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SECTION TS 8. CONCRETE REPAIRS

SECTION TS 8. CONCRETE REPAIRS

8.1 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 10 respectively of this Specification excepted as modified below.

8.2 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.

8.3 REPLACEMENT OF CONCRETE

8.3.1 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.

8.3.2 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 Pretreatment 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.

8.3.3 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 10 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.

8.4 REPAIRS TO CONCRETE

8.4.1 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.

8.4.2 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.

8.4.3 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.

8.5 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.

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SECTION TS 9. FALSE WORK AND SCAFFOLDING

SECTION TS 9. FALSEWORK AND SCAFFOLDING

9.1 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 bridges, weirs, buildings 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 TS3 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.

9.2 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.

9.3 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 –

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.

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 kiloNewtons applied at any point of the structure, whichever is the more severe.

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.

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.

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.

9.4 ERECTION AND USE

9.4.1 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.

9.4.2 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.

9.4.3 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.

9.4.4 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.

9.4.5 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.

9.4.6 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.

9.4.7 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.

9.4.8 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.

9.5 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.

For bridgework over navigable waters removal of the falsework shall include complete withdrawal of falsework piles and footings. After falsework has been dismantled, temporary piles shall be cut back to a depth of 300 mm below ground level.

Under the proposed road pavement the piles shall be cut back 1 metre below finished surface level. All temporary footings shall be removed and excavations associated with the falsework shall be backfilled in accordance with the requirements of Section TS2 of this Specification.

9.6 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.

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SECTION TS.10 EPOXY RESINS

SECTION TS 10.EPOXY RESINS

10.1 SCOPE

This Specification covers the supply and application of epoxy resins as coatings, adhesives and structural systems in the construction, maintenance and repair of concrete structures.

10.2 GENERAL

The Contractor shall employ, or seek the advice of, personnel experienced in the use and application of epoxy materials in the construction of the works, and shall provide the Engineer with evidence of such experience before of commenced.

Epoxy resins may be modified by the use of flexibilisers, plasticisers, dilutants, filters, and pigments, subject to the consent of the Engineer. The choice of the proper system for a given application shall be based on the modulus of elasticity, creep characteristic, rate of heat development, and quantity of head developed during curing. The Contractor shall seek the manufacturer's guidance as to the most suitable system for the required application and shall abide by the manufacturer's recommendations as to properties of the materials to be used.

Adverse environmental conditions will severely affect the performance of the epoxy resin, and the Contractor shall schedule his work to coincide with suitable environmental, conditions or provide a favourable artificial environment at his expense.

The Contractor shall be solely responsible for the performance of the epoxy resin and its compliance with the requirements of this Specification and the Drawings.

10.3 MATERIAL

10.3.1 General

Epoxy Resins shall, unless otherwise shown on the Drawings or consented to by the Engineer, comply with the requirements of ASTM C 881 Type 1, 2 or 3 as appropriate.

The epoxy resin used for a particular job shall have properties suited for the job application as recommended by the manufacturer.

10.3.2 Definitions

For the purpose of this Specification the following definitions will apply :

Adhesive	An adhesive is a substance capable of holding solid materials together by surface attachment.
Epoxy Resin	A resinous polymer containing more than one epoxide group per molecule and which is capable of being converted to a useful thermoset form by reaction with a second component called a hardener. The converted materials are also referred to as epoxy resin.
Hardener	Chemicals resinous in form capable of reacting with epoxy groups in epoxy resins to produce a cross-linked polymer. They usually contain amine or amide groups.

Flexibilisers and Plasticisers — These are usually long chain liquid compounds added to the epoxy resin. Some react during curing to impact a degree of resilience and toughness to a normally rather rigid system. Other are non-reactive and are commonly described as plasticisers.

Fillers, extenders — These are finely divided, non-reactive inert materials added to epoxy and Pigments resins to modify certain properties such as consistency density, and colour.

Aggregates — Stable, non-reactive minerals of specified size grading, which have adequate hardness and strength. Aggregates and sands used for Portland cement concrete are usually satisfactory, but must be dust free and oven dry.

10.3.3 Physical Requirements

The epoxy resin shall not react chemically with the environment in which it is placed and shall remain stable. The curing period of the epoxy shall be such as to allowed adequate time to complete the required operations at the maximum operation temperature.

10.3.4 Sampling and Testing

Epoxy resins shall generally comply with the requirements of AASHTO M 235 'Epoxy Resin Adhesive' and/or ASTM C 881 as applicable.

At least eight weeks prior using and epoxy resin, and on request at any time during the Contract period, the Contractor shall make available an amount of epoxy material sufficient to carry out tests as determined by the Engineer. No epoxy materials shall be used until the results of the tests on samples are known and/or the Engineer gives his consent to proceed.

The Engineer may, at his discretion, arrange to take samples from each separate batch of the delivered epoxy resin. These samples shall be submitted to such test as are deemed to be necessary by the Engineer to prove their conformity with the manufacturer's advance samples and with the details given in the manufacturer's product data sheets.

10.3.5 Information to be Provided by the Contractor

- mixing directions for the base/hardener components of the system
- surface preparation needed or other conditions for use
- minimum and maximum application temperature in degrees Celsius
- curing conditions including maximum and minimum curing temperature in degrees Celsius and curing time
- percentage by mass of volatile material in the mixed resin system
- modulus of elasticity of the cured epoxy resin
- viscosity
- batch number and date of manufacture
- pot or working time for various air temperature between 5 degrees Celsius and 30 degrees Celsius
- safety precautions
- storage temperature of epoxy resin
- shelf life

10.3.6 Rejection and Replacement

If, in the opinion of the Engineer, the samples taken from the epoxy resin delivered to the work are of inferior quality to the advance samples, the Engineer may reject all material delivered to the work which, in this opinion, is represented by the samples. Rejected material shall be replaced by the Contractor at his own cost, or the Engineer may cancel the order for further supplies for the epoxy resin.

10.3.7 Test Methods

The basic procedures of the epoxy resin shall be assessed in accordance with the following Test Methods which are attached as Appendix 'A' and are an integral part of this Specification.

Preparation of Epoxy Concrete.

Making and curing Epoxy Concrete Test Specimens for determining Compressive Strength and Flexural Strength.

Inspection and capping of Epoxy Concrete Compressive Test Specimens.

Composite Cylinder test for Evaluation of Wet-to-dry concrete adhesive.

Tensile Bond Strength of Epoxy Concrete.

Compressive strength of Epoxy Concrete.

10.3.8 Properties Prior to Curing

Shelf Life

The two part epoxy components shall comply with all properties specified for a minimum period of 18 months after delivery. The expiry date of the shelf shall be marked on each container.

Work Time

Unless otherwise consented to by the Engineer, after blending of both component parts of a 4 litre mix at 30 degrees Celsius ± 2 degrees Celsius, the viscosity of the mixture shall remain within a workable range for at least 30 minutes.

Hardening Time

When mixed in the proportions recommended for a project, the compressive strength of epoxy resin mortar or concrete at 24 hours after mixing and curing at 30 degrees Celsius shall be not less than 75 percent of the strength developed in 7 days at 23 degrees Celsius ± 2 degrees Celsius.

10.3.9 Properties in the Cured State

Adhesion. When tested in accordance with Test Method No. 5 the strength of the composite cylinder shall be at least 90 percent of the control specimens at 14 days.

Compressive Strength. When tested in accordance with Test Method No. 7 the compressive strength shall be not less than 70 MPa (700 kg/cm^2) at 7 days.

10.3.10 Supply

The materials shall be packed in standard commercial containers so constructed as to protect the product from contamination. The quantities of resin and hardener packed in their separate containers shall be such that when the contents of the containers are mixed the epoxy materials shall be in their required reacting ratio.

10.3.11 Safety Precautions

All personnel shall be fully instructed in the potential hazards of the material, correct use of equipment, protective clothing washing procedures, washing materials and barrier creams.

Particular care shall be taken to prevent the material from coming into contact with the skin. Before using the epoxy compound, the manufacturer's technical data shall be read with particular reference to information on protective measures.

Personnel shall be informed that toxic fumes may be emitted from epoxy compounds and adequate provision shall be made for ventilation if conditions so dictate.

10.3.12 Storage

Component of epoxy resin shall be stored at a temperature recommended by the manufacturer. Components shall not be kept for more than 18 months and shall be checked before use for signs of crystallisation.

10.4 SURFACE PREPARATION

When removal of concrete is required the removal of dust, scale, oil, grease, dirt or any foreign matter shall be achieved by grinding, abrasive blasting, jackhammering, hand chipping, compressed air and water, or high pressure water jet. The use of hydrochloric acid may be consented to by the Engineer for selected applications.

The Contractor shall submit to the Engineer for his consent the proposed method of surface preparation. The method shall be in accordance with the relevant methods A to H inclusive of this Specification and with the consent of the Engineer. References shall also be made to AS 1627 'Metal Finishing- Preparation and pretreatment of surfaces'.

The Contractor shall be wholly responsible for adequate surface preparation prior to the application of epoxy resin.

10.4.1 Method 'A' Solvent Cleaning- Refer to AS 1627

This method shall be to remove oil, grease, wax, tar and other solvent soluble contaminants from the surface of non-porous materials. Large quantities of contamination shall be removed by hand or power tools prior to solvent cleaning.

Suitable solvents are Petroleum Solvents, Aromatic Solvents or Chlorinated Solvents except that petrol, Benzol or Carbon Tetrachloride shall not be used due to their flammable and toxic nature.

Surfaces may be cleaned by solvents using several techniques :

- immersion in the solvent
- spraying with the solvent
- swabbing with rags or cloths
- immersion in boiling solvent vapour
- trichloroethylene using suitable equipment

Except for the last method repeated cleaning using fresh solvent shall be done for a completely clean surface.

The use of this method alone is subject to the consent of the Engineer who will usually direct that it be used in conjunction with another of the methods below.

10.4.2 Method 'B' Abrasive Blast Cleaning

Abrasive blast cleaning shall be used to prepare steel surfaces to a Class 3 standard as specified in AS 1627. Degreasing of steel surfaces shall be undertaken before abrasive blast cleaning commences. The abrasive used shall be subject to the consent of the Engineer. Abrasive blast cleaning may also be used in galvanised steel, concrete, plastics and ceramics.

Before abrasive blasting a surface, heavy rust, weld spatter or major irregularities shall be removed by mechanical means. Heavy deposits of oil, grease, wax, tar shall be removed by solvent cleaning (Method A) before abrasive blasting.

After abrasive blasting the surface shall be cleaned of any traces of any blast products by clean brushing, blowing with clean dry air or vacuum cleaning. After cleaning, the surface shall be promptly coated with the adhesive before contamination can occur.

10.4.3 Method 'C' Ferric Chloride Etching

This method shall be used to prepare copper, grass and bronze surfaces. These metals are subject to rapid surface and shall be coated with adhesive immediately after preparation.

The surface shall first be degreased by solvent washing (see Method A).

Ferric chloride solution shall be made by mixing ferric chloride, distilled water and nitric acid.

The ferric chloride shall be dissolved in the water in a glass or glazed earthenware container and then the nitric acid added with stirring.

The surface to be etched shall be immersed in the bath at 25 degrees Celsius for 1 to 2 minutes, then washed thoroughly with clean water and finally rinsed with distilled water.

10.4.4 Method 'D' Chromic Acid Etching

This method shall be used to prepare aluminium surfaces which have a tightly adherent film of inert aluminium oxide.

The aluminium shall first be degreased by solvent washing (Method A), followed by chromic acid etching.

Glass or glazed earthenware containers shall be used to hold the chromic acid solution. Eye protection and protective clothing shall be worn at all times when using chromic acid.

The Chromic Acid solution shall be made by mixing water, sodium dichromate and sulphuric acid.

The sodium dichromate shall be dissolved in the water and then the sulphuric acid added slowly with stirring. Water shall not be added to sulphuric acid as violent reaction will result.

The surface to be etched shall be immersed in the solution heated to a temperature between 60 to 70 degrees Celsius for 10 to 15 minutes. The surface shall then be washed thoroughly with clean water and finally rinsed in distilled water. After cleaning, the surface shall be promptly coated with the adhesive contamination can occur.

10.4.5 Method 'E' Hydrochloric Acid Cleaning

This method shall be used to clean sound concrete surfaces which have not been penetrated by contaminants.

If the concrete has been contaminated by oil, grease, paint, tar etc. other cleaning measures shall be adopted.

The hydrochloric acid solution of one part commercial hydrochloric acid to two parts of water by volume shall be made up in rubber, glass, glazed earthenware or plastic container. Suitable eye protection and protective clothing shall be worn when making of using this solution.

The acid shall be added to the water while constantly stirring.

The solution shall be applied to the surface of the concrete at the rate of 1 litre per square metre. When frothing ceases the surface shall be washed with water using a high pressure hose. If thorough hosing is not possible the surface shall be neutralised by washing with a weak solution of ammonia.

10.4.6 Method 'F' Preparation of Rubber Surfaces

This method shall be used to prepare rubber and neoprene surfaces.

Oil and bloom shall be removed from the surface with toluol to produce a uniform jet black appearance, then buffed with 80 grit emery paper or cloth to give a matt finish. All dust shall be removed and the adhesive applied in a uniform layer.

10.4.7 Method 'G' Preparation of Timber Surfaces

The surfaces to be joined shall be dry, sound and free from contamination by oil, grease, tars or old paint. Surface contamination and roughness shall be removed by planning and sanding. All dust shall removed.

10.4.8 Method 'H' Preparation of Bridge Decks

New bituminous road surfaces generally do not need preparation before mixing ceramic road markers. However, old surfaces which are uneven or contaminated with oil shall be prepared by one (or more) of the following methods :

Grinding	A grinding wheel may be used to removed surface irregularities
Burning	A burner may be used to remove oily residues
Detergent	This mild but effective method may be used to remove
Oily washing	Residues from bituminous surface. Neat detergent and a stiff bristle brush shall be used to clean the road surface then wash thoroughly with clean water.

10.5 MIXING

10.5.1 Mixing Equipment

All equipment and materials required for mixing of epoxy components shall be to the approval of the Engineer. All equipment shall be clean and free from harmful residue or foreign particles.

10.5.2 Mixing

Mixing shall be done in accordance with the manufacturer's directions.

The mixing of epoxy components shall in strict accordance with the manufacturer's instructions. Before any mixing is carried out, the correct proportions of components as recommended by the manufacturer shall be arranged into separate batches. All materials shall be conditioned to the temperature recommended by the manufacturer before mixing, usually 20 to 30 degrees Celsius. The base resin shall be stirred by a mixer for 10 seconds or until homogeneous prior to adding the hardener. The hardener shall then be added gradually to the base resin with constant mixing until the components are uniformly mixed.

Mixing shall be performed in a manner which will prevent frothing or air entrainment as this will considerably reduce the strength of the finished product. Mechanical mixing is preferable to hand mixing. The minimum time of mixing is five minutes.

The minimum time of mixing is five minutes.

Only small quantities (less than 1 litre) will be approved fir hand mixing.

When preparing epoxy mortars or epoxy concretes, aggregates shall be added after the epoxy components have been mixed thoroughly mixed prior to adding the next larger grade. Mixing shall then continue until a uniform mixture is produced.

All mixing shall occur as near as possible to the place of application. Mixing time shall not exceed five minutes. Part mixes will not be permitted.

10.6 METHODS OF APPLICATION

10.6.1 General

An epoxy resin shall not be applied over an epoxy application which has already hardened. No epoxy resin shall be applied until the consent of the Engineer's Representative has been obtained as to surface preparation and method of application.

10.6.2 Bonding

The epoxy resin shall be applied to the prepared surface by brush, roller, broom, squeegee, rubber gloves or spray equipment.

The epoxy resin shall be applied at a thickness to fill, with slight excess, the gap between substrate and the element to be bonded. Unless the date is available from the manufacturer the Contractor shall determine on the basis of trial joints an approximate applied rate of epoxy resin per square metre. The Contractor shall monitor the consumption of epoxy resin during the application to ascertain if significant variations occur which may indicate that either too much or too little epoxy is being applied.

Elements to be bonded shall be positioned within the contact time of the epoxy resin, as recommended by the manufacturer. If the movement of the element to be bonded is likely, the element shall be temporarily stressed or shored, within the contact time. The joint shall be checked to ensure uniform bearing and fit. Temporary fastenings or shores shall not be removed without permission of the Engineer. The joint shall not be disturbed until the epoxy resin has set.

Around cable ducts a distance of 25 mm should be kept free of epoxy resin to minimise flow into the ducts.

The Contractor shall have an experienced supervisor on site at all times during jointing operations.

Where it becomes necessary to stop work on joint after the application of epoxy resin has commenced, the Contractor shall scrape off as much of the epoxy resin as possible before it sets. The remaining hardened epoxy resin shall be removed by abrasive blasting and surface prepared according to Clause 18.4

10.6.3 Repair of Damaged Concrete

Repair of Damaged concrete shall conform to the requirements of clause 16 of this Specification.

10.6.4 Date To Be Recorded

The contractor shall keep records of all jointing operations which shall be made available to Engineer if required.

The information recorded shall include :

a Joint number
b date and time
c weather conditions
d shade temperature
e maximum temperature of mix
f time between adding components and initial application
g time between initial application and temporary stressing of elements to be bonded, or final application of surface coatings and fillers
h volume material used

10.6.5 Environmental Restrictions

The Contractor shall comply with the manufacture's recommendations as to environmental conditions under which the epoxy resin may be applied.

Epoxy resins shall not be applied when rains falling unless a non-moisture sensitive epoxy resin used. If rain falls on applied epoxy resin before the surfaces are brought together the application shall be stopped. If it become necessary to stop work on a joint the Contractor shall scrape off as much applied epoxy resin as possible before the material sets, and prepare the surface according to Clause 18.4 before re-applying epoxy resin.

10.6.6 Temperature

When the surface and atmospheric temperatures exceed 32 degrees Celsius difficulties may be experienced in mixing and application. Work shall scheduled when the temperature is generally lower, as in the early morning hours, or the work area should be shaded from direct sunlight prior to, and during the application.

10.6.7 Clean-up

The Contractor shall protect surface beyond the limits of surface receiving the epoxy application from spillage. Any epoxy spilled or applied beyond the desired area of application shall be immediately removed, and the area affected shall be cleaned with material recommended by the manufacturer. The Contractor shall avoid contaminating the work area with the clean-up materials.

All tools and equipment should be cleaned immediately after completion of the application.

10.7 MEASUREMENT AND PAYMENT

Measurement and Payment for Epoxy Resins 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 Epoxy Resins. These shall include the entire cost of completing the work including materials, labour, equipment, transportation and any other associated costs.

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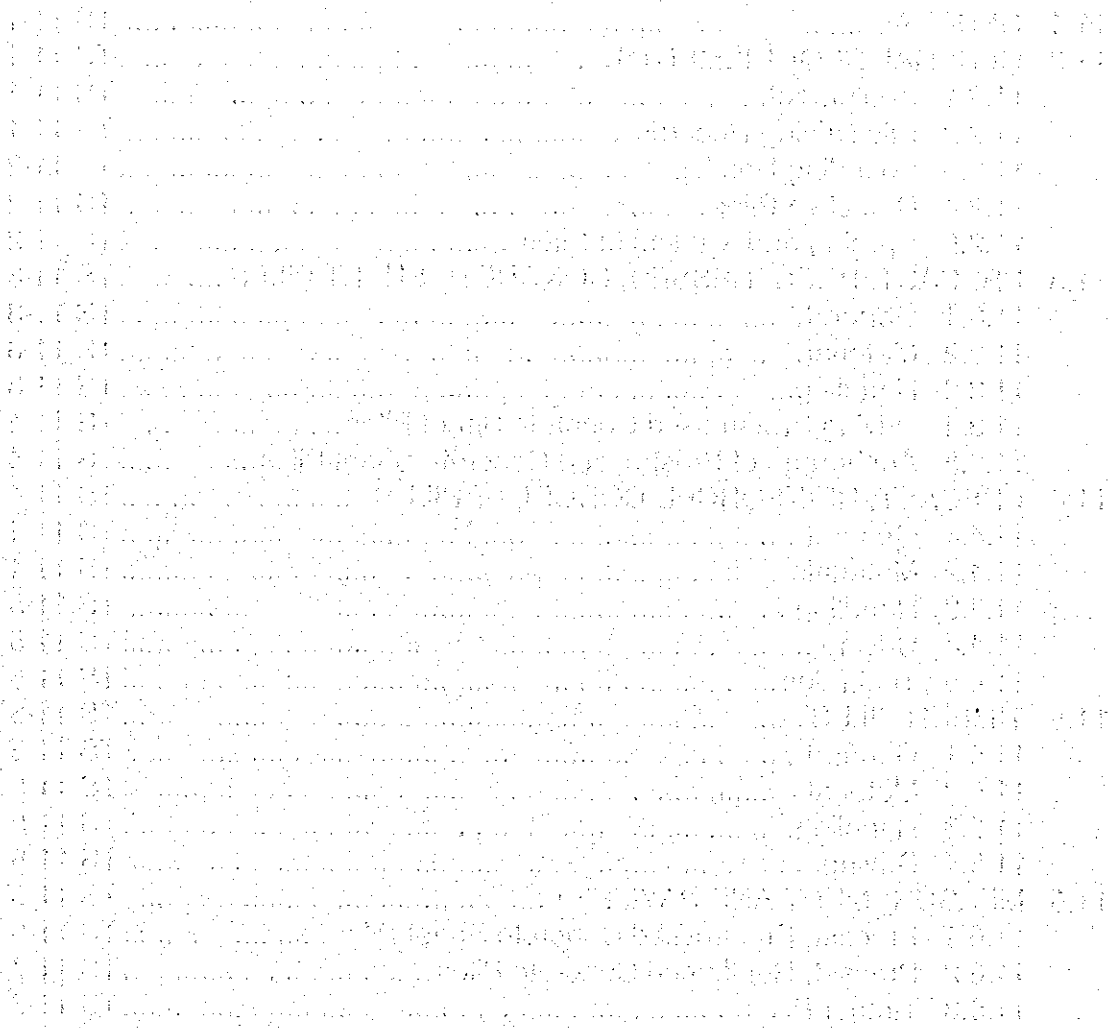
SECTION TS 11. PILING WORKS



SECTION TS 11.PILING WORKS

11.1 GENERAL

This section refers to the supply and installation of the following:

- precast, prestressed concrete sheet piles supplied by a specialist contractor
- precast, reinforced concrete piles
- timber piles (log piles)

The Contractor shall supply all labour, materials, equipment and incidentals as necessary to furnish, install, drive and test the piles as shown on the Drawings and in accordance with the requirements of the Specification or as directed by the Engineer.

11.2 GENERAL REQUIREMENTS

The following requirements apply to the various classes of piles specified in this section. Specific requirements for each class of pile, to be read in conjunction with the general requirements, are also shown below.

11.2.1 Equipment

Before any pile driving equipment is brought to the Site, the Contractor shall submit to the Engineer for approval particulars of the equipment and driving methods which the Contractor proposes to employ.

Piles may be driven by steam, vibration, gravity or diesel hammers subject to the approval of the Engineer.

When diesel hammers or any other types requiring calibration are used, they shall be calibrated with proper measures approved by the Engineer.

Pile hammers, except gravity hammers, shall be approved steam, air or diesel hammers that develop sufficient energy to drive the piles at a penetration rate of not less than 3.2 mm per blow at the required bearing value. When steam, air or diesel hammers are used, the total energy developed by the hammer shall not be less than 1000 kg-m per blow, except as specified below for concrete piles.

Steam, diesel, or air hammers used for driving concrete piles shall develop an energy per blow at each full stroke of the piston of not less than 625 kg-m per cubic meter of concrete piles driven. No driving of piles shall be done within the distance of 6 m from concrete structures which are less than 4 days in age after placing.

Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in such a manner as to afford freedom of movement of the hammer, and they shall be held in position by guys or steel braces to insure rigid lateral support to the pile during driving. Except where piles are driven through water, the leads shall, preferably be of sufficient length to make the use of a follower unnecessary, and shall be designated as to permit proper placing of battered piles where applicable.

11.2.2 Pile Driving Records

The Contractor shall take complete pile driving records of each pile in the presence of the Engineer's representative, to be submitted in duplicate and to include the following information:

- Date and climatic condition;
- Production serial number of pile and age in days, if concrete pile;
- Pile type and size;
- Location of pile in pile group and sequence of driving piles in group;
- Number of hammer blows per 300 mm interval of penetration throughout the length of piles;
- Final driving resistance in blows per centimetre for the last 150 mm of driving;
- Pile driving length, length of cut-off, final trip and cut-off elevation;
- Other pertinent information such as interruption of continuous driving, pile damage, etc.;
- Water jetting of hammer, stroke or related energy;
- Type and make of hammer, strike or related energy;
- Other driving equipment used including driving cap cushion, etc.;

11.2.3 Founding Depth

The Engineer shall determine in the field the final depth to which piles shall be driven, for obtaining the required bearing capacities of the piles. Such depths shall be determined by the use of test piles for the case of reinforced concrete piles or by directives given by the Engineer during production driving for other classes of piles.

11.2.4 Defective Piles

The procedure to be adopted in driving of piles shall be such that it will not subject the pile to excessive and undue force producing crushing and spalling of the concrete or splitting of timber piles. Manipulation of piles to force them into final position, considered by the Engineer to be excessive, will not be permitted. Any pile damaged by reason of internal defect or by improper driving or driven out of its proper location, driven below the elevation fixed by the Drawings or by the Engineer, shall be corrected at the Contractor's expense by one of the following methods approved by the Engineer for pile in question:

The pile shall be withdrawn and replaced by a new pile and, if necessary, a longer pile.

A second pile shall be driven adjacent to the defective or low pile.

The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the pile shall be extended to properly embed the pile. All piles pushed up during the driving of adjacent piles or by any other cause shall be driven down again.

A concrete pile will be judged as defective if it shows a visible crack or cracks extending around the entire perimeter of the pile or any defect which, in the opinion of the Engineer, affects the strength or life of the pile.

11.2.5 Splicing and Cutting of Piles

Prestressed concrete piles shall, when approved by the Engineer, be cut off at such a level that at least 50mm *of* undamaged pile shall be embedded in the concrete structure. If a pile is damaged below this level, the Contractor shall repair the pile in accordance with Section TS8, Concrete Repairs, to the satisfaction of the Engineer. The longitudinal reinforcement of the piles shall be embedded the structure above to a length equal to at least 40 times the diameter

of the main reinforcing bars. The distance from the side of any pile to the nearest edge of the cap shall be not less than that shown on the Drawings.

When the cut-off elevation for the pile is below the elevation of the bottom of the pile cap, in accordance with the Engineer's direction, the pile may be built up from butt of the pile cut-off elevation to the bottom of the cap by means of a reinforced concrete extension at the Contractor's expense. Should splicing of concrete piles be permitted by the Engineer, the method of the splicing shall be as shown on the Drawings or as directed by the Engineer.

11.3 PRECAST, PRESTRESSED, CONCRETE SHEET PILES

11.3.1 General

The piles shall be standard products of a manufacturer regularly engaged in the production of high-quality piles for a period of at least 5 years. Prior to manufacturing, the Contractor shall submit the following data to the Engineer for approval:

The manufacturer's specifications covering the design criteria, materials to be incorporated, methods of manufacture and requirements for handling.

Working drawings of the prestressing system showing complete details and substantiating calculations of the method and materials the manufacturer proposes to use.

11.3.2 Material

All materials and workmanship shall comply with the general requirements specified in sections 3,4,5 and 6.

Concrete shall be Class A-1 in accordance with Section TS3 of this specification

Prestressing tendons shall comply with the requirements of Section TS5 of this specification.

Piles shall measure 500 mm x 220 mm in cross section with male and female shaping of the edges to permit jointing between adjacent installed piles and shall be manufactured to the required lengths as shown on the Drawings.

The bending moment capacity shall be equal or greater than 5.90 tf.m (cracking bending moment).

11.3.3 Handling

Precast, prestressed concrete sheet piles, shall not be moved before they have been fully stressed and the compressive strength has reached 80% of the specified characteristic strength of the concrete.

Prestressed concrete piles shall be handled and supported at points one-third of their length from the ends.

During transport piles shall be supported at their one-third points and protected with timber packers to prevent contact with adjacent piles.

For stacking of piles, heavy sill logs shall be well bedded and flattened to give a bearing area width of not less than 200 mm and a minimum clearance of 300 mm above the ground. Piles may be stacked on top of each other up to six layers with the consent of the Engineer. Each layer shall be separated from the next layer by timber bearers, each 100 mm wide and 75 mm high located at the lifting points described above.

11.3.4 Driving Prestressed Concrete Sheet Piles

Prestressed concrete sheet piles be pitched and driven accurately in the positions shown on the Drawings and to the required depths as directed by the Engineer. The piles shall be pitch inside a braced template and carefully aligned and positioned before driving. The piles shall then be driven to the required penetration in such a manner as to ensure that the vertically of the piles is maintained. In the event of any misalignment developed during driving, the Contractor shall take appropriate action to correct the condition during driving. Piles driven in excess of 10 mm, per meter of pile length or damaged during driving may be rejected, if, in the opinion of the Engineer, the improperly aligned or damaged pile adversely affects the structure. The Contractor shall propose the corrective measures to be taken for approval by the Engineer. All corrective measures shall be at the Contractor's own expense. Rejected piles shall be extracted, re-driven or placed or cut off at a level approved by the Engineer.

11.3.5 Anchorage of Prestressed Concrete Sheet Piles

Prestressed piles which are to be anchored in accordance with the Drawings or as directed by the Engineer shall incorporate factory made holes of sufficient diameter to accommodate tie rods.

Steel tie rods, turn buckles, nuts and plates shall be mild steel complying with the requirements of the relevant ASTM or JIS standards. Painting of steel components is not required.

Turnbuckles shall not be tightened until concrete in the coping beams has reached an age of 7 days.

11.4 PRECAST, REINFORCED CONCRETE PILES

11.4.1 General

This item refers to the precast reinforced concrete piles which shall form parts of groin structures as part of the protection works for the river bank.

The piles may be fabricated by the Contractor or may be standard products of a manufacturer regularly engaged in the production of high-quality piles for a period of at least 5 years. In the event of intending purchase from a supplier, prior to manufacturing, the Contractor shall submit the following data to the Engineer for approval :

The manufacturer's specifications covering the design criteria, materials to be incorporated, methods of manufacture and requirements for handling.

Working drawings of the piles showing complete details of concrete and reinforcing.

11.4.2 Materials

Concrete shall be Class A-3 in accordance with Section TS3 of this specification. Steel reinforcement shall be deformed bars in accordance with Section TS3 of this specification.

Piles shall be manufactured to conform to the dimensions and details as shown in the Drawings and in accordance with the requirements of Section TS4 of this specification.

11.4.3 Handling

Handling, transportation and storage shall be in accordance with the requirements of Section TS4 of this specification.

11.4.4 Driving

Driving shall be carried out in accordance with the procedures specified in clause 9.2 and with the Contractors procedure statement as approved by the Engineer.

11.4.5 Test Piles

The Engineer may order the execution of test piles as he may consider necessary to ascertain the number and length of piles at the location designated by the Engineer. The Contractor shall furnish and execute test piles which shall be of greater length than the length assumed in design in order to provide for any variation in soil conditions. The number and lengths of test piles will be directed by the Engineer.

The Contractor shall not manufacture or purchase piles for the Works before the Engineer approves the number and length of piles proposed based on the results of test piles by the Contractor.

11.5 TIMBER PILES

11.5.1 General

This item refers to the timber log piles to be driven as part of foundations in various parts of the Works.

11.5.2 Materials

Timber piles shall be cylindrical logs cut from timber with recognised qualities of durability and suitability for installation as piles in wet conditions. The Contractor shall propose timber of a type or species for the Engineer's approval prior to procuring timber pile material. Logs shall be straight to a tolerance of 20 mm over their full length and shall be free of branches. The diameter of the thinnest part of any pile shall not be less than 150 mm and not shorter than the length specified on the drawings. All logs shall be treated with creosote using a method subject to the Engineer's approval. Any log not complying with the above requirements shall be removed from the site.

11.5.3 Handling

Timber piles shall be kept in neat stacks on site until ready for use. Handling shall be conducted in such a manner so as not to damage the integrity and strength of the piles.

11.5.4 Driving

Timber piles shall be pitched and driven accurately in the position and at the location shown on the Drawings and to the required depths as directed by the Engineer. During driving operations, timber pile heads shall be protected and held in position by use of a combination creation-driving head and pilot.

Timber piles shall be fresh-head and square and, when directed by the Engineer, the pile heads shall be protected by means of heavy steel or wrought iron rings. The driving head shall closely fit the top of the timber pile and shall extend down the sides of the pile at least 75 mm. During driving operations, each pile shall be restrained from lateral movement and the pile shall be kept moving by continuous

operation of the hammer. If the specified penetration has not yet been reached when the energy required to continue driving is endangering the pile integrity the driving may be discontinued with the approval of the Engineer. Piles driven materially out of line and position as indicated on the Drawing shall be pulled and replaced. Deviations in the excess of 200 mm out of position and 2 percent out of plumbness or batter indicated on the Drawings shall be cause for rejection.

Cutting off and trimming of timber piles shall be done at the designated elevations. Splicing of timber piles shall not be permitted except when approved by the Engineer in writing. Piles inaccurately cut off shall be replaced. The sawn heads of all treated piles which are not embedded in concrete shall be brushcoated with 3 applications of hot creosote and covered with hot roofing pitch. The sawn heads of all treated piles to be encased in concrete need not to be treated further.

11.6 MEASUREMENT AND PAYMENT

11.6.1 Precast, Prestressed Concrete Sheet Piles

Furnishing and Driving

Measurement shall be made of the length of prestressed concrete sheet piles in place and accepted by the Engineer.

Payment for prestressed concrete sheet piles will be made at the rate entered in the priced Bill of Quantities which shall be full compensation for materials, labour, tools, equipment including furnishing, handling, pitching, driving and cutting and all other items for completing the work in accordance with the specification.

Anchors and Associated Steel Work

Measurement shall be made of the amounts of steel anchorage works used for horizontal anchorage of sheet piles. The mass of steel rod shall be calculated using nominal unit mass per metre as published in relevant Indonesian Standards. The mass of non- standard items shall be calculated on the basis of volume and the density of steel.

Payment shall be made at the rate entered in the priced Bill of Quantities and shall be full compensation for materials, labour and equipment for furnishing, installing and completing the anchors and associated steelwork for sheet piling in accordance with the Drawings, the Specification and to the approval of the Engineer.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
D.4.4	Furnishing and Driving PC Sheet Pile (K 500, t=220 mm, w=500mm)	m
E.2.4	Furnishing and Driving PC Sheet Pile (K 500, t=220 mm, w=500mm)	m
F.2.5	Furnishing and Driving PC Sheet Pile (K 500, t=220 mm, w=500mm)	m
H.6.3	Furnishing and Driving PC Sheet Pile (K 500, t=220 mm, w=500mm)	m
D.4.5	Fixing Steel Tie Rod, Steel Channel and Steel Plate to PC Sheet Pile	kg

11.6.2 Precast, Reinforced Concrete Piles

Measurement shall be made of the length of reinforced concrete piles in place and accepted by the Engineer and shall include the length of any portion cut off on the direction of the Engineer and the portion chipped back on the head for the purpose of tying into the capping beam. Measurement shall not be made of any portion of a pile in excess of the length of pile so instructed by the Engineer for production or procurement following the results of test piling.

Payment for reinforced concrete piles shall be at the rate entered in the priced Bill of Quantities which shall be full compensation for materials, labour, tools, equipment including all other items for manufacturing or procuring the piles from an approved supplier, handling, pitching and driving the piles in accordance with the Specification.

Test Pile

Measurement for test pile shall be of the length of the pile supplied in accordance with the length directed by the Engineer, handled, pitched and driven for the purpose of testing. It will not include test piles furnished and driven at the option of the Contractor unless such test piles comply fully with the requirement specified herein and accepted by the Engineer, in which case they shall be paid for under pay item D.8.2.

Payment shall be full compensation for the cost of materials labour, tools, equipment including furnishing, supply handling, driving and cutting the test piles and incidental items necessary to complete the test piles in accordance with the Specifications and instructions by the Engineer.

Cutting and Chipping

Measurement shall be made of the volume of concrete chipped out for the purposes of cutting the pile to the required elevation and to expose reinforcement for the purpose of tying into the capping beam.

Payment shall be full compensation for the cost of materials labour, tools, equipment and incidental items necessary to complete the Works in accordance with the Specifications and instructions by the Engineer.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
D.8.2	Furnishing RC Pile, Concrete Type A3, Section 200 x 200	m
D.8.3	Test Piling for D.8.2	m
D.8.4	Driving R C Piles	m
D.8.5	Cutting Pile Head	m^3

11.6.3 Timber Piles

A count shall be made of the number of timber piles in place and installed in accordance with the specification then that total multiplied by the nominal length of pile specified on the Drawings.

Payment for timber piles will be made at the rate entered in the priced Bill of Quantities which shall be full compensation for materials, labour, tools,

equipment including furnishing, handling, pitching, driving and cutting and all other items for completing the work in accordance with the Specification.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
C.2.10	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m	m
D.2.8	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m and 3.00m	m
G.2.3	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m	m
H.3.3	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m	m
H.5.3	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m	m
H.6.13	Furnishing and Driving Log Pile, Dia 150 mm, L=2.00m	m

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SECTION TS 12. STONE MASONRY

SECTION TS 12.STONE MASONRY

12.1 GENERAL

This section covers the construction of the following type of masonry work:

Wet stone masonry in flood walls, revetment construction of various types, retaining walls, ground sills , channels, dikes, drainage structures, stairways and other structures included in the Works and in places where shown on the Drawings or directed in writing by the Engineer in writing.

Stone facing in revetments.

Rip Rap.

12.2 MATERIALS

12.2.1 Stone

Stone shall be clean, hard, and durable. Adobe blocks shall not be used unless specified or consented to by the Engineer.

Samples of stone proposed for use in masonry construction shall be submitted to the Engineer for his consent.

Stones shall be of the sizes shown on the Drawings or appropriate for the particular application. Unless otherwise shown on the Drawings, stones shall have thickness of not less than 150 mm, widths of not less than one and a half times their respective thicknesses, and lengths of not less than one and a half times their respective widths. Each stone shall be free of depressions and projections that would prevent it from being properly bedded.

Stone to be used in wet stone masonry revetments shall be regular is size and their thickness shall be approximately 200 mm.

Stone shall be dressed to remove any thin or weak portions. Face stone shall be dressed to provide bed and joints lines that do not vary more than 20 mm from true lines and to ensure the meeting of bed and joints lines without the rounding of the corners of the stones in excess of 30 mm in radius. Bed surfaces of face stones shall be normal to the faces of the stones for 80 mm and from this point may depart from a normal plane not to exceed 50 mm in 300 mm.

Face stones shall be pitched to line along all beds and joints. The maximum projections of rock faces beyond the pitch lines shall not be more than 50 mm.

Stones shall increase in thickness from bottom to top of wall.

12.2.2 Mortar

Cement mortar shall be composed of one part of cement to three parts of fine aggregate by volume, or such other proportions as shall be directed by the Engineer, or as shown on the Drawings mixed with water so that the water-cement ratio does not exceed 0.45 by weight.

Hydrated lime may be added in an amount not exceeding ten (10) percent of the cement by weight. The hydrated lime shall comply with the requirements for type "N" lime in ASTM C 207 "Hydrated Lime".

12.3 CONSTRUCTION

12.3.1 Wet Stone Masonry Walls

12.3.1.1 General

This clause refers to the construction of wet stone masonry walls including, but not limited to, retaining walls, parapet walls, flood walls and leaning walls.

12.3.1.2 Selection and Placing

When the masonry is to be placed on a prepared foundation bed, the bed shall be firm and normal to, or in steps normal to, the face of the wall, and shall have been approved by the Engineer before any stone is placed.

Care shall be taken to prevent the bunching of small stones or stones of the same size large stones shall be used for the bottom courses and large, selected stones shall be used in the corners.

All stones shall be cleaned thoroughly and wetted immediately before being set, and the bed which is to receive them shall be cleaned and moistened before the mortar is spread. They shall be laid with their longest faces horizontal in full beds of mortar, and the joint shall be flushed with mortar.

The exposed faces of individual stones shall be parallel to the faces of the walls in which the stones are set.

The stones shall be so handled as not to jar or displace the stones already set. Suitable equipment shall be provided for setting stones larger than those that can be handled by two men. Rolling or turning stones on the walls will not be permitted. If a stone is loosened after the mortar has taken initial set, it shall be removed, the mortar cleaned off, and the stone re-laid with fresh mortar.

12.3.1.3 Beds and Joints

Beds for face stones may vary from 20 mm and to 50 mm in thickness. They shall not extend in an unbroken line through more than five stones. Joints may vary from 20 mm to 50 mm in thickness. They shall not extend in unbroken line through than two stones. They may be at angles with the vertical from 0 to 45 degrees. Face stone shall bond at least 150 mm longitudinally and 50 mm vertically. At no place shall corners of four stones be adjacent to each other.

Beds for vertical faced walls shall be level, and battered walls may vary from level to normal to the batter line of the face of the wall.

12.3.1.4 Headers

Headers shall be distributed uniformly throughout the walls of structures so as to form at least one fifth of the exposed faces. They shall be of such lengths as to extend from the front face of the wall into the backing at least 300 m. When a wall is 450 mm or less in thickness, the headers shall extend entirely from front to back face.

12.3.1.5 Backing

The backing shall be built with greater than 75 percent of stones having a minimum dimension of 200 mm. The individual stones composing the backing and hearting shall be well bonded with the stones in the face wall and with each other. All openings and interstices in the backing shall be filled completely with mortar or with spalls surrounded completely by mortar.

12.3.1.6 Pointing

Joints not pointed at the time the stone is laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into pointing tool. The wall shall be kept wet while pointing is being done and in hot or dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least 3 days after completion.

After the pointing is completed and the mortar set, the wall shall be thoroughly cleaned and left in a neat and workmanlike condition.

12.3.1.7 Plastering

Plaster shall of the same mix proportions as for mortar. Before plastering commences the surface to be plastered shall be cleaned of any dirt, grease, organic matter or any other deleterious substance. The surface shall then be wet with water. Plaster shall be applied so as to firmly key into the surface being treated. The finished surface shall be uniform in texture and regular in appearance. Flat surface shall be flat to a tolerance of 10 mm measured with a 2 m long straight edge.

12.3.1.8 Coping

Copings, if called for, shall be as shown on the Drawings. Where copings are not called for, the top of the wall shall be finished with stones wide enough to cover the top of the wall from 450 mm to 1 metre in length, and of random heights, with a minimum height of 150 mm. Stone shall be laid in such a manner that the top course is an integral part of the wall. The tops of the top courses of stone shall be pitched to line in both vertical and horizontal planes.

12.3.1.9 Weep Holes

All walls and abutments shall be provided with weep holes. Unless otherwise shown on the Drawings or directed by the Engineer, the weep holes shall be placed at the lowest points where free outlets for water can be obtained and shall be spaced not more than 2 metres centre to centre.

Weep holes shall be constructed in accordance with the requirements of Section TS12, Weep Holes.

12.3.1.10 Cleaning Exposed Faces

Immediately after being laid, and while the mortar is fresh, all faces stones shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed.

12.3.1.11 Curing

The masonry shall be satisfactorily protected from the sun and shall be kept wet for a period of at least three days after completion.

12.3.2 Wet Stone Masonry for Revetment Facing

12.3.2.1 General

This clause refers to the use of wet stone masonry for surface protection construction in revetments or where otherwise required to complete the Works.

12.3.2.2 Preparation

The gravel bed shall be completed to the approval of the Engineer prior to placing wet stone masonry.

All concrete work around the perimeter of the intended wet stone masonry work shall be completed to the satisfaction of the Engineer prior to commencing wet stone masonry.

12.3.2.3 Selection and Placing

All stones shall be cleaned thoroughly and wetted immediately before being set, and the gravel bed which is to receive them shall be cleaned and moistened before the mortar is spread. They shall be laid with their longest faces horizontal in full beds of mortar, and the joint shall be flushed with mortar.

The exposed faces of individual stones shall be parallel to the faces of the revetment face in which the stones are set and the pattern shall be regular.

The stones shall be so handled as not to jar or displace the stones already set.

12.3.2.4 Beds and Joints

Beds for stones may vary from 20 mm and to 50 mm in thickness. At no place shall corners of four stones be adjacent to each other.

12.3.2.5 Pointing

Joints not pointed at the time the stone is laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into gaps between stones with a pointing tool. Stones shall be proud of the pointed mortar by approximately 30 mm. The wall shall be kept wet while pointing is being done and in hot or dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least 3 days after completion.

After the pointing is completed and the mortar set, the wall shall be thoroughly cleaned and left in a neat and workmanlike condition.

12.3.2.6 Weep Holes

Weep holes shall be constructed at the locations as shown on the Drawings or as directed by the Engineer in accordance with the requirements of Section TS 14, Weep Holes.

12.3.2.7 Cleaning Exposed Faces

Immediately after being laid, and while the mortar is fresh, all faces stones shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed.

12.3.2.8 Curing

The masonry shall be satisfactorily protected from the sun and shall be kept wet for a period of at least three days after completion.

12.3.3 Stone Facing

12.3.3.1 General

This clause refers to the construction of dry stone masonry (i.e. stone masonry without mortar) in revetments.

12.3.3.2 Preparation

All surfaces on which stone facing is to be placed shall be completed to the satisfaction of the Engineer prior to placing stone facing.

12.3.3.3 Selection and Placement

Stones of size 250 mm to 400 mm in maximum dimension in accordance with clause 12.2.1 shall be selected for use.

Stones shall be carefully placed such they are stable, closely interlock with adjacent stones and are arranged such that they comply with the lines, levels and profiles of the stone facing as shown on the Drawings to a tolerance of + or – 30 mm.

12.3.4 Rip Rap

12.3.4.1 General

This clause refers to the construction of rip rap for protection works a shown on the Drawings or directed by the Engineer.

12.3.4.2 Preparation

Where applicable, surfaces on which rip rap is to be placed shall be completed to the satisfaction of the Engineer prior to placing rip rap.

12.3.4.3 Selection and Placement

Stones of size 250 mm to 400 mm in maximum dimension in accordance with clause 12.2.1 shall be selected for use.

Stones shall be carefully placed such they are stable, closely interlock with adjacent stones and are arranged such that they comply with the lines, levels and profiles of the stone facing as shown on the Drawings to a tolerance of + or – 100 mm. Particular care shall be taken not to damage structures (e.g. sheet piling or existing structures) when placing rip rap. Any such damage caused shall be rectified by the Contractor at his expense.

12.4 MEASUREMENT AND PAYMENT

Wet Stone Masonry

Measurement will be made of the volume of stone masonry complete in place and accepted. Projections extending beyond the faces of the walls will not be included. In computing the quantity for payment, the dimensions used shall be those shown on the Drawings or ordered in writing by the Engineer. No deductions shall be made for weep holes, drain pipe, pipe, or other openings of less than 0.01 square metres in area.

Payment 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 works incidental to the completion of stone masonry.

Pointing

Measurement will be made of the area of the surface of wet stone masonry in which the mortar has been pointed and accepted. The area measured will be the gross area which includes stone and pointed mortar. No deduction shall be made for the areas occupied by stone, weep holes or openings less than o0.01 square metres.

Payment 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 works incidental to the completion of pointing.

Plastering

Measurement will be made of the area of the surface of wet stone masonry or Floodwall which has been plastered and accepted. No deduction shall be made for the areas occupied by stone, weep holes or openings less than o0.01 square metres.

Payment 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 works incidental to the completion plastering.

Stone Facing

Measurement will be made of the volume of Stone Facing complete, in place and accepted. Projections beyond the lines and profiles shown on the Drawings shall not be measured.

Payment 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 works incidental to the completion of stone facing.

Rip Rap

Measurement will be made of the volume of Rip Rap complete, in place and accepted. Projections beyond the lines and profiles shown on the Drawings shall not be measured.

Payment 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 works incidental to the completion of rip rap.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
B.5.4	Wet Stone Masonry	m^3
D.2.4	Wet Stone Masonry	m^3
D.6.5	Wet Stone Masonry	m^3
D.7.4	Wet Stone Masonry	m^3
E.2.11	Wet Stone Masonry for Revetment	m^3
E.3.5	Wet Stone Masonry for Main Body and Side Wall	m^3
E.3.7	Wet Stone Masonry for Revetment	m^3
F.3.5	Wet Stone Masonry	m^3
F.4.4	Wet Stone Masonry	m^3
F.5.5	Wet Stone Masonry	m^3
G.2.12	Wet Stone Masonry	m^3
H.2.3	Wet Stone Masonry	m^3

B.5.7	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^3
D.2.5	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
D.6.6	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
D.7.5	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
E.2.12	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
E.3.8	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
F.3.6	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
G.2.13	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
G.2.16	Plastering on Surface of Wet Masonry	m^2
F.4.5	Mortar Plastering on Surface of Wet Stone Masonry	m^2
F.5.6	Cement Mortar Pointing on Surface of Wet Stone Masonry	m^2
H.2.5	Cement Mortar Plastering	m^2
H.2.6	Cement Mortar Pointing on Riverside Surface of Wet Stone Masonry	m^2
C.2.14	Cement Mortar Plastering on Roadside Surface of Floodwall	m^2
D.3.3	Stone Facing (Dia. 250 mm to 400 mm)	m^3
H.6.6	Stone Facing (Dia. 250 mm to 400 mm)	m^3
D.9.8	Riprap Mound (Dia. 250 to 400 mm)	m^3
D.4.10	Rip Rap Mound (Dia 250 mm to 400 mm)	m^3
D.8.8	Stone Facing (Dia 250 mm to 400 mm)	m^3