Fabricate all structural steelwork within the tolerances set out in Section 14 of AS 4100. Straighten steelwork, if necessary, by methods that will not damage the metal. If it is necessary to heat the steel for straightening, do not exceed 650 C, and allow the steel to cool slowly.

Column bases

Ends of columns shall be accurately saw cut or machined to provide full contact with mating surfaces, surfaces shall be perpendicular to the axis of the column unless otherwise shown.

Mechanical and Electrical Equipment etc.

Check all dimensions of all equipment, plant platforms, lifting beams etc. prior to fabrication to ensure that the design and work is fully coordinated.

Trimmers

Allow for all trimming of purlins and girts as required for roof and wall penetration for ducts, flues, windows, doors, angle cut cladding, access panels and the like whether or not they are shown on the drawings.

Ladders and Walkways

All ladders and walkways to conform to this Specification, to AS 1657 and to the NCC as a proprietary item.

5.6.2 BOLTING

All bolts to be galvanised and painted where specified.

5.6.3 WELDING

General

Welding shall be performed strictly in accordance with AS 1554, all relevant parts. Welding operators shall be suitably qualified in accordance with AS 1554, and referenced codes. Comply with all parts of AS 1554 as the minimum standard for structural steel, in accordance with AS 1554.1. For other materials, refer to the relevant part of AS 1554.

5.7 ERECTION

General

Erection of structural steel shall be in accordance with Section 15 of AS 4100. All temporary works associated with the safe erection of the structure in the temporary condition will be the responsibility of the Contractor to suite their construction criteria.

Temporary Members

Particular attention is drawn to the necessity of providing and installing, and afterwards removing, if necessary, sufficient temporary bracing to keep the structure plumb and in true alignment until other structural units provide the necessary permanent bracing.

Deflections in the temporary condition

The Contractor shall make all allowance for the deflection of steel members in the temporary condition during erection and will where necessary provide temporary propping or support of members in this temporary condition until such time as the permanent structure is completed.

Clearances

The maximum erection clearance for web cleated beams is 1.5 mm at each end. The maximum erection clearance for beams without web cleats is 3 mm at each end.

Surveys

Tolerances shall be in accordance with AS 4100

Permanent Steel Formwork

Purlins and Girts

Ensure purlins and girts do not deviate from straightness by more than one five-hundredth of their length with a maximum deviation of 20 mm. Ensure the tops of purlins, prior to erection of the roof sheeting, are substantially in a plane parallel to the specified roof slope and do not deviate from this plane by more than one two-hundredth of the purlin spacing.

All suspension systems off purlins shall be in accordance with all manufacturer's requirements.

All purlins shall be provided with thermal spacers between roofing and insulation.

5.8 FINISHES

5.8.1 PROTECTIVE COATINGS

All steelwork shall be provided with a corrosion protection system that shall have a period to first maintenance of at least 20 years minimum for both internal and external applications.

Refer also to Architectural Steel Paint Specification which documents the extent of additional/amended building paint specification/system that is to be applied to both internal

and external architecturally nominated steelwork members.

5.9 COMPLETION

5.9.1 TEMPORARY CONNECTIONS

Remove temporary cleats on completion and restore protective coatings to the surface.

5.9.2 CONSTRUCTION CERTIFICATION

The Contractor shall provide construction certification such that all steelwork is designed and installed in accordance with the design, specification, drawings and shop drawings.

The Contractor's certification shall be submitted to the Superintendent for review and shall be modified as necessary to the satisfaction of the Superintendent.

Acceptance of the certification of adequacy shall in no way reduce the Contractor's responsibility for the design, fabrication and quality of their final product.