TABLE OF CONTENTS

SECTION TS 4. PRECAST CONCRETE

SECTION TS 4. PRECAST CONCRETE

4.1 GENERAL

This section of the technical specification covers the general and specific requirements of precast concrete. It shall apply wherever precast concrete is used in the Works, as shown on the Drawings or specified in this and other technical specification clauses or where it is approved in writing by the Engineer in writing to be used as alternative form of construction.

Concrete in precast concrete units shall be in accordance with the requirements of Section TS 3 of this Specification.

Storage handling, transport from the site storage area and erection of the precast concrete members are covered in Section TS 8 of this Specification.

This section shall apply whether or not precast concrete units are manufactured directly by the Contractor or a specialist, reputable manufacturer approved by the Engineer. Where precast concrete units are obtained from an approved specialist manufacturer, other than the Contractor, the Engineer may, at his sole discretion, waive the need for the Contractor to submit detailed manufacturing plans and calculations.

4.2 FORMWORK

4.2.1 General

Formwork shall comply with the requirements of Section TS 3 of this Specification except as modified below.

Prior to the commencement of manufacture of this units, the Contractor shall submit detailed plans and calculations of the proposed formwork. These plans shall include details of all formwork, formwork joints, sealing procedures, ties, size and spacing of framing and details of any propriety fittings or systems proposed to be used.

The dimensions of formwork shall make allowance for changes in dimensions due to shrinkage, elastic shortening and creep, so that the completed unit conforms with the tolerances specified.

Formwork shall be constructed so that movement of the unit resulting from the effects of shrinkage, steam curing and prestress is not restrained and so that the unit is not damaged by movement within the formwork, Special attention shall be given to projecting reinforcement and bolts and to the methods of fixing base plates and devices for holding down deflected tendons.

4.2.2 Formwork Materials

Forms shall generally be manufactured from steel only. However, the Engineer may consent to the use of plywood and timber formwork for non-repetitive non-prestressed units.

4.2.3 Forms

Where forms incorporate insertions for forming voids in the units, the formers and the method of securing them in position shall be subject to the consent of the Engineer. Void formers shall be securely restrained in position vertically against the action of placing concrete and subsequent

flotation under vibration. The void former shall likewise be laterally restrained against forces arising from differential pressure during placing of concrete.

4.3 STEEL REINFORCEMENT

The supply, bending, cutting and placing of reinforcement shall be in accordance with the requirements of Section TS 3 of this Specification except as modified below.

Reinforcement shall be supported at no more than 0.5 metre intervals transversely and 1.0 metre longitudinally or vertically unless otherwise consented to by the Engineer.

Unless shown otherwise on the Drawings the clear cover to bars shall be the greater of one and a half (11/2) times the diameter of the bar and 25 mm.

4.4 PROJECTING REINFORCEMENT

Where shown on the Drawings, steel reinforcement shall be left projecting for the purpose of bonding on subsequent work. Care shall be taken to avoid disturbing the bars during the specified period for curing of the concrete. Projecting reinforcement which has been damaged or dislodged or which is loose in the concrete will be cause for rejecting of the units.

4.5 BEARING PLATES

This clause is not applicable to this contract.

4.6 UNIFORMITY OF PROFILE-PRECAST BEAMS

Where a number of beams are to placed in one span, it is essential that the hog of these beams be as nearly uniform as practicable. Accordingly, the Contractor shall ensure that:

- The concrete in these beams is uniform in compensation, consistency, compaction and strength.
- The curing conditions are as uniform as practicable.
- The concrete in each beam is approximately the same age when tensioned.
- All the beams or segments for any one span are cast within as short a time as is reasonably practicable.

4.7 MARKING

The identification number, date of casting, the lifting positions and the word 'TOP' shall be marked on every unit.

Immediately after screeding, temporary identification shall be made on the top surface of the unit near an end. Final marking shall be made by indelible marking material, using letters approximately 75 mm high.

The ends of unsymmetrical members shall be clearly marked to indicate the manner in which they are to be oriented in the structure.

4.8 PREPARATION OF STORAGE AREA AND ACCESS TRACKS

The Contractor shall construct a storage area and access tracks in accordance with the requirements of this Clause.

The storage area shall be sufficient size to accommodate all units and allow for handling and manoeuvring of cranes and vehicles. The surfaces of storage areas and access tracks shall be paved to provide adequate drainage and ensure that surface water will not pond.

The width of access tracks shall not be less than 3.5 metres. Access tracks shall be widened on curves where required to accommodate trailing bogies for transport of long units.

Crossfall on access tracks shall not be greater than 1 in 30 unless consented to by the Engineer.

The alignment and grading of the access tracks shall be as shown on the Drawings or as consented to by the Engineer.

After completion of the works or at a time consented to by the Engineer, the Contractor shall reinstate the access track and storage area to the satisfaction of the Engineer.

4.9 DEFECTIVE CONCRETE

Concrete which is not placed and completed in accordance with this Specification, or does not meet the requirements of this Specification in regards to surface finishes, or which is, in the opinion of the Engineer, defective, shall be removed within the limits assigned by the Engineer and replaced in accordance with the requirements of Section TS 9, Concrete Repairs, of this Specification. Repairs to concrete shall not be carried without the consent of the Engineer.

If a unit is to be repaired the Contractor shall submit for consent details of the materials to be used and the method to be adopted in effecting the repair.

4.10 GENERAL STORAGE REQUIREMENTS

Where units are placed in storage side by side, the minimum lateral clearance between side faces of adjacent units shall be a nominal 50 mm unless otherwise directed by the Engineer.

Where lifting frames are used in handling units, the minimum lateral clearance shall be the overall width of the frame plus 100 mm unless otherwise directed by the Engineer.

Where are stored in the vicinity of trees, the units shall be protected from damage caused by staining from foliage.

Units shall not be stored in areas subject to flooding, within 10 m of existing or proposed overhead power or telephone lines, or over service conduits, drainage pipes or uncompacted fill without the consent of the Engineer.

Concrete foundations used for storage shall be removed from the storage area by the Contractor after the units have been erected.

4.10.1 Storage and Temporary Supports for Precast Beams

Temporary supports for beams shall be concrete unless otherwise specified or consented to by the Engineer.

The Contractor shall submit details of the proposed system of temporary supports for the consent of the Engineer. This information shall be submitted not less than 4 weeks prior to the proposed delivery of the units.

The width of temporary supports shall not be less than 100 mm for units under 7 tonnes in weight and not less than 200 mm for units 7 tonnes and over.

The length of the temporary support shall not less than the height of the unit, or the width of the bottom flange plus 600 mm, whichever is the greater, and the unit shall not be placed within 300 mm of the end of the support.

Temporary supports shall be clear of the sole plate.

The maximum ground bearing pressure for designing supports shall not exceed 500 kPa (50 t/m^2).

All beams shall be laterally supported. The lateral bracing shall be designed for 10% of the dead load of the beam at the mid height of the beam.

The ground or space between supports of a unit shall be carefully cleared and levelled to prevent the unit from being supported at intermediate points.

A minimum clearance of not less than 100 mm shall be provided between soffit of units and the ground. This amount shall be increased in instances where greater clearance is required for handling operations involving lifting frames.

4.10.2 Storage and Temporary Supports for Piles and Slabs

All units shall be supported on bearers clear of the ground. The bearers shall be either steel, concrete or merchant grade hardwood. The bearing pressures on supports and/or ground shall be as shown on the Drawings or as consented to by the Engineer. The safe bearing pressure on ground shall not exceed 500 kPa (50 t/m^2) where units are stacked. The bearing pressures of units on timber shall not exceed 2.0 MPa (200 t/m^2).

Each layer of stacked units shall be separated by seasoned hardwood timber bearers of at least 100 mm wide and not more than 75 mm thick and not less than 30 mm thick. The bearing stresses on these timbers shall not allowable stresses.

Units maybe stored in separate stacks of identical units up to a maximum height of 2 m or 2 units high, whichever is the greater, subject to the consent of the Engineer.

Each layer of units shall be separated by timber bearers in line vertically with the underlying supports.

Piles may be stacked to a maximum of six layers, if consented to by the Engineer. The minimum bearing width for the piles in each instance shall not be less than 200 mm.

4.11 HANDLING

Units shall be carefully handled at all times and shall not be subject to shock and impact loads. They shall be lifted at the positions, and in a manner required by the Drawings and Specification or as consented to by the Engineer. Where the method of handling is not specified the Contractor shall submit, for the consent of the Engineer, details of his proposals for handling the units.

Unless otherwise specified, units such as beams and structural slabs shall be lifted and supported with the top surface uppermost at all times. Beams shall be stored and handled with webs vertical at all times.

Stiffening frames, where required, shall be attached as shown on the Drawings during lifting and handling.

Where shown on the Drawings the Contractor shall provide lifting frames for lifting of the units. Except during the initial lift from the casting bed, units shall be lifted and moved with the lifting frame. When the units are first lifted off the casting bed they shall only be raised vertically and sufficiently to permit attachment of the lifting frame.

The position and mode of attachment of slings or other tackle for guiding and controlling the movement of the units during lifting and transport shall be subject to the consent of the Engineer. Special care shall be taken to protect the units from damage due to slings or other tackle.

The angle subtended by the slings and the longitudinal axis of the unit shall be not less than 60 degrees. A single sling lifting will not be permitted.

Guide ropes shall be attached to each end of units for the purpose of hand guiding the units when being lifted. The guide ropes shall have a nominal capacity of 10 kiloNewtons (1 tonne).

Temporary supports during handling operations shall comply with the relevant provision of this Specification unless otherwise to by the Engineer.

All handling, transport and erection operations shall be performed in the presence of the Engineer or his representative.

4.12 TRANSPORTING

Units shall not be transported to the temporary storage or the Site less than 7 days after casting nor until concrete test samples representing the concrete in the units have reached a strength of not less than the specified 28 days strength.

No unit shall be removed from the casting yard prior to a release note having been issued by the Engineer.

During transporting units shall be handled and supported as specified in Clause 4.11 above.

Units shall be securely fixed to the transporter by means of wire ropes or steel chains of adequate size at each end. They shall pass over the top flange and shall be fitted with suitable tensioners. Provision shall be made to protect the units from damage caused bay these lashings. Adequate restraints shall be provided against lateral deflection.

4.13 DAMAGE TO UNITS

In the event of any unit sustaining damage such as cracking, spalling or deformation of projecting reinforcement or bolts, the unit shall be set aside until it has been inspected by the Engineer, who will decide whether it shall be rejected, tested or repaired.

If a unit is to be repaired, the Contractor shall submit for consent details of the materials to be used and method to be adopted in effecting the repair. Repairs shall be carried out in accordance with the requirements of Section TS 9, Concrete Repairs, of this Specification. Repairs to damaged units and the replacement of rejected units shall be at the expense of the Contractor.

4.14 ACCEPTANCE

Consent or comment given by the Engineer to any drawings, work or methods will be tentative only and will not relieve the Contractor of the responsibility for producing units in accordance with this Specification.

Any unit which is cracked, honeycombed or otherwise defective to an extent which, in the opinion of the Engineer renders it unfit for its intended purpose, will be rejected.

For units made at locations remote from the site, the Engineer will arrange to supervise and inspect the processes involved in the manufacture of the units only, with limited attention to the checking of dimensions of the forms and the finished units. On delivery to the Site, the units will be inspected by the Engineer who will advise the Contractor if the units are acceptable for incorporation into the Works.

Acceptance will only be made following Completion of the Works in accordance with the General Conditions of Contract.

4.15 MEASUREMENT AND PAYMENT

Measurement and Payment for Precast Concrete will not be made exclusively and all costs incurred by the Contractor in complying with the requirement of this clause shall be deemed to be included in the rates and lump sum prices entered in the priced Bill of Quantities for works which incorporate the requirements of Precast Concrete. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs.

SECTION TS 5. Deleted

SECTION TS 6. Deleted

SECTION TS 7. Deleted

TABLE OF CONTENTS

SECTION TS 8. HANDLING AND ERECTION OF PRECAST CONCRETE UNITS

SECTION TS 8. HANDLING AND ERECTION OF PRECAST CONCRETE UNITS

8.1 GENERAL

This section of the Technical Specification covers the general and specific requirements of handling and erection of precast concrete units. It shall apply wherever handling and erection of precast concrete units is required within the works, such as bridge beams or precast units used in building works, or specified in this and other Technical Specification clauses.

The section covers the handling, transport from the site storage area and erection of precast concrete units previously manufactured and placed in temporary site storage area in accordance with the requirements of Section TS 4 of this Specification.

The installation of bearings is covered in Section TS 11 of this Specification.

The supply and replacement of concrete is covered in Section TS 3 of this Specification.

The design, erection and removal of falsework is covered in Section TS 10 of this Specification.

The Contractor shall be responsible for the care of the units while in the storage area and for the maintenance of supports, storage areas, access tracks and drains.

8.2 HANDLING

Handling of precast concrete units shall be in accordance with the requirements of Section TS 4 of this Specification except as modified below.

8.3 SECURING DEVICES, ANCHOR POINTS AND BEARING

The Contractor shall ensure that lashings of chain or wire rope, bearings, lateral bracing and other fittings will not cause spalling or damage to units at contact surfaces.

A minimum of two anchor points per side at each support shall be provided. Bearings or supports shall have low compressive deflection and shall provide adequate frictional restraint to movement of the units. They shall allow for longitudinal rotation of the unit in transport and have adequate width and bearing capacity.

8.4 TRANSPORT OF PRECAST CONCRETE UNITS

Transport of precast concrete units shall be in accordance with the requirements of Section TS 4 of this Specification except as modified below.

During transport of beam units from the storage area to the bridge, the Contractor shall provide end bracing and, if necessary, top flange bracing as consented to by the Engineer or as shown on the Drawings.

For units which are support on a prime mover and a steerable bogie, the prime mover turntable shall have a low coefficient of friction to prevent damage to units. Where the turntable and springing of prime mover does not provide satisfactory rotation requirements, special bearings may be required to support beams during transport.

Beams shall not be handled when wind velocities exceed 30 km/hr. No beam shall be transported from the storage to the bridge and erected if has a bow in excess of 1 in 400 of the length. The bow shall be measured when the beam is on the transporter and before delivery is begun. A beam with a bow greater than 1 in 400 of the length may have approved devices fitted to reduce the bow to an amount acceptable to the Engineer. The bow of each beam shall be continuously observed during the journey by means of a stringline or other approved equipment. Should the bow at any time exceed 75 mm the transporter shall be stopped and steps taken to ensure the safety of the unit before the journey is continued.

8.5 TRANSPORTER TIME RESTRICTIONS

The Contractor shall satisfy himself as to conditions of permits that will apply, and make due allowance in his Bid for transport time restrictions.

8.6 WEATHER AND ACCESS CONDITIONS

When in the opinion of the Engineer, conditions at the site, in storage areas or access roadways are considered to be unsafe for satisfactory transport of units, delivery or handling of units shall be postponed until such times that weather conditions and access are considered by the Engineer to be satisfactory. The Contractor will not be entitled to claim for any financial loss due to adverse weather conditions which prevent the units being delivered to the specified point of delivery.

8.7 DAMAGE TO UNITS

If any unit which has been approved in accordance with the provisions of Section TS 4 of this Specification sustains damage such as cracking, spalling or deformation of projecting reinforcement, the unit shall be set aside it has been inspected by the Engineer.

The Engineer will decide the units is to be rejected and removed form the site, or repaired by the Contractor.

If a unit is to be repaired, the Contractor shall submit for approval details of the materials to be used and method to be adopted in effecting the repair. Repairs shall be carried out in accordance with the requirements of Section TS 9 of this Specification. Repairs to damaged units or the removal from site and replacement of rejected units shall be at the expense of the Contractor.

8.8 ERECTION OF PRECAST CONCRETE UNITS

8.8.1 General

At least four weeks prior to the proposed date of erection precast concrete units the Contractor shall submit to the Engineer for his consent details of his transport and erection methods and the equipment proposed to be used for these operations.

The Contractor shall not commence transport and erection of any concrete units until the Engineer's consent has been received to the methods proposed.

Precast units shall not normally be placed in position less than 14 days after casting supporting structures. Where an earlier placing the time is requested by the Contractor, two additional concrete test specimens shall be prepared when casting the supporting structure, cured and tested. The average

compressive strength of the two specimens shall be not less than the specified Characteristics Minimum Compressive Strength at 28 days and the compressive strength of either specimen shall be not less than 90% of the specified Characteristic Minimum Compressive Strength at 28 days for the supporting structure as shown on the Drawings. Where fixed bearings are specified beams shall not be placed until at least 4 days after fixing the dowels.

Erection operations shall be carried out using only experienced crane operators and cranes which are of a capacity sufficient for the proposed lifting operations.

Where directed by the Engineer the Contractor shall carry out a load test to demonstrate that the crane proposed to be used is stable against overturning when operating at the required radius with a load equal to that of the concrete unit to be lifted.

The crane will be deemed to have passed the test if all outriggers remain firm on the ground when the load is positioned one metre in excess of the proposed maximum working radius.

8.8.2 Erection of Precast Concrete Beams

Concrete beams shall be erected as shown on the Drawings.

Care shall be taken that concrete units scupper openings or with one end constructed differently from the other correctly positioned in the structure.

Beams shall be placed so that anchor dowels at fixed bearings are bearings engaged in the holes provided in the sole plates of beams.

Except as indicated below, beams to be supported on bearings shall be placed only when the temperature of the concrete is less than 30 degrees, as determined by the Engineer. Subject to the Engineer's approval, beams may be placed in position when the temperature is outside the above limit, provided the bearings are pre-test to compensate for the difference between the length of the beam at 27 degrees Celsius and the actual length at temperature occurring during erection.

Similar pre-setting of the bearings may be required to compensate for shortening of the concrete beams due to creep, elastic movement, or other causes, if this requirement is shown on the Drawings or called for in the Special Specifications.

The bearing seatings on the substructure shall be specially prepared to the correct form, dimensions levels and/or slope so that the bearings when lowered into position make full and even contact over their full bearing area, both against the beams and against the contact surface of the substructure, without causing any uneven compression of the bearing.

Where pre-setting of the bearing is required to compensate of the concrete beams due to variations in temperature or other causes, the specially prepared surface shall make allowance for this distortion.

When beams are being placed in position, they shall be braced independently against overturning, before being released by the crane or other lifting device.

Concrete shall not be placed in the deck until all tests of the bridge beams have been completed satisfactorily, and the beams have been accepted by the Engineer.

When bridge beams are in place within one span, permanent formwork (if used) shall be placed close together on a thin bed of cement mortar.

Unless otherwise consented to by the Engineer, formwork shall be supported by the bridge beams, except that the formwork for the end cross girders may be supported by the substructure.

8.9 MEASUREMENT AND PAYMENT

Measurement and Payment for Handling and Erection of Precast Concrete Units will not be made exclusively and all costs incurred by the Contractor in complying with the requirement of this clause shall be deemed to be included in the rates and lump sum prices entered in the priced Bill of Quantities for works which incorporate the requirements of Handling and Erection of Precast Concrete Units. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs and, in particular, shall be deemed to include, but not be limited to, the following:

1) equipment and work involved in the loading onto transport, handling, placing and fixing the units in position and no separate payment will be made for any of these.

TABLE OF CONTENTS

SECTION TS 9. CONCRETE REPAIRS

SECTION TS 9. CONCRETE REPAIRS

9.1 GENERAL

This section of the Technical Specification covers the general and specific requirements of concrete repairs. It shall apply wherever concrete repairs are required within the Works or specified in this and other Technical Specification clauses.

This section covers the repairs of concrete as shown on the Drawings or ordered by the Engineer. The supply and placing of concrete and reinforcement and the supply and use of epoxy resins are covered in Sections TS 3 and TS 12 respectively of this Specification excepted as modified below.

9.2 IDENTIFICATION OF DEFECTS

The defects to be repaired shall be as shown on the Drawings or as directed by the Engineer. The extent of the areas to be repaired shall be subject to the decision of the Engineer who may direct that additional concrete be removed to allow assessment of the defect to be made. In addition the Engineer may direct that the defect be exposed or further exposed prior to giving consent to the method of repair.

9.3 REPLACEMENT OF CONCRETE

9.3.1 Removal of Concrete

Where shown on the Drawings or ordered by the Engineer areas where concrete is to be replaced shall have the existing concrete to the limits assigned by the Engineer.

The Contractor shall submit details of the proposed of removal of the concrete to the Engineer for his consent prior to commencement of any removal operations.

Where concrete is to be removed from a load bearing structure the Contractor shall submit for the consent of the Engineer details of his proposed method of support of the structure.

The area to be removed shall be marked with saw cuts 20 mm deep, cut on straight lines. Corners shall be rounded to obtain good contact between the existing concrete and the new material. Edges shall be undercut to eliminate feather edges and to provide a keyed joint. Where the extent of the area to be removed is not known beforehand the Engineer may consent to the use of a jackhammer to mark the edge. The type and weight of hammer and the type of pint on the tool to be used shall be subject to the consent of the Engineer.

The Contractor shall ensure that the reinforcement is not damaged during the concrete removal process. Any reinforcement damaged by the Contractor shall be repaired at the Contractor's expense in a manner as directed by the Engineer.

After removal of concrete the area shall be flushed with high pressure water or other approved method to remove loose materials and dust. Air blowing may be used if the compressor is lifted with a functioning oil trap.

9.3.2 Reinforcement

Where more than the perimeter of a reinforcement bar is exposed concrete shall be removed to a minimum of one and one half bar diameters beyond the bar. Loose scaly rust on the reinforcement shall be removed. Tightly adhering mortar, if sound, may be left on the steel.

Where the Engineer so directs the surface of the reinforcement shall be prepared to Class SA 2 ½ in accordance with AS 1627 "Metal Finishing – Preparation and Pre-treatment of Surfaces" or equivalent standard. This shall be carried out using water blasting.

Where replacement of reinforcement is required due to corrosion or other causes new bars may be added by splicing onto the walked bars, by welding new bars to the existing with full strength welds or by additional bars into holes drilled into concrete. The Engineer shall direct which method, if any, of the above is to be adopted.

Coating of reinforcement shall only be carried out if ordered by the Engineer.

9.3.3 Concrete

Prior to replacement of concrete the existing concrete surface shall be treated as directed by the Engineer. This treatment may consist of saturating the existing concrete and/or coating the existing concrete with a bonding agent.

The concrete may be replaced with either a Portland cement concrete or an epoxy concrete as directed by the Engineer.

Replacement of concrete, including formwork, placing and curing shall be in accordance with the requirements of Section TS 3 and TS 12 of this Specification except as modified below.

Details of the mix design for concrete intended for use in repair work to be carried out in accordance with this Section shall be submitted to the Engineer at least six (6) weeks before concrete work is to commence.

The mix shall have a minimum cement content of 410 kg/cm^3 and a maximum water cement ratio of 0.40. Where directed by the Engineer a mixture of 65 % Portland cement and 35 % silica fume shall be used for the cement. The maximum aggregate size shall be 10 mm.

No concrete shall be placed until the excavated area has been inspected by the Engineer and his consent obtained in writing.

9.4 REPAIRS TO CONCRETE

9.4.1 Non-Injection Repair

This clause covers the repairs of cracks which are wider than 0.1 mm and which are clean or are capable of being cleaned.

Where shown on the Drawings or ordered by the Engineer repairs shall be carried out by "V" ing the crack to a width of 5 mm at the surface.

Where the cracks are in horizontal surfaces and are to be filled with epoxy by gravity flow the top surface shall be chipped or sawn to form a small trough to provide an inlet for the pouring of epoxy into the crack.

Cracks wider than 6 mm at the surface shall be filled with an epoxy concrete which contains a mineral filler. The Contractor shall submit details of his proposed method of repair for the consent of the Engineer.

Any lines or spills of epoxy shall be immediately removed and the repair finished to an even surface.

Where pouring of epoxy cannot be used an approved epoxy adhesive putty or drypack cement mortar shall be placed into crack and finished to a smooth even surface.

9.4.2 Structural Crack Repairs by Epoxy Injection

Where epoxy injection repairs are shown on the Drawings or ordered by the Engineer the Contractor shall submit to the Engineer for his consent details of an epoxy resin suitable for crack injection.

The crack shall be "V"ed to a width of 25 mm at the surface. The surface shall be then be cleaned free from dirt and broken concrete and any area oil or grease shall be cleaned with solvent. Hole10 mm in diameter shall be drilled to intersect the crack 50 mm below the surface with spacings as shown below.

a. Where the crack does not extend the full depth of the member holes shall be spaced at the desired depth penetration. For cracks less than 0.15 mm wide the maximum spacing shall be 150 mm.

b. Where the crack extends the full of the member the holes shall be spaced as shown:

   (i) For members 0.3 m or less in thickness holes shall be drilled in the crack on one side only and spaced at the thickness of the member.

   (ii) For members greater than 0.3 m thick and less than 0.6 m thick holes shall be drilled on all available sides and spaced at the thickness of the member.

   (iii) For members greater than 0.6 m thick holes shall be drilled generally as in (ii) above but subject to the direction of the Engineer.

The Engineer may direct that intermediate holes be drilled to monitor the flow of injected epoxy.

Nipple stems shall be bonded in each hole and the winded crack filled with an approved epoxy putty. If the crack extends through the member back sealing shall be done to prevent run out. After the epoxy putty has hardened, the heads of all nipples shall be removed except for the nipple at the lowest point.

The resin shall be pumped into the nipple until the epoxy appears at the adjacent stem. After a nipple to the adjacent stem the pumping shall continue through this nipple until the epoxy resin appears at the next stem. This procedure shall be repeated until all the nipples have been injected. On vertical or sloping members the first nipple to be injected shall always be the lowest and the injection shall progress upwards.

Final cleaning of the concrete surface shall be carried out after the grout is seven days old. The injection valves and the hardened sealing compound shall be removed from the surface of the concrete.

9.4.3 Repair of Spalled Concrete

The repair of spalled concrete as shown on the Drawings or ordered by the Engineer shall be carried out in accordance with the requirements of the various clauses of this Section of the Specification as appropriate.

9.5 MEASUREMENT AND PAYMENT

Measurement and Payment for Concrete Repairs will not be made exclusively and all costs incurred by the Contractor in complying with the requirement of this clause shall be deemed to be included in the rates and lump sum prices entered in the priced Bill of Quantities for works which may need to incorporate the requirements of Concrete Repairs. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs and, in particular, shall be deemed to include, but not be limited to, the following:

1) Removal and replacement of concrete, surface preparation, cleaning existing reinforcement, supply and placement of new reinforcement, coating of reinforcement (if ordered) and supply, resurfacing aggregate exposed concrete and repair of spalled concrete, placement and curing of new concrete.

2) crack surface preparation, supply and placement of epoxy to be injected into cracks, drilling of holes for injection valves and supply and placement of injection valves

3) surface preparation, supply and application of sprayed concrete and curing of finished concrete.

TABLE OF CONTENTS

SECTION TS 10. FALSEWORK AND SCAFFOLDING

SECTION TS 10. FALSEWORK AND SCAFFOLDING

10.1 GENERAL

This section of the Technical Specification covers the general and specific requirements of falsework and scaffolding. It shall apply wherever falsework and scaffolding is required within the Works, such as for construction of the Goa Kreo Bridge, buildings in the Dam Management Complex and the like, or specified in this and other Technical Specification.

This section covers design, erection and removal of falsework used to support steel or concrete during erection.

Supply and placement of concrete shall be in accordance with the requirements of Section TS 3 of this Specification.

Falsework is defined as the structural system required to support the permanent structural components, material, plant, equipment and personnel required in the construction of the works.

The structural system comprises foundations and all structural members supporting the formwork, or supporting permanent structural components.

10.2 FALSEWORK PROPOSALS

All erection gear, falsework, props, access ways, scaffolding, platforms, railings, erection and dismantling procedures and the like shall comply with the relevant requirements of any local scaffolding regulations.

If required by the Engineer details drawings and design calculations shall be submitted for consent at least four (4) weeks prior to commencement of falsework manufacture. Submission of falsework proposals and subsequent consent by the Engineer shall in no way affect the responsibility of the Contractor for the proper design and construction of the falsework system.

The submitted computations and drawings shall have been certified by an engineer experienced in structural design.

10.3 DESIGN

Falsework shall be of sufficient strength to carry all applied loads, including erection loads, vibration effects, and load concentrations produced by prestressing operations, wind and water loads, including flood debris and drift where applicable. Falsework for prestressed concrete shall be of a design which shall permit the application of prestress without damage to the completed structure. The design shall allow removal of the falsework without damage to the finished work.

Falsework shall be designed to withstand all forces resulting from the loads as specified in this Clause or, in the case of falsework used to support concrete works, from the loads specified in ACI 347 'Recommended Practice for Concrete Formwork' and the Indonesian Loading Code (PMI 1970 - N.I. 18), whichever produces the most significant effect, and any additional loads that may be imposed on the falsework during construction. The design shall take into account the magnitude, direction and duration of these forces individually and collectively.

The design loads (other than those in ACI 347 or PMI 1970 - N.I. 18) shall be –

1. Dead load - this shall include the weight of form, falsework, wet concrete, reinforcement, steel sections and any other material. The density of wet concrete, including reinforcement shall be taken as 2700 kilograms per cubic metre. The density of steel shall be taken as 7850 kilograms per cubic metre.

2. Superimposed load -- this shall include the weight of workmen, plant, equipment and runways, stacked material and an impact allowance equal to 25 per cent of the all up weight of any mechanically operated plant.

   In no case shall the superimposed load be less than 2 kPa (0.02 kg/cm^2) (plus the weight of stacked material) on the plant area of the finished concrete or a single isolated load of 2.5 kilo Newtons applied at any point of the structure, whichever is the more severe.

3. Wind load - this shall be 2.4 kPa (0.024 kg/cm^2) minimum acting on the exposed area of falsework, formwork and any object supported by the falsework or formwork.

4. Other loads – these shall include any special conditions likely to occur during construction, the effects of prestressing, construction stages and removal of falsework. Reference shall be made to the relevant section on Bridge Loads I the Bina Marga Bridge Design Code.

5. Horizontal loading – this shall include wind loading, horizontal surge loading equal to 25 percent of the all up weight of any mechanically operated plant and loading occurring during construction.

In no case shall the design value of the horizontal load acting and any direction be less than 1.5 kiloNewtons per metre applied at the edge of deck or 3 per cent of the total dead load, whichever is the greater.

Unless specified otherwise, the design of all falsework members and connections shall comply with AASHTO HB-14 'Standard specifications for highway Bridges' and ACI 347.

Falsework members supporting concrete shall be design to limit deflections to prevent cracking of previously cast sections due to subsequent casts. Deflections of beams and dimensional changes in other members and connections shall be limited to ensure that the erected steel members or finished concrete (as appropriate) is within the specified tolerances for line level.

The Contractor shall make allowance for the deflections and foundations settlements due to loading prestressing (if any) during the progress of the work, to ensure that the completed work shall conform in respect of all levels and dimensions shown on the Drawings or specified elsewhere

The falsework shall be such as to produce the least practicable obstruction in the waterway area or vehicular or other access. Clearances in the falsework shown on the Drawings or specified shall be provided.

The computations submitted to the Engineer shall state all design assumptions and shall include a detailed analysis of the forces, stresses, stability, deflections and other dimensional changes due to loading in all members of the falsework.

The drawings shall be fully detailed including all member sizes and materials, dimensions, levels, erection procedures and other relevant details including bracing, connections and foundations.

10.4 ERECTION AND USE

10.4.1 General

Falsework shall be erected on firm and secure footings and, in the case of bridges over streams, shall be safe from scour.

Materials shall be sound and sufficiently durable for the purpose intended. Particular consideration shall be given to protection of timber against marine organism in brackish or tidal waters.

10.4.2 Provision for Adjustment

The falsework shall have provisions for making adjustment to level. where the falsework is of tubular construction, screw jacks shall be provided at both top and bottom of the standards.

For other types of falsework construction, provision for a similar form of adjustment shall be made.

10.4.3 Provision for Longitudinal and Lateral Movements

The structural members of the falsework shall be designed for loads which may result from longitudinal or lateral movements caused by thermal or shrinkage effects. Alternatively, provisions shall be incorporated in the falsework to permit these movements.

10.4.4 Bracing

Adequate bracing shall be provided longitudinal and transversely to ensure that the falsework is stable and that significant horizontal movements resulting from the applied loads are limited. Additional bracing shall be provided after erection of the falsework if, in the opinion of the Engineer, the falsework is not sufficiently rigid.

10.4.5 Foundations

The foundations of the falsework shall be designed to prevent excessive settlement, including relative settlement between adjacent supports, and rotation of supports.

Individual footings and groups footings shall be designed also to satisfy stability criteria.

Where the foundation material can become saturated with water, the foundation material can become saturated with water, allowance shall be made for possible reduction in bearing capacity, consequent changes in stability, and increased settlement or heave of foundation. Bearing surfaces of footings shall be horizontal.

Footings shall not be founded directly on filled ground without the consent of the Engineer. Refer also to Clause 10.4.6 below.

Foundation material such as soil, filling, or other materials which are soft and compressible, or which may be subject to erosion by water, shall be removed as required to expose a suitable foundation.

Where such materials have been removed, the excavation may be backfilled to the required level by compacted stabilised crushed rock or equivalent containing not less than three (3) percent cement, to the satisfaction of the Engineer. No such excavation shall be backfilled without the prior examination and the consent of the Engineer.

Footings supported directly on the ground near surface level shall comprise concrete bases, timber and bed logs, or other types of materials approved by the Engineer. Where Contractor proposes to use timber bed logs, they shall comprise sound timber of dimensions not less than 200 mm wide and 100 mm deep.

Timber bed logs, which in the opinion of the Engineer do not satisfy these requirements, shall be removed from the site immediately. Unless approved otherwise, each bed log shall be bedded for its full length on net freshly placed concrete of thickness not less than 150 mm.

The concrete used for footings or under bed logs shall be Class K220 (220 kg/cm^2) or stronger.

Base plates for the falsework standard shall be located to ensure uniform bearing pressure under each footing. Where timber bed logs are used base plates shall be placed not less than 600 mm from the ends centrally within the width of bed logs. Comprise driven piles, bored cast-in-place concrete piles or other suitable type of foundation.

10.4.6 Test Loading

The Contractor shall allow for the falsework, or the foundations of falsework to the best loaded if so required by the Engineer. The test load shall be applied for a period of 48 hours and shall be equivalent to the design load.

The deflection and settlement under test shall not exceed 1/300 of the span of the member being supported. Testing shall be at the Contractor's expense.

10.4.7 Drainage

The Contractor shall provide adequate for stormwater to prevent scour of falsework foundations. Prior to commencement of erection of the falsework, the ground surface under the falsework shall be shaped, and if necessary filled to bring the site to a suitable level, to prevent ponding of water in the vicinity of the falsework footings. Foundations on batters shall be protected against scour directing drainage away from the falsework.

All drainage trenches, pipes and diversion channels shall at all times be maintained to the satisfaction of the Engineer. Where roadside drainage channels pass through the site, the Contractor will be responsible for maintenance of this drainage.

10.4.8 Settlement of Falsework

If falsework settles during construction to and extent which in the Engineer's opinion appreciably alters levels of the supported materials those shown on the Drawings, the Engineer may stop the work and require removal of the supported materials and a through remodelling of the falsework. This work shall be carried out at the Contractor's expense.

10.5 REMOVAL OF FALSEWORK

As soon as practicable all falsework, including fill and other material placed to facilitate construction shall be removed and ground levels as existing prior to the commencement of the work by the Contractor shall be restored, unless shown on the Drawings or as directed by the Engineer.

The Contractor shall submit details of the method he proposes to use to release falsework two weeks prior to commencing this operation.

No falsework shall be released until the Engineer gives his written consent.

Provision shall be made to permit an even and gradual release of the falsework. Where shown on the Drawings the Contractor shall provide for the release of defined sections of the falsework.

10.6 PAYMENT

Measurement and Payment for Falsework and Scaffolding will not be made exclusively and all costs incurred by the Contractor in complying with the requirement of this clause shall be deemed to be included in the rates and lump sum prices entered in the priced Bill of Quantities for works which incorporate the requirements of Falsework and Scaffolding. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs.

TABLE OF CONTENTS

SECTION TS 11. BEARINGS

SECTION TS 11. BEARINGS

11.1 GENERAL

This section covers the general and specific requirements for the supply and installation of the bridge bearings which shall be in accordance with the requirements of this Specification and as shown on the Drawings.

The Contractor shall exercise the utmost care in setting out and fixing all bearings in their correct positions, and in ensuring that uniformity is obtained in all bearing surfaces. Bearings shall be handled with care and stored under cover by the Contractor. The Contractor shall be responsible for any costs involved in making good damaged which may occur after delivery.

Expansion bearings are designed and dimensioned for installation at a nominated temperature. Where the temperature is likely to vary by more than ± 5 degrees Celsius from the nominated temperature, the Contractor shall request the Engineer to give a direction regarding any allowance which shall be made insetting the bearings.

11.2 ELASTOMERIC BEARINGS-LAMINATED-SUPPLY

11.2.1 General

All bearings shall comply with the requirements of AASHTO M 251 'Laminated Elastomeric Bridge Bearings' except where modified by this Specification.

Bearings shall be made from natural rubber and other materials so compounded and cured as to give the properties specified. However, consideration will be given to the use of elastomeric materials other than natural rubber, subject to approval of the Engineer to any variations proposed to the properties specified. Layers of elastomeric material shall be bonded to the steel plates during the vulcanisation in a mould under pressure. Bearings shall comply with the dimensional and shear and compressive stiffness requirements specified in Tables 11.1, 11.2 and 11.3.

11.2.2 Elastomer

The elastomer to be used in the manufacture of the bearings shall be tested as set out in Table 11.1 These tests shall be done at an approved laboratory and two days notice shall be given so that preparation and /or testing of the specimens may be observed by the Engineer, if so required. Three samples shall be taken from every 250 kg batch of mixed elastomeric material and each sample shall meet the requirements specified.

Materials which does not comply with the requirements stated in Table 11.1 shall not be used in the manufacture of the bearings.

All testing shall be at the Contractor's expense.

11.2.3 Bearings

a. Tolerances on dimension

Bearings shall be manufactured to the dimensions as shown on the Drawings within the tolerances given in Table 11.2 . Bearings which do not comply with the requirements specified may be rejected.

b. Testing

i. General

All bearing shall be tested at the Contractor's expense. Tests shall be done at an approved laboratory and in presence of the Engineer or his Representative who shall be given days notice of the tests. The equipment used for testing shall be capable of determining compressive and shear loads to within ± 3% and deflections to within ± 1%. Where necessary to achieve the specified accuracy of testing, equipment shall be calibrated and results obtained corrected accordingly. Bearings shall only be tested after a minimum period of two days elapsed after pressure moulding.

ii. Stiffness in Compression

Each bearing shall be tested for stiffness in compression. The rated load at zero shear is as shown on the Drawings.

Bearings which exceed the relevant tolerance given in Table 11.3 on the compressive stiffness as shown on the Drawings may be rejected.

iii. Stiffness in Shear

After completion on the tests on the stiffness in compression, all bearings shall be tested in shear. (The rated load at maximum shear deflection capacity are given on the Drawings).

The effective shear stiffness at zero shear is shown on the Drawings. Bearings which exceed a tolerance of ±20% on this shear stiffness shall be rejected.

iv. Test With Applied Rotation

One representative bearing selected by the Engineer from every twenty bearings, or part thereof, of each size of bearing shall be tested. Bearings to be tested shall be subject to an angular rotation equivalent to the rotational capacity at rated load at zero shear rounded to the nearest 0.005 radian (or given on the Drawings in the case of non-standard bearings). The angular rotation shall be applied at right angles to the long axis of the bearing while applying the rated load at zero shear.

On completion of rotation test the bearing shall again be loaded in compression in accordance with Clauses 11.3.3.b.ii, above and its compressive stiffness determined. Should this stiffness differ from that previously determined by more than 10%, the bearing, and those bearings represented by it, may be rejected.

v. Visual faults

During the tests for compression and shear stiffness and under rotation, close observation of the bearings shall be maintained so as to detect any fault or variation due to lack of elastomer to steel bond, misplaced plates or inadequately cured elastomer etc.

Should any bearing exhibit any sign of failure such as:

- splitting
- permanent deformation or
- significantly irregular or unsymmetrical surface bulging.

then, unless the Contractor can demonstrate to the Engineer that the fault can be rectified satisfactory, such bearings shall be rejected.

11.2.4 Delivery of Bearings

No bearings shall be delivered to site prior to the Engineer notifying the Contractor in writing that the proposed bearings are acceptable. The issue of such notification will be dependent on each individual bearing complying with Clauses 11.2.2 and 11.3.3 of this Specification and exhibiting satisfactory workmanship.

11.2.5 Test Certificates

The Contractor shall supply a copy of the test certificates showing details of the results from the tests set out in Clauses 11.2.3, and 11.3.3.b for each sample of the elastomer used in the manufacture of bearings, and of the hardness and stiffness in compression of the bearings and note whether any tolerances have been exceeded or whether any faults have been observed.

Table 11.1 – Properties of Elastomer

Properties	Methods of Test	Requirements
Hardness	ASTM D 2240	48 min
Ultimate Tensile Strain		5.75min
Tensile Strength	ASTM D 412	17.5 MPa min
Tear Resistance	ASTM D 624 - Die. C	40.0 kN/m min
Compression Set	ASTM D 395 Method B (22 hrs 70 degrees Celsius)	25% max
Ozone resistance *	ASTM D 1149 20% strain at 40 degrees Celsius ±1 and 1 ppm	No cracking visible by eye after 100 hrs
Accelerated Ageing	ASTM D 573	Maximum Permissible change in properties : Hardness +4 Tensile Strength ±10% Ultimate Tensile Strength -15%
Statistic Modulus in compression and shear **	ASTM D 945	Values to be recorded

* Evidence of recent testing of identical material may be accepted by the Engineer

**Three samples per job where required by the Engineer.

Table 11.2 – Tolerances on Dimension

Dimension	Tolerance (mm)	
	Rectangular ≤ 350x170 mm and Circular ≤ 330 mm Ø	Rectangular ≤ 350x170 mm and Circular ≤ 330 mmØ
Plan dimensions	±2.0	±4.0
Bearing thickness		
T≤ 100 mm	±1.0	±1.0
T> 100 mm	±2.0	±2.0
Rubber side cover	±2.0	±4.0
Outer rubber layer thickness *	±0.5	±0.5
Inner rubber layer thickness *	±0.5	±0.5
Out of parallel between top and bottom surfaces, or between any two non-adjacent plates *	≤ 1.0	±2.0

* These dimensions may be determined be probing or drilling a small diameter hole subsequently plugged with identical material to that used in the manufacture of the bearings.

Table 11.3 – Tolerances on Compressive Stiffness

Compressive Deflection * (mm)	Layer Thickness (mm)	Tolerance (%)
< 0.75	6	30
	9,12,15,18	25
0.75 to 1.25	6	25
	9,12,15,18	20
1.25 to 4.0	6	25
	9,12,15,18	20
2.5 to 4.0	6	20
	9,12,15,18	15
> 4	6	15
	9,12,15,18	15

Note The tolerance for compressive stiffness is based on allowances for variations in properties of elastomer, layer and overall bearings thicknesses and measurement of compressive deflection.

* As measured from 0.1 to 1.1 times the rated compressive load at zero shear.

11.3 ELASTOMERIC BEARINGS-INSTALLATION

11.3.1 Marking and Delivery of Elastomeric Bearings

Each elastomeric bearing shall be clearly labelled or marked with the part number or type, or other specified identification number.

The bearings shall be wrapped in a double thickness of reinforced paper, lapped and taped. They shall be packed in timber crates, with styrene inserts and packing to prevent movement and to protect corners and edges. The crates shall be of substantial construction, well braced and strapped and marked with the contents.

Care shall be taken to avoid damage to the bearings during transport and handling prior to and during installation.

11.3.2 Installation of Elastomeric Bearings

a. Bearing Pedestals

Pedestals shall be cast monolithic with the substructure concrete with aggregate not less than 10 mm diameter. Alternatively they may be cast afterwards with a construction joint set at least 25 mm below the top of the supporting concrete or bonded to the concrete with an approved bonding agent after scabbling.

Pedestals shall be cured in accordance with the requirements of Section TS 8 this Specification for a minimum period of 7 days.

The bearing pedestals shall not loaded before 10 days after casting.

Cored holes shall be provided in the position as shown on the Drawings.

Upper surfaces of pedestals shall receive a Class 2 finish in accordance with the requirements of Section TS 8 of this Specification.

Tolerances on line and level of the bearing surfaces shall in accordance with the requirements of Section TS 8 of this Specification with the additional requirement that the permissible deviation at any point under a 300 mm straight edge placed level in any direction is 1mm.

b. Mortar Pads

Mortar pads, where shown on the Drawings, shall be a stiff cement mortar as specified in Section 3 of this Specification.

Concrete surfaces shall be treated as for pedestals before placing mortar and shall be cool and damp immediately before mortar placing.

Mortar shall be compacted by hammering and shall be trowelled and extended a minimum of 25 mm beyond the bearing edge and finished to a neat inclined face.

Finish and tolerance shall be as for pedestals. The mortar shall be cured under damp hessian for 7 days, or alternatively as consented to by the Engineer.

c. Installation

Elastomeric bearings shall be accurately aligned of the pedestals or mortar pad in the position shown on the Drawings.

The superstructure concrete, if cast in place, may be cast directly over the bearings provided that there is no disturbance to the bearing during these operations and also that there is a minimum 25 mm horizontal extension of the concrete soffit all around the bearing edge.

Where steelwork or precast concrete is to be placed on the bearing the member may be placed directly onto the elastomeric bearing. If any gaps greater than 1 mm occur then the member shall be lifted to permit coating the top of the bearing with an excess amount of an approved epoxy mortar and the member reseated. Any excess of mortar squeezed out is to be removed immediately before it has set and the bearing cleaned and adjacent surfaces made good.

Placing of the bearing, mortar and steel or concrete member shall only be carried out in the presence of the Engineer or his representative and the bearing shall be temporarily restrained as necessary to avoid any disturbance in position during member placing operations.

11.4 MEASUREMENT AND PAYMENT

Elastomeric Bearing Pad

Measurement, for payment, for bearings shall be based on the number of bearing pads supplied, inspected and accepted by the Engineer and installed in accordance with this Specification.

Payment for bearings will be made at the rate entered in the priced Bill of Quantities which shall include full payment for providing all labour, materials tools, equipment and any other work incidental to the supply and installation of the bearings.

Payment for the item will include handling, storage, temporary supports, placing, construction of bearing pedestals (where applicable), placing holding down bolts (where applicable) and finishing and no separate payment will be made for any of these.

Categories of work to be paid under this clause are as follows:

Description	Unit of Measurement
Elastomeric Bearing Pad (316 mm x 316 mm x 41 mm)	No.