



Annexure F: Technical Specification



Particular Specifications: Latimer's Landing Refurbishment

For: Execution
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Latimer's Landing
Particular Specifications

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1. GENERAL

The following Particular Specifications are applicable for this contract, and are included in this document:

- STRUCTURAL WORKS
- PILING SPECIFICATION
- Specifications for fenders and bollards
- Specification for corrosion protection
- specification for STRUCTURAL STEEL
- TIMBER SPECIFICATIONS
- ROCK SPECIFICATION
- SPECIFICATION FOR EARTHWORKS
- ELECTRICAL WORKS

2. STRUCTURAL WORKS

2.1 Concrete, Formwork and Reinforcement

This section covers the construction of all new reinforced concrete and associated concrete works requirements for the proposed construction of the new reinforced concrete wharf, as directed by the Engineer, at the Port of East London, Latimer's Landing wharf refurbishment Project.

2.1.1 Particular Specifications for Concrete

The following specifications shall apply:

- a) NB: All in situ concrete work (mass and reinforced) shall comply with SANS Specification 1200G ("8 Measurement and Payment" is not applicable) supplemented by the clauses in this section. Where SANS Specification 1200G and the clauses in this section are in conflict the clauses in this section shall take precedence.
- b) In addition, the "Model Preambles for Trades" as recommended and published by the Association of South African Quantity Surveyors, 1999 Edition, shall be read in conjunction with and shall apply to all items in the Bill of Quantities not covered by the 'SANS Standardised Specifications' SANS 1200 Series.
- c) Where the term "plain concrete" appears in SANS Specification 1200G it shall be read as "mass concrete".
- d) SANS 1200 G - Concrete
- e) SANS 2001: CC1 - Construction Works: Concrete Works (Structural)
- f) SANS 1083: 2006 - Aggregates from natural sources
- g) SANS 10100-2:2000 - The Structural use of concrete – Part 2: Materials and execution of work.
- h) SANS 50197-1:2000 - Cement – composition, specifications and conformity criteria. Part 1: Common cements
- i) SANS 1491-1:2005 - Portland cement extenders – Part 1 Ground granulated blast furnace slag.
- j) SANS 1491-2:2005 - Portland cement extenders – Part 2 Fly ash.
- k) SANS 1491-3:2006 - Portland cement extenders – Part 3 Condensed Silica Fume
- l) S437 (Transnet) - Concrete Pavement

2.1.2 Cement

- a) Common cements, complying with SANS 50197-1 shall be used for all concrete work. On no account shall masonry cements be used for concrete work, even if the strength designations are the same as for common cements.
- b) The Supervisor for test purposes may require samples of cement from any one, or from every consignment. Cement in any consignment from which a sample may have been taken for testing shall not be used until it has been approved. Allowance must be made for possible delay in that tests may take 10 days to carry out.
- c) Bags of cement shall be stacked in a waterproof, solidly constructed shed with a central door and a floor rendered damp-proof with a tarpaulin. The bags of cement shall be closely stacked (but not against walls) in order to reduce air circulation in such a manner that the cement is used in the order in which it was received, i.e. first in first out.

2.1.3 Alkali reactive concrete

- a) Alkali Reactive Aggregates shall not be used in this project. The equivalent Na₂O content of the concrete shall not exceed 2, 0 kg/m³ where % Na₂O equivalent = % Na₂O + (0,658 x %K₂O).

2.1.4 Aggregates

- a) Fine and coarse aggregate shall comply with the relevant clauses of SANS 1083.
- b) Where aggregates have constituents, which in the opinion of the Project Manager, may give rise to damage due to alkali-aggregate reactions, the provisions of 6.3.3.3 shall be applicable.
- c) Evidence of compliance of the aggregates with the requirements of 6.3.3.1 & 6.3.3.2 shall be furnished as early as practical. No aggregate shall be delivered for use in the works until approval is given.
- d) Sand (fine aggregate):
The fine aggregates shall comply with the requirements of SANS Specification 1083. Other aggregates may be approved if they have a satisfactory history and / or test results.
- e) No aggregate may be used until it has been approved. Samples having a mass of 25kg (16.5 litres) of the proposed aggregate to be used may be required by the *Supervisor* for test purposes. Samples having a mass of 25kg shall be forwarded every 3 months during concreting work and also if the source of supply is changed.

Allowance must be made for possible delay in that the tests may take 14 days to carry out.

2.1.5 Admixtures

- a) Admixtures containing chlorides are not permitted in reinforced concrete.

2.1.6 Cover blocks

- a) Cover blocks used to ensure the cover to reinforcement shall be made of cement mortar.
- b) Cover blocks shall be dense and have a minimum 28 day crushing strength of 40 MPa and shall be cured in water for at least 14 days before being used.
- c) Cover/spacer blocks made of plastic will not be permitted.

2.1.7 Concrete quality

- I. Prior to the start of any concrete work on site, the Contractor shall submit a quality assurance plan which will ensure compliance with specification and provide acceptable documentary evidence that all specified operations have been carried out satisfactorily.
- II. Where the minimum dimension to be placed during a single pour is larger than 600mm, and the cement content of the reinforced concrete exceeds the following:
 - a) Cement Types I and II/ * S: 400 kg/m³
 - b) Cement Types II/B-V and II/B-W: 450 kg/m³
- III. The Project Manager may require that measures be instituted to reduce heat development in the concrete.

2.1.8 Unreinforced concrete

- a) 40 Mpa/19mm Concrete

2.1.9 Unreinforced concrete cast against excavated surfaces

- a) 15 Mpa/19mm Concrete
- b) Surface blinding under footings and bases.

2.1.10 Reinforced concrete

- a) 40 MPa/19mm Concrete:
- b) Bases
- c) Foundation beams.
- d) Surface beds cast in panels on waterproofing.
- e) Walls in foundations (Provisional)

2.1.11 Batching

- a) No cementitious binders shall be batched by full sack or by mass batching with approved precision weighing equipment.
- b) All aggregates shall be precisely measured by mass using approved precision weighing equipment, unless otherwise permitted by the Project Manager.
- c) Should any variation in the composition of the aggregate become apparent, the Project Manager shall be notified, and a further sample of aggregate submitted immediately for his approval.

2.1.12 Concrete placing

- a) The size, shape and depth of any excavation shall be approved by the Project Manager before concrete is placed.
- b) Unless otherwise permitted by the Project Manager, no concrete shall be placed until the fixed reinforcement has been accepted by him and confirmed in writing by way of a release certificate.

2.1.13 Construction joints

- a) Unless otherwise shown on the drawings, the exact position of horizontal construction joints shall be marked on the formwork by means of grout checks to obtain truly horizontal joints.
- b) Stub columns, stub walls and stays on footings shall be cast integrally with the footing and not afterwards, even where another class of concrete is being used.
- c) Joint lines shall be so arranged that they coincide with features of the finished work.
- d) Where new concrete is to be cast against a hardened concrete surface, neat cement slurry mixed to a creamy consistency shall be brushed onto the cleaned concrete surface.

Contraction joints shall be smooth and shall have one coat of limewash or PVA applied to the older surface prior to casting the fresher concrete.

2.1.14 Movement joints

- a) All movement joints are to be filled in with approved bitumen impregnated soft board or expanded polyethylene strip unless otherwise specified or detailed on drawings. Descriptions (Prices) of movement joints shall be deemed to include formwork.

2.1.15 Grouting

- a) 25 MPa non-shrink cementitious grout: Bedding approximately 25mm thick under base plate including chamfered edges all round.

2.1.16 Curing compound

Unless otherwise directed by the Project Manager, the curing compound shall be:

- a) An approved trafficable, resin-based, white pigmented, membrane forming for slopes flatter than 1:1.
- b) An approved clear, aesthetically acceptable, membrane forming for all other concrete surfaces, including beam and slab soffits.
- c) The curing compound shall comply with specification ASTM C309, except that the maximum permissible water loss in the test shall be 0.40 kg/m².
- d) Alternatively, the curing compound shall be acceptable if the treated concrete retains 90% or more of its mixing water when subject to the test set out in BS 8110 Part 1 – Chapter 6.6.

2.1.17 Curing compound application

- a) The total application rate of the curing compound shall be the greater of the supplier's specification or 0.90 l/m². On textured concrete surfaces, the total application rate shall be 0.90 l/m².
- b) In cases of concrete surfaces with run-off problems, it may be necessary to apply more than one coat of membrane forming curing compound to obtain the specified total or cumulative application rate.
- c) Curing in accordance with SANS 1200 G shall commence on all concrete surfaces as soon as it is practical in the opinion of the Project Manager.
- d) On unformed surfaces the curing compound shall be applied after finishing and as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete.
- e) On formed surfaces, the exposed concrete shall be wet with water immediately after the forms are removed and kept moist until the curing compound is applied.
- f) Application of the curing compound shall begin once the concrete has reached a uniformly damp appearance with no free water on the surface.

- g) Application of the compound may be done by hand or power spray.
- h) The compound shall be applied at a uniform rate with two applications at right angles to each other to ensure complete coverage.
- i) Pigmented compounds, without a thixotropic agent, shall be adequately stirred to assure even distribution of the pigment during application.
- j) Unless otherwise directed by the Project Manager, the initial 24 hour curing of concrete surfaces not covered by formwork shall be carried out by ponding, covering with constantly wetted sand or mats, or continuous spraying in accordance with SANS 1200 G when the following climatic conditions occur:
 - i) Wind velocity greater than 5 m/s and/or
 - ii) Ambient temperature is above 25°C and/or
 - iii) The relative humidity is below 60 %
- k) If plastic shrinkage occurs, the concrete, while still plastic, shall be re-vibrated, floated and re-coated with curing compound as if no curing has previously taken place.

2.1.18 Curing period

- a) The curing period for concrete containing only CEM 1 shall be 7 days.
- b) The curing period for concrete containing CEM 1 plus cement extenders (MGBS, FA) shall be 10 days.
- c) The curing period will start on completion of the concrete pour and for formed surfaces shall be included the time for which forms are still in place after the pour.

2.1.19 Concrete records

The Contractor shall maintain the following daily records for every part of the concrete structure and shall make these available at all times during the progress of the work for inspection by the Project Manager.

- a) The date and time during which concrete was placed.
- b) Identification of the part of the structure in which the concrete was placed.
- c) The mixed proportions and specified strength.
- d) The type and brand of cement.
- e) The slump of the concrete.
- f) The identifying marks of test cubes made.
- g) Curing procedure applied to concrete placed.
- h) The times when shuttering was stripped and props removed.
- i) The date of despatch of the cubes to the testing laboratory.
- j) The test results.

The records shall be delivered to the Project Manager each week except in the case of sub-standard concrete when the Project Manager shall be informed immediately.

2.1.20 Tolerances

- a) Deviations shall be within the limits listed in SANS 1200 G for degree of accuracy II unless otherwise specified.

2.1.21 Testing and monitoring

- a) Frequency of sampling and testing shall be as specified in SANS 1200 G.

2.1.22 Cost of tests

- a) The costs of making, storing and testing of concrete test cubes as required under clause 7 'Tests' of SANS 1200 G shall include the cost of providing cube moulds necessary for the purpose, for testing costs and for submitting reports on the tests to the Project Manager. The testing shall be undertaken by an independent firm or institution nominated by the Contractor to the approval of the Project Manager (Test cubes are measured separately).
- b) If the quantity of concrete from which samples were taken exceeds 40 m³, it shall be subject to the testing of a minimum of 3 sets of samples per day from each grade of concrete placed in each independent structure.
- c) If the quantity of concrete from which samples were taken is less than 40 m³, it shall be subject to the testing of a minimum of 2 sets of samples per day from each grade of concrete placed in each independent structure.
- d) If the Contractor disputes the results of the tests on concrete cubes, the concrete represented by the cubes will be considered acceptable if the Contractor, at his own cost, proves to the satisfaction of the Project Manager that the estimated actual strength of cores taken from the structure, determined in accordance with SANS Standard Method SM 856, is not less than the specified strength.
- e) If the strength of the concrete fails to meet the acceptance criteria stipulated, the Project Manager may in his sole discretion and in addition to the options listed in SANS 1200 G:
 - i. Accept the concrete subject to approved remedial measures being undertaken by the Contractor; or
 - ii. Permit the concrete to remain subject to the payment of a penalty
- f) The penalty referred to will be determined as follows:

$$\text{Penalty} = V \times R \times F$$

Where:

V = Volume (in the opinion of the Project Manager) of concrete of unsatisfactory strength represented by the test result.

R = Relevant scheduled rate

$$F = 1 - \sqrt{\frac{\text{Average strength of unsatisfactory concrete}}{\text{Specified strength} + 6 \text{ MPa}}}$$

Where the relevant scheduled rate (R) includes the cost of formwork or

$$F = 1 - \frac{\text{Average strength of unsatisfactory concrete}}{\text{Specified strength} + 6 \text{ MPa}}$$

Where the relevant scheduled rate (R) excludes the cost of formwork or where no formwork was involved.

2.1.23 Formwork

- a) Descriptions of formwork shall be deemed to include use and waste only (except where described as left in or permanent), for fitting together in the required forms, wedging, plumbing and fixing to true angles and surfaces as necessary to ensure easy release during stripping and for reconditioning as necessary before re-use.
- b) Formwork to sides of bases, pile caps, ground beams, etc. have been measured provisionally and will only be paid for where it is specifically prescribed by the Supervisor for design reasons. Formwork necessitated by irregularity or collapse of excavated faces will not be measured and the cost thereof shall be deemed to be included in the allowance for taking the risk of collapse of the sides of the excavations, provision for which is made in Earthworks.

i. Rough formwork (degree of accuracy ii)

Rough formwork to side:

- a) Strip footings.
- b) Bases.
- c) Walls in foundations.
- d) Outer face of walls flushes with perimeter of concrete structure.
- e) Edges not exceeding 300mm high.

ii. Movement joints etc.

Expansion joints with soft board between vertical concrete surfaces:

- a) 12mm Joints not exceeding 300mm high.

iii. Saw cut joints

- a) 3.2 x 50mm and 6.4 x 20mm saw cut joints in two operations in top of concrete.
- b) Seal Sikaflex-11FC or similar approved, on backing chord to manufacturer's specification.
- c) Horizontal toggle construction joints through concrete including thick cement slurry to one face.
- d) Surface beds not exceeding 300mm thick.

iv. Reinforcement (provisional)

- a) High tensile steel reinforcement to structural concrete work in various diameters and lengths.
- b) Mild steel reinforcement to structural concrete work in various diameters and lengths.

v. Sleeve pieces and ties

- a) Where it is necessary to leave plugs or holes in beams, slabs or any other reinforced concrete, all such plugs or holes must be situated in positions approved by the Supervisor before concreting. Where it is necessary to carry pipes, bolts, wires or any other fittings through reinforced concrete members, approved pipe sleeves must be provided and placed in position before concreting.
- b) Where waste, ventilation water, heating or other pipes under 100mm diameter pass through concrete slabs and beams, galvanised mild steel sleeve pieces or diameters shown or required shall be cast into such concrete slabs and beams.
- c) Chases shall be formed in edges of slabs or slots shall be formed in the slabs, or sizes required, where two or more pipes pass through together.
- d) All necessary bolts, plugs, brackets, cramps, etc. shall be cast into the concrete as the work proceeds.
- e) Where brickwork abuts against concrete, the brickwork is to be tied to the concrete with galvanized hoop-iron ties 1.6m thick by 32mm wide and approximately 600mm long to every third course of brickwork with one end of each tie cast approximately 150mm deep into the concrete. Where such fixing is impossible, i.e. where steel formwork is used, the ties are to be gun-nailed against concrete with steel nails to less than 38mm long.

vi. Bagged finish to concrete

- a) Concrete surfaces to receive bagged finish shall be prepared by removing sharp projections and making good defects with 3:1 cement mortar. Finish by rubbing over the whole area with wet rough sacking and cement grout to obtain an even surface.

vii. Power floated finish

- a) Power floated finish to floors etc. means that surfaces shall be floated c\mechanically to a smooth and even finish before the concrete has set. Small areas inaccessible to the machine are to be floated by hand. Under no circumstances is cement mortar to be added while floating the concrete.

viii. "No fines" concrete

- Fillets against up stands:
 - a) Form triangular fillets, size 100 x 100mm, in corners with walls, kerbs, etc. neatly mitred at angles, stopped where necessary and finished smooth ready to receive waterproofing.

- To raised floor, bases, etc:
 - a) No-fines" concrete for raised floors, bases, etc. shall be in the proportions specified. Finished smooth with 3:1 sand/ cement screed to receive waterproofing.

2.1.24 Precast concrete

i) Materials

Cement, water, aggregates and reinforcement shall be as described under: CONCRETE, FORMWORK AND REINFORCEMENT.

ii) Concrete

Concrete shall be as described under: CONCRETE, FORMWORK AND REINFORCEMENT and, unless otherwise specified. 40 Mpa/19mm concrete shall be used.

iii) Smooth finish

- a) Where described as "finished smooth from the mould" such surfaces shall have a layer of fine stuff composed of 1:4 (1 part cement and 4 parts clean fine sand by volume) packed against the faces of the mould before placing the concrete backing. The concrete backing shall be disposed into the moulds in a wet state (not dry pressed) while the facing is still wet.
- b) Projections shall be rubbed off the faces shall be of even colour and free from blemishes, cracks, and other imperfections. Salient angles shall be arras rounded.

iv) Reinforcement protruding from precast units

- a) Reinforcement protruding from pre-cast concrete units shall be covered with cement grout to prevent corrosion during storage of the units. The reinforcement shall be

inspected at least once every two months during storage and the cement grout touched up to the satisfaction of the Engineer. A maximum of one week before lifting into the final position the cement grout shall be completely removed to the satisfaction of the Engineer.

3. PILING SPECIFICATION

3.1 REFERENCES

- All installation shall be done in accordance with the requirements stated in the Project Specifications and the Standards listed below.

- Items not covered by Standards or Regulations shall be the best of their respective kinds, and in accordance with the best trade practices. The fabrication, testing and performance of all of the equipment and materials must comply with the latest edition of the following Normative Agencies, Design Standards and Codes of Practices:

Table 1: Codes and Standards

Number	Description
BS 6349 Part 1	Maritime Structures Code of Practice for General Criteria
BS EN 12699:2001	Execution of Special Geotechnical Work: Displacement Piles
ASTM D4945-08	Standard Test Method for High Strain Dynamic testing of Piles
API RP 2A	Recommended Practice for Planning, Designing and Constructing Fixed Offshore
API SPEC 2B	Specification for fabricated structural steel
BS EN 1997-1	Geotechnical Design. General Rules
EN 10025-2	Technical delivery conditions for non-alloy structural steel

3.2 PILE PROCUREMENT

Piles are to be designed in accordance with API RP 2A considering all the service and construction loads to which it will be subjected.

The steel plate used in the manufacture of the spirally welded piles shall be made in accordance with EN 10025-2 using grade X52 steel to API specification 5L, product specification level PSL 1. Minimum yield strength to be 359 MPa and tensile strength 458 MPa. Alternatively grade S355JR to SANS 1431 can be used by the Contractor. Welding and tolerances to be in accordance with API SPEC 2B.

3.3 PILE INSTALLATION

3.3.1 *Plant*

The Contractor shall be responsible for assessing the pile installation and marine plant necessary to install the piles to the penetrations, position tolerance and ultimate geotechnical strengths necessary to fulfill the requirements of the approved design. If the pile installation and marine plant proposed in the tender proves to be inadequate for achieving the accomplishment rate required by the Contract Programme, the Contractor shall increase the number and or capacity of the installation equipment at his own cost.

Pile installation equipment shall be in good condition and shall at all times be maintained and operated at the efficiency and capability stated by the manufacturer.

3.3.2 *Handling, Pitching and Installing Piles*

Handling, transporting, pitching and installing piles shall be carried out by the use of nylon slings and soft faced packers between piles to ensure that damage to the piles or the protective coatings is minimised. Any damage to protective coatings must be repaired prior to installation in accordance with Supplier's specification.

Holes for lifting shall be permitted, provided the section in which the hole is located does not form part of the finished installed pile and protective coating repair is undertaken.

3.3.3 *Pile Driving*

The Contractor shall make an assessment of the foundation conditions to ascertain the difficulty of driving and shall be solely responsible for this assessment and any costs arising out of any errors in this assessment. The Contractor shall use a hammer for pile driving, capable of imparting a minimum driving energy specified in the Contractor's method statement.

The Contractor shall include in the pile design strengthening of the heads and toes of piles as required to resist the driving forces.

Each pile shall be driven continuously until the required penetration and set is

obtained except for any additional splicing necessary, or to remove rock or hard material encountered during driving. Should the required driving set be achieved before sufficient penetration has been obtained, driving shall continue until the minimum penetration has been achieved. Where required, piles shall be driven into rock using an approved rock chopper or similar device prior to driving the pile into the shattered rock.

After the minimum penetration has been achieved, driving shall continue until the required set has been achieved over a minimum continuous length of driving of 500 mm or refusal, whichever occurs first.

3.3.4 *Marking of Piles*

Each pile shall be clearly marked with its overall fabricated length, and prior to installation, a part length of each pile shall be marked in 100 mm intervals to facilitate the making of pile installation records by the Contractor. The Contractor shall ensure that there is no damage to the pile protective coating resulting from marking the piles.

3.3.5 *Tolerances for Position of Piles*

The Contractor shall be responsible for achieving the positional tolerances as specified in API RP 2A. Where a pile is installed outside of this tolerance the Contractor shall submit for approval, a Method Statement, calculations and drawings setting out the details of the proposed remedial solution.

3.3.6 *Defective Piles*

Piles structurally damaged shall be removed from the works and replaced. The Contractor shall submit for approval, a Method Statement, calculations and drawings setting out the proposed remedial solution. If there is any doubt about the integrity of a pile and the Contractor wishes to keep the pile as part of the works, a pile integrity test in accordance with the requirements of BS EN 1997-1:2004 shall be conducted by the Contractor.

3.3.7 *Splicing*

Where the Contractor is unable to drive a pile in one complete length, or where considered necessary to extend the pile in the leaders for further driving, an additional length of tube section shall be spliced onto the driven pile in accordance with the requirements of Supplier. Approved Full Penetration butt welds shall be used for all connections. The coating protection shall be redone for this section, as per particular specification 3.5.

3.3.8 Pile Stability

The bracing system proposed by the Contractor for free standing piles connected to partly completed structures shall be detailed in a Method Statement.

Temporary bracing shall not be welded to structural elements forming part of the completed works, where protective coatings have already been applied.

3.3.9 Infilling of Piles

The piles for the wharf shall be infilled with concrete. The concrete specification for this shall be as for 40MPa tremie concrete.

Each pile to be filled shall be thoroughly cleaned out by an air lift or other approved means to remove soft sediments down to firm material.

3.3.10 Health, Safety and Environment

All material/equipment suppliers, manufacturers' fabricators and contractors shall ensure that they comply with the requirements of the Occupational Health and Safety Act and Regulations of the country of manufacturing and installation.

In addition to this, manufacturers and contractors shall also adhere to any additional requirements as set out in the Project Safety, Health and Environmental Management.

3.4 DOCUMENTATION

3.4.1 Piling Method Statement

Not less than 28 days before commencement of piling works, the Contractor shall provide a full and detailed Method Statement to the Engineer for review for the fabrication and installation of each type of piling required for the various structures. The Method Statement shall confirm and expand upon information previously supplied and shall include as a minimum, but not limited to:

- i. Type and details of permanent piles including materials, outside diameter and wall thickness.
- ii. Details of the method of fabricating and details of method of installation of permanent piles including all temporary works and details of method by which required verticality or rake will be achieved and measured.

- iii. Details of the methods of advancing a pile in the event that obstructions are encountered during piling, to be compatible with item v) below.
- iv. Details of method of pre-boring, grubbing out, chiseling or other such technique to permit the installation of pile casings to the minimum design penetrations required.
- v. Details of proposals for the use of any reinforcing to pile toe and/or head which together with iii) and iv) above will ensure that a pile achieves the minimum design penetration without damage.
- vi. Details of method for demonstrating that the casing has achieved minimum design penetration and criteria for determining the toe levels of individual piles.
- vii. If applicable, details of the method of forming sockets beneath pile toes and for maintaining the temporary stability of the bore prior to placement of the concrete.
- viii. Details of method of fixing reinforcement.
- ix. Details of method of placing concrete.
- x. Details of the method of applying surface treatment (corrosion protection) to the piles and details of the method of repair of such treatment.
- xi. Details and numbers of plant and personnel to be used for pile installation.
- xi. Detailed construction programme showing the sequence of and periods for pile construction.
- xii. Disposition of piling plant during piling operations.
- xiii. Details of proposals for storage, handling and transporting the piles.
- xiv. Method of extending a pile, including the welding procedure to be used.
- xv. Pile driving acceptance criteria and the basis of assessment.
- xvi. Any other details required by the Employer's Representative.
- xvii. Methods of protecting of piles & piling equipment during storm surges
- xviii. Detailed procedure to ensure no contamination or leaks in to the environment.

3.4.2 Piling Programme

Contractor shall submit to the Engineer a programme setting out the sequence and planned operation for the Work. An updated programme for each week must be submitted to the Engineer (or his representative on site). During the daily meeting the Engineer (or his representative) will be informed of the piling for the following day, in particular if there will be changes to the weekly program that was submitted.

3.4.3 Obstructions

If an obstruction to normal driving is encountered, driving shall cease and the Contractor shall employ the measures proposed in his Method Statement and submitted to the Engineer for review. Notwithstanding any such review, the Contractor shall be entirely responsible for ensuring that the piles are installed to the required depth and on the required line and position.

3.4.4 Installation Records

The Contractor shall keep records on the installation of every pile and shall submit pile driving records to the Engineer for sign-off not later than 24 hours after the installation of each pile. The installation records shall be created covering general, driving, and socketing installation as appropriate. These records will form part of the data report documents to be submitted at the end of the project.

3.4.4.1 General

The general records of the manufacturer's data records (MDR) shall include, as a minimum, the following:

- The pile reference number
- The size and pitched length of the pile
- The seabed level, related to Chart Datum
- Final level of pile toe
- Cut off level
- Lengths of pile extensions and positions of site welds
- The level of ground inside the pile

- Details of any obstruction encountered, obstruction time and other interruptions to the progression of the work
- Final locations of the pile head, giving offsets to the vertical in two perpendicular directions
- Whether the pile is anchored or socketed
- Any other relevant information.

3.4.4.2 *Driven Piles*

The driving records included in the manufacturer's data records (MDR) shall include, as a minimum, the following:

- The date and time at commencement and completion of driving/installation
- Set, i.e. rate of driving, measured as blows per 250 mm of penetration
- Final set for the last 10 blows and temporary compression for one of the blows
- Hammer stroke during the last 10 blows
- The type, weight, maximum stroke and reference number of the hammer
- The type and the condition of the packing on the pile head, and of the dolly or follower if used
- An estimate of the energy per blow or the actual energy output of the hammer
- Where proving of ultimate geotechnical strength is performed, the method used and the recording of all information relevant to the determination of the ultimate geotechnical strength

3.5 INSPECTION AND TESTING

3.5.1 *General*

Pile Load Tests shall be in accordance with the guidelines of BS EN 1997-1:2004 Section 7.5. **An initial static pile test shall be conducted for capacity verification (including lateral deflection evaluation).**

The capacity of driven piles may be established

hed using a combination of dynamic formulae and PDA testing and CAPWAP (Cape Pile Wave Analysis) analysis (signal matching).

Pile load testing and frequency of testing shall be as required by ASTM D4945-08.

The proposed pile testing procedures shall be detailed in the pile method statement.

3.5.2 Test Results

The results of the PDA testing shall take precedence over determinations of pile capacity based on Hiley Formula or any other dynamic formula used to estimate the capacity of piles. CAPWAP results shall take precedence over PDA test results.

3.5.3 Dynamic Testing of Driven Piles

Prior to commencement of piling, the Contractor shall nominate, to the Engineers approval, the company providing dynamic pile testing services. The PDA testing equipment and operator shall be arranged and provided by the Contractor.

Dynamic testing needs to be done on the piles as per the contractor's drawings and the capacity verified relative to the results obtained with the test pile. The piles should be tested to the following working loads:

Compression	1238kN
Tension	160kN

Piles shall be tested during initial driving and on re-strike using a pile driving analyser (PDA) to measure mobilised load capacity.

The Contractor shall fully cooperate with the PDA operator during testing. Safe access to the pile head shall be provided by the Contractor to allow the operator to attach gauges below the pile head. The Contractor shall provide all necessary equipment to re-strike test piles and shall use a pile driving hammer of a rated energy no less than that used to initially drive the piles. During both initial driving and re-strike testing, the Contractor shall measure by remote theodolite, the pile penetration per blow to within $\pm 0.5\text{mm}$.

For re-strike testing the test procedure shall be as follows.

- When using a drop of air / hydraulic hammer the pile shall be given ten consecutive blows at the normal drop height, or using the normal operating pressure for air or hydraulic hammers. Additional blows may be required at different drop heights or different operating pressures as directed by the PDA operator.
- The Contractor shall provide a stable source of 240V AC single phase

power (minimum 750V A) to run the PDA equipment. Access and working space shall be provided within 15m of the pile head for the PDA field equipment.

- The head of the pile to be PDA tested during driving shall be drilled and tapped as required by the PDA Testing Authority prior to commencement of piling. Following pile head preparation, the Contractor may elect to pitch the pile with the PDA gauges attached, providing it can be ensured that the pitching process will not damage the PDA gauges after pitching.
- Access for the PDA operator to prepare the head of the pile, (if this has not been done previously) and to attach the PDA gauges up to a distance of 2.5 pile diameters below the top of the pile. In cases where the pile has been driven too close to ground level, this may require excavation around the pile head or addition of pile section for a distance of at least 2.5 pile diameters.
- Following pile head preparation and gauge attachment, which will normally take up to 30 minutes, the Contractor shall position the pile driving hammer above the head of the pile and conduct the re-strike test as directed by the PDA operator.
- The Contractor shall state the type and size of hammer that they propose to use and must give evidence that such is the appropriate hammer. Drop heights shall be determined from appropriate driveability studies. Hiley formulae or other dynamic formulae shall not be used to determine drop heights.
- The Contractor shall be liable for any damage caused to the PDA gauges or cables due to handling of the pile, objects falling from the pile, the pile frame or the pile hammer.

3.5.4 Rejection

Any pile which is tested and found not to meet the required design ultimate load capacity shall be rejected. If the rejected pile is representative of other untested piles based on similarities in driving records, then the other similar piles shall be tested.

3.5.5 'CAPWAP' Analysis

Readings shall be taken during PDA testing for subsequent CAPWAP analysis. CAPWAP analysis results shall take precedence over PDA test results.

3.6 QUALITY CONTROL

3.6.1 Pile Installation and Remedial Work Reviews

Pile installation or remedial work shall not commence without the written review of the Engineer.

3.6.2 Supervision

Piling supervisors experienced in the handling, pitching and driving of large tubular steel piles shall be employed by the Contractor on site and shall directly supervise the piling work. The piling supervisors shall be responsible for maintaining the pile driving records and pile installation records under this Contract.

Approval to commence piling works is contingent upon this appointment and the Engineer may without prior notice, order that the piling works cease until a suitably qualified piling supervisor is reinstated.

In addition to the piling supervisor the Contractor shall also provide all necessary qualified manpower resources for the implementation of the works in accordance with the Specifications to meet all the requirements of quality, health and safety, and the planning objectives.

4. SPECIFICATIONS FOR FENDERS AND BOLLARDS

4.1 REFERENCE DOCUMENTS

The design for the fenders and bollards shall comply with the following requirements of the standards and regulations as listed below.

PIANC MarCom Report of WG 33

Guidelines for the design of Fender Systems: 2002

BS6349: Maritime Structures.

Part 1: 2000: Code of practice for general criteria.

Part 4: 1994: Code of practice for design of fendering and mooring systems.

EN 1993: Eurocode 3

ROM 0.2-90 [Ref 203]

Where standards applicable to design, manufacture or finishing of specific components are not clearly stipulated, appropriate BS, EN, ISO, DIN, ASTM, JIS or other internationally recognised standards shall be used. In the absence of appropriate standards then good engineering practice will be adopted in consultation with the Engineer.

4.2 DESIGN AND TECHNICAL PERFORMANCES

4.2.1 *Description*

Each fender system shall be tyres on one portion of the jetty or D-type extruded rubber fender as shown on the drawings.

The system fender shall be capable to absorbing stated berthing energy at rated deflection.

4.3 FENDERING SYSTEM PERFORMANCE

4.3.1 *Rubber Fender Materials*

The rubber for the fender shall be vulcanized natural or synthetic rubber or a mixture between both. It shall be reinforced with carbon black and resistant to aging, seawater, abrasion, and ultraviolet rays. Recycled rubber is not allowed. Rubber must be homogenous in quality and free from any foreign material, bubbles, injuries, cracks and other harmful defects. The embedded fixing steel plates shall be firmly bonded into the rubber body through the process of vulcanization, and completely encapsulated so that no steel is exposed.

4.3.2 Rubber Properties

The minimum properties of rubber shall be the following:

Property	Testing Standard	Condition	Requirement
Tensile Strength	DIN 53504; ASTM D 412 Die C; AS 1180.2; BS ISO 37; JIS K 6251	Original	13.0 MPa (min)
		Aged for 96 hours at 70oC	10.4 MPa (min)
Elongation at Break	DIN 53504; ASTM D 412 Die C; AS 1180.2; BS ISO 37; JIS K 6251	Original	280% (min)
		Aged for 96 hours at 70oC	224% (min)
Hardness	DIN 53505; ASTM D 2240; AS1683.15.2; JIS K 6253	Original	78° Shore A (max)
		Aged for 96 hours at 70oC	Original +8° Shore A (max)
Compression Set	ASTM D 395 Method B; AS 1683.13 Method B; BS903 A6; ISO 815; JIS K 6262	22 hours at 70°C	30% (max)
Tear Resistance	ASTM D 624 Die B; AS1683.12; BS ISO 34-1; JIS K 6252	Original	60kN/m (min)
Seawater Resistance	BS ISO 1817; ASTM D 471	28 days at 95°C	Hardness: }10° Shore A (max) Volume: +10/-5% (max)
Abrasion	ASTM D5963-04; BS ISO 4649 : 2002	Original	180mm3 (max)

4.3.3 Performance Verification

The performance capabilities of the rubber fender units must be demonstrated by testing. Testing shall be performed according to PIANC 2002 or ASTM F2192. The specimen for testing and inspection of the materials, dimensions, and performance shall be sampled as specified below. The specimen to be used for the material test

shall be taken directly from the product or from the rubber prepared in the quality check and under the condition of the same vulcanization as the products.

Test Item	Number of Sampling
Rubber Material	1 set by rubber batch (1)
Dimensions	All fenders (2)
Performance	10% of fenders (3)

- (1)- in case of non-compliance of the batch with requirements, all fenders made with rubber from this batch shall be rejected and new fenders shall be built at vendor own cost.
- (2)- in case of dimensions being out of tolerance, the fender will be rejected and a new one shall be fabricated at vendor own cost.
- (3)- in case of one fender test being out of tolerance, 100% of fenders shall be tested at vendor own cost and the fenders which tests will be out of tolerance will be rejected and new ones fabricated at vendor own cost.

4.4 FASTENERS AND HARDWARES

All fasteners and hardware for mounting the panel to the fender shall be supplied by the fender manufacturer. All fasteners and hardware for mounting the fender to the structure (including hex bolts, nuts and washers) shall be included. Size and grade of the mounting hardware shall be in accordance with the fender manufacturers' recommendations.

All fixing bolts and anchors are grade 8.8 and hot dip galvanised. All threads are ISO metric thread. Washers are standard or oversize. Where required, lock nuts, spring washers or other methods are used to prevent loosening of fixings.

4.5 Bollards

Bollards shall be of the type, capacities and pattern shown on the Drawings. The bollards shall have the rated safe working load shown on the Drawings and shall have the relevant test certificates. Installation of the bollard shall be according to the manufacturer's specifications, including the holding-down bolts and fasteners. The *Contractor* shall provide evidence that the manufacturer of the bollards has a proven track record of manufacturing bollards and shall demonstrate proof of previous satisfactory installations similar to those proposed.

5. SPECIFICATION FOR CORROSION PROTECTION

5.1 SCOPE

This specification covers the corrosion protection requirements for newly fabricated and any subsequent repair of metal surfaces for the Latimer's Landing Jetty Structure. This section covers the requirements for surface preparation, galvanizing, painting and sets out the Cathodic protection functional where needed and technical specification.

5.2 APPLICABLE DOCUMENTS

This specification includes all clauses of the standards stated below.

Standards Applicable

No.	Title
BS 3900	Methods of Test for Paints
BS 4652 - 1995	Specification for metallic zinc-rich priming paint.
BS EN ISO 12944 1-3	Corrosion protection of steel structures by protective paint systems. General introduction.
BS EN ISO 16276	Corrosion protection of steel structures by protective paint systems. Assessment and acceptance criteria for adhesion of a coating.
ISO 1461 – 2009	Hot dip galvanized coatings on fabricated iron and steel articles

5.3 MATERIALS

5.3.1 *Paints*

The coating systems specified have been chosen for their ability to provide the long-term corrosion protection required in conjunction with the other anti-corrosion techniques also specified in this document. The Contractor must ensure correct application of all coating systems. Products equivalent to those specified may be submitted for approval and shall only be used on this project after such approval has

been granted in writing by the Engineer. This approval will only be considered if the manufacturer provides adequate evidence of similarity and supports his claim by submission of adequate technical data.

5.3.2 *Material to be Galvanized*

The grade of carbon steel that is specified by the Engineer for fabrication of the D-fender panel is a typical grade 250WA carbon steel (or similar) but with a maximum phosphorous content of 0.05% as well as silicon content of 0.5% respectively.

These specific elemental contents necessitate tight control of the time the object being galvanized will spend in the molten zinc bath so as to avoid excessive thicknesses and brittleness of the galvanising layer. (See section 5.5.2.6).

5.4 PLANT AND EQUIPMENT

- I. Galvanizing: The Galvanizing Company (further referred to as the "Galvanizer") shall supply all equipment, products and consumables necessary to apply and test the galvanizing in accordance with the requirement of this specification.
- II. Organic Coating: The Coating application Contractor (further referred to as the "painting contractor") shall supply all equipment, products and consumables necessary to apply and test the organic coating corrosion protection system in accordance with the requirements of this specification.
- III. Main Contractor: The Civil Contractor shall supply all equipment, products and consumables necessary to ensure compliance with all anti-corrosion requirements during erection, installation, assembly and commissioning of the structure. This shall include equipment and packaging to minimise damage to any anti-corrosion system that has been installed onto any component of this project. This includes using only broad band slings and other handling equipment that will not damage them (for example the use of a softer cushioning material between hard surfaces such as the forks of a forklift and similar cranes etc.).

5.5 CONSTRUCTION

5.5.1 *General*

A Quality Control Procedure (QCP) document shall be submitted to the Engineer for approval in which the coating and galvanising contractor will set out all the relevant quality procedures for applying the organic / galvanized coating. This document will include the Inspection and Test (ITP) matrix that will be used to ensure the conformance to all quality related steps. The contractor shall be responsible to record all relevant and stipulated quality measuring parameters relevant to achieving the stipulated coating parameters as prescribed in the QCP. It shall also confirm whether the relevant requirements, conditions and processes are within the specified limits as indicated in paragraphs 5.5.3.5 and 5.5.5.8. No alteration to these records shall be allowed and all original documentation shall be retained for subsequent scrutiny by the Engineer or his representative. These records will be retained in the data report file.

5.5.2 System A: Galvanizing of newly fabricated carbon steel components

5.5.2.1 Galvanizing: General

Apart from the steel piles that support the jetty, all structural steel, that are meant for either anchoring, supporting or making up the platform shall be galvanised in accordance with ISO 1461 – 2009 "Hot dip galvanized coatings on fabricated iron and steel articles" with coating thickness in accordance with the requirements for "heavy duty applications". Care must be taken when galvanizing these parts to prevent hydrogen embrittlement or brittle coatings as well as component distortion by the heat it is subjected to, by keeping acid pickling and zinc bath immersion times to a minimum. The Galvanizer shall comply with the quality procedures as set out in ISO 1461: 2009 and shall record zinc film thickness measurements taken and in the case where the galvanizing is to be subsequently painted shall present a copy of this record to the contractor who shall include these in his own quality records that shall ultimately form the data report and be handed to the Engineer on completion of the coating job.

For galvanized items that in accordance with this specification do not require subsequent painting before installation, the galvanizer shall instead hand the quality records over to the Engineer after galvanizing.

5.5.2.2 Galvanizing: Surface Preparation

All blasting shall be by dry abrasive blast cleaning. The medium for abrasive blast cleaning shall be clean contamination-free granular abrasive slag, iron shot or chilled iron grit. Sand shall not be used for blast cleaning. If abrasive slag grit is used it shall be platinum slag grit free of chromium and copper or their salts and only fresh grit as opposed to recycled grit shall be used for blasting. If recyclable iron shot or chilled iron abrasive is used for surface preparation then it shall either be clean new or thoroughly cleaned and uncontaminated recycled grit. The complete surface to be galvanized shall be thoroughly blast cleaned to Swedish Standard Sa 2.

5.5.2.3 *Galvanizing: Cleaning Up Of Welds*

All welds are to be cleaned and dressed correctly before the item is galvanized. Remnants of weld spatter are not allowed and areas where such spatter exists must be properly cleaned to remove all such contamination prior to delivery to the Galvanizer.

5.5.2.4 *Galvanizing: Oil and grease contamination*

Degrease all surfaces with a water-soluble degreaser to remove all oil, grease and other forms of contamination, followed by a thorough fresh potable water rinse ensuring that a water break free surface is achieved. If required the item(s) to be hot dip galvanized are to be further cleaned as per ISO 1461:2009 Appendix C paragraph C.1.2. The item that is to be galvanized shall subsequently to being degreased and/or subjected to pickling, and any subsequent rinsing operation but before being immersed into the molten zinc bath be allowed to dry completely.

5.5.2.5 *Galvanizing: Shielded Surfaces*

All surface areas that are not to be galvanized but are on surfaces of the items that will undergo hot dip galvanizing shall be shielded from galvanizing by the galvanizer by way of masking the surfaces prior to dipping using an appropriate stop off material. 'Stopgalv' or 'Galva Stop' masking material or an equivalent substance shall be used.

5.5.2.6 *Galvanizing: Thickness of Film*

The nominal thickness of the galvanizing before it is prepared for accepting the organic coating shall be 105 microns with the minimum thickness being 85microns and the maximum thickness being 125 micron.

5.5.2.7 *Galvanizing: Treatment of Bolts and Nuts*

All steel components that have not been defined elsewhere as an area that is not to be galvanized or is of aluminium (anodes) and other mechanical or polymeric or electrical working items (i.e. components that shall remain bare) shall be hot dip galvanized. All bolts, nuts and washers, unless specified otherwise, shall be hot dip galvanized in accordance with ISO 10684:2010 read in conjunction with ISO 1461:2009. It must be ensured that Grade 8.8 bolts that are galvanized are not subject to hydrogen embrittlement. These bolts needs to sourced from reputable suppliers and must be approved by the Engineer. Electroplating of fasteners will not be acceptable. All fasteners are to be supplied in the correct length before galvanizing. On such fasteners the minimum coating thickness shall be 55micron and maximum thickness shall be 90micron. Nuts and bolts to be galvanized shall be undercut and cleaned after galvanising to ensure a good fit.

5.5.2.8 *Galvanizing: Hanging of Items during Zinc bath immersion & access and drainage ports*

The dipping into the molten zinc for the purpose of hot dip galvanizing shall be done by hanging the component being galvanized into the bath from an appropriate location to enhance the chance of achieving an acceptable galvanizing surface finish as per ISO 1461:2009 specification.

This hanging point shall be discussed with the Galvanizer prior to the component being galvanized so that any possible modifications (such as molten zinc drainage and entry holes and/or rounding of sharp edges) can be done to ensure an optimal galvanising end-product. Furthermore, any access and drainage ports required to ensure full surface coverage during the HDG process shall be installed after gaining approval for their location(s) from the Engineer.

5.5.2.9 *Galvanizing: Post Galvanizing Surface Treatment*

The galvanized items that are to be coated with a subsequent organic coating shall prior to being coated be cleaned and degreased after galvanizing using a recognised and paint supplier approved galvanise cleaner that shall be used in such a manner to completely remove the passivation or conversion coating that galvanizers typically apply to the standard galvanised items. Alternatively, the galvanised item that is to be painted shall not be passivated or be coated with any conversion coating after it has been galvanized and it shall be coated with the organic specification as set out in paragraph 5.4.2 Table A-2 within 12 hours of it being galvanized. Care shall be taken to restrict any surface contamination and damage occurring prior to the item being coated. If required, it shall be transported from the galvanizer to the coating contractor under cover i.e. shielded from the elements. Refer to paragraph 5.4.3 (table B) for degreaser to be used.

5.5.2.10 *Galvanizing: Repairing of Damaged Hot Dip Galvanizing Areas*

Welding, flame cutting, drilling or other heat processes shall not be carried out on any galvanized article.

5.5.2.11 *Galvanizing: Application of Organic Coating of Galvanizing Surfaces*

The hot dip galvanized surfaces to be coated with System A shall prior to being coated be sweep blasted to create an acceptable key so as to enhance the adhesion between the substrate and the primer. Subsequent painting of the galvanised surface is to be done with one of the paint coating systems listed below in 5.5.4.2 Table A-2.

Refer to paragraph 5.5.2.2 for surface preparation specification of galvanised surfaces for subsequent organic coating application. Application method shall be as prescribed in the chosen coating product data sheet that is obtainable from the relevant paint supplier. All other prescribed requirements as set out in the relevant paints product data sheet shall also be complied with.

5.5.3 Corrosion Protection

5.5.3.1 Scope

Structural steelwork in coastal area (within 10km from coast):

Structural steelwork is to be protected against corrosion as follows:

This specification covers requirements for protective coating of iron and steel structures, electrical motors, gear boxes etc. against corrosion and must be read in conjunction with the main specification as well as the following (latest editions):

SANS 10064	"Preparation of steel surfaces for coating"
SABS 121	"Hot-dip (galvanized) zinc coatings"
SANS 1091	"National colour standards for paint"
BS 5493	"Code of practice for protective coating of iron and steel Structures against corrosion"

5.5.3.2 Types of Corrosion Protection to be Used

- i. The coatings specified in this Specification are chosen according to BS 5439, Table 3, part 9, to ensure that the condition of the surface will be at least RE2 on the European scale of degree of rust, after 10 years in an environment of frequent salt spray, chemicals, and polluted coastal atmosphere. During the 10 years, the normal maintenance painting will be done.
- ii. The paint manufacturer shall guarantee the paint for at least 10 years.
- iii. Should a tenderer wish to offer coating systems other than those specified, as an alternative, he shall submit full technical details and a list comparing all appropriate details of the alternatives proposed for the approval of the *Project Manager*.
- iv. Tenderers must ensure that the different coats they offer in their tenders are compatible with each other.
- v. The coating of proprietary items must be done according to Clause 3.
- vi. All galvanized components including bolts and nuts but excluding walkway gratings, must be painted with the specified system, unless otherwise approved by the *Project Manager*.

5.5.3.3 *The following coating systems must be used unless otherwise specified in the main specification:*

Substrate	Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (mM)
3cr12 Steel	1	Surface Tolerant Epoxy Primer	Dulux /Sigma Sigmacover Primer International (Plascon) Intergard 269 Stoncor (Chemrite Coatings) Carboline 193 Primer	65-75
	2	Two Component Re-Coatable, Polyurethane Finish (Gloss)	Dulux / Sigma Sigmadur Gloss International (Plascon) Interthane 990 Stoncor (Chemrite Coatings) Carboline 134	65-75
Galvanized Steel	1	Surface Tolerant Epoxy Primer	Dulux /Sigma- Sigmacover Primer International (Plascon) Intergard 269	65-75

			Stoncor (Chemrite Coatings) Carboline 193 Primer	
	2	Two Component Recoatable, Polyurethane Finish (Gloss)	Dulux /Sigma- Sigmadur Gloss International (Plascon) Interthane 990 Stoncor (Chemrite Coatings) Carboline 134	65-75

Substrate	Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (mM)
Mild Steel	1	Two Component Self Curing Inorganic Zinc Ethyl Silicate Or Two Component Zinc Rich Polyamide Cured Epoxy Primer	Dulux /Sigma- Sigma Mc60 Or Sigma-Cover Primer International (Plascon) Interzinc 233 Or Interzinc 52 Or 53 Stoncor (Chemrite Coatings) Carbo Zinc 11 Or Carbo-Line 658 Primer	65-75

	2	Flexible Recoatable High Build Polyamide Cured Mio Epoxy	Dulux/Sigma – Sigmacover Cm Mio International (Plascon) Interseal 010 Mio Stoncor (Chemrite Coatings) Carboline 190 Hb M.I.O. Or Carboline 193 M.I.O.	125-150
	3	Two Component Recoatable, Polyurethane Finish (Gloss)	Dulux/Sigma Sigmadur Gloss <i>International (Plascon) Interthane 990</i> Stoncor (Chemrite Coatings) Carboline 134	65-75

The paint manufacturer's recommendations for the application of the different coating systems, curing time before handling or application of subsequent coats, health and safety recommendations etc. must be carefully adhered to.

Paint *Contractors* must have a quality management system which must be submitted to the Engineer for approval before commencement of the work.

Galvanizing shall be done to SANS 121 heavy duty hot dip galvanizing to a thickness of at least 85mm. Electroplated components in zinc or cadmium are not acceptable.

All mounting bolts, nuts, washers and brackets as well as all fixing bolts, studs nuts and washers shall be of stainless steel. Fixing rivets shall be of either stainless steel or brass.

High tensile bolts for friction grip joints must be hot dip galvanized and painted. High tensile bolts must be certificated after galvanizing.

The full paint system shall be applied to all surfaces which are to be covered with wear pads, linings etc.

For steelwork which will be transported over long distances and erected on site the two pack epoxy primers is preferred.

5.5.3.4 *Propriety Items*

Proprietary items such as gearboxes, motors, brakes etc. must either be painted according to this specification or where the coating system is equal to or exceeds this specification sufficient proof of the coating system applied must be provided. Items which are nearly equal to this specification shall be given a finishing coat according to this specification's thicknesses and final colours and to the following procedure:

- i. A cross cut test must be done to SANS SM159 to determine if the original coating adheres correctly to the substrate;
- ii. The original coating shall be rubbed down to remove any smooth finishing to form a suitable key for the finish coat and any damaged areas prepared and patch primed with a suitable primer;
- iii. The item must then be detergent washed to remove any foreign matter, taking care that no dust, solvent etc. contaminates any working part of the item;
- iv. A test shall be done on the existing coat to ensure that the finish coat will not react with and cause undue dissolving and lifting of the existing coat. This can be done by applying a small quantity of the finishing coat thinners.
- v. Should any undue dissolving or lifting occur, a suitable intermediate or barrier coat must be applied before the finishing coat is applied.
- vi. Proprietary items which failed the cross cut test and which generally have inadequate protection shall be dismantled and the full corrosion protection specification applied.

5.5.3.5 *Surface Preparation*

- i. All steel surfaces shall be detergent washed and fresh water rinsed to remove all oil, grease and surface contaminates before shot blasting.
- ii. Sharp edges shall be radiused and major roughness of welds shall be removed by grinding. Welding spatter and flux shall be removed.
- iii. Components manufactured from hot rolled steel sections and steel plate shall be blast cleaned to base metal in accordance with SANS 10064 grade SA2½ - very thorough blast cleaning, to remove all mill scale, rust, weld spatter etc.
 - a. "Sharp" chilled iron shot, chilled iron grit, or granular abrasive slag is to be used to produce a proper degree of surface roughness.
 - b. Blast profile shall be determined by micrometre profile gauge, Keane-Tator surface profile comparator or Testex press-o-film.

- c. The profile height shall be between 40 and 50mm at any point.
- iv. Good quality blast cleaning and spray painting equipment shall be used. Air used for spraying and blast cleaning shall be free from all traces of oil, water and salinity. Water and oil traps must be fitted to all equipment.
- v. Wheel abrading equipment shall not be used unless an angular profile the same as clause 4.3.3 is achieved.
- vi. When wet blasting is done the primer shall be applied before oxidization starts or surface contamination occurs.
- vii. Components manufactured from 3CR12 steel shall be lightly abraded. The components shall then be passivized by using a mixture of 10 - 15% nitric acid in water which is rinsed off after 10 - 15 minutes. The surface shall be neutralized to pH 7 before it is coated.
- viii. Hot-dip galvanized components, galvanized bolts and nuts etc. shall be lightly abraded with a galvanizing pre-cleaner. The components shall then be washed with detergent and water and washed down with clean water until a water break free surface is achieved. Allow to dry thoroughly.

5.5.3.6 *Joints and Mating Surfaces of Members*

- i. Mating (faying) surfaces of members which have to be joined by high tensile steel bolts in friction grip shall be cleaned according to Clause 4 and painted with primer only.
 - a. After being assembled joints so formed shall be seal welded and painted or after the intermediate coat was applied the edges shall be sealed with an approved brand of paintable flexible sealant or mastic (e.g. Butyl rubber, polyurethane sealer or two -component epoxy), by means of a suitable caulking gun.
- ii. All rivets, bolts, welds, sharp edges etc. must be covered with a "stripe coat" of the primer or intermediate coat specified to ensure the correct dry film thickness on sharp edges, as well as sealing of bolt threads to head etc.
- iii. All other mating surfaces must be sealed with an approved brand of flexible Butyl rubber, paintable Silicone, polyurethane sealer or two component epoxy sealer, and joined while still wet. All excess compounds must be completely removed.

5.5.4 *Painting Procedures*

- i. Directly before the application of paint, the area to be painted shall be degreased with a suitable degreaser and left to dry.
- ii. Paint shall only be applied under the following conditions: -

- a. There is adequate light.
 - b. The steel temperature is between 5 and 50°C and at least 3°C above the dew point of the air.
 - c. The relative humidity of the air is between the limits specified by the paint supplier.
 - d. Wind does not interfere with the method used and sand and dust cannot be blown onto wet paint.
- iii. Steelwork shall be supported on trestles, at least 900 mm off the ground for painting purposes.
- iv. An adequate number of test readings shall be taken per square meter in order to determine the dry film thickness.
- a. The paintwork shall be acceptable if the average of the test readings taken falls within or exceeds the ranges given.
 - b. Paintwork shall not be acceptable if any single test reading is less than the specified minimum thickness.
- v. An ultrasonic or electronic magnetic flux thickness measurement gauge shall be used, but in case of dispute, destructive testing shall be applied. The painted steelwork shall present a clean, neat appearance of uniform colour and gloss as applicable to the paint used. Each coat of paint shall be applied as a continuous, even film of uniform thickness. More than one application of paint may be required to achieve the dry film thicknesses specified or to obliterate the colour of the previous coating.
- vi. The use of thinners or solvents at any stage of the work is prohibited, unless specified by the paint manufacturer.
- vii. Precautions shall be taken to prevent coatings from being applied to equipment nameplates, instrument glasses, signs etc.

5.5.4.1 *Colour Codes*

Machinery and equipment shall be painted in the following final colours:

Area	Colour	Code No. [SABS 1091 and International No's]
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<p>Mobile equipment (cranes, loaders etc.):</p> <p>a) Structure, machinery and electrical houses, operator's cabins, chutes, hoppers etc.</p> <p>b) Undercarriage, travel bogies, rubber tyred rims</p>	<p>Transnet White</p> <p>Transnet dark grey</p>	<p>RAL 9016</p> <p>RAL 7024 (Graphitgrau) SABS 1091 GO4 (Bluegrey) BS 381C-633</p>
<p>Industrial buildings, conveyor structures:</p> <p>a) Roofs and canopies</p> <p>b) Painted walls</p> <p>c) Steel columns, rafters, trusses</p>	<p>Pantone cool grey 10</p> <p>Pantone cool grey 3</p> <p>Pantone cool grey 5</p>	<p>RAL 7037 (Staubgrau)</p> <p>RAL 7035 (Lightgrau) or SABS 1091 G62 (Pale grey)</p> <p>RAL 7004 (Signalgrau)</p>
<p>General:</p> <p>a) Guards</p> <p>b) Sheaves</p> <p>c) Cable reels (Stainless steel)</p>	<p>Golden yellow</p> <p>Orange</p> <p>Orange</p>	<p>SABS 1091-B49</p> <p>RAL 1003</p> <p>RAL 2008</p> <p>RAL 2008</p>
<p>Machine buffers and parts of machine which could constitute a serious hazard</p>	<p>Golden Yellow (High Gloss) with Luminous green stripes in chevron pattern</p>	<p>SABS B49 and Luminous green</p>

Area	Colour	Code No. [SABS 1091 and International No's]
e) Any exposed rotating part of machinery, electrical Switch-gear (other than starting and stopping devices and emergency stop control), electrical services e.g. conduit and allied fittings	Light Orange (High Gloss)	SABS 1091 B26 BS 381C-557
f) Low voltage switchgear panels where orange is not aesthetically acceptable	Light grey	SABS 1091-G29 BS 381C-631
g) Medium voltage cable trays, switchgear and motors (3,3 kV and up)	Oxford Blue	SABS FO2 BS 381C-105 RAL5003
h) Starting devices, low voltage cable trays and switchgear	Mid Brunswick green (high gloss)	BS 381C-228 SABS1091-E04 RAL6005
i) Parts of stationary machinery (Electrical, motors, gearboxes, brakes, transformers, etc.)	Light Grey	SABS G29 BS 381C-631
j) Hand levers, hand wheels, oiling points, handrails on walkways, ladders	Golden Yellow (High Gloss)	SABS 1091 B49 BS 381C-356
k) Stopping devices, grease points , motor fan covers and danger signs (not symbolic safety signs for which see SABS 1186)	Signal red (High Gloss)	SABS 1091 A11 BS 381C-537 RAL3001
l) Walkways (non-slip surfaces) (galvanized gratings not to be painted)	Shop floor green	
m) Informatory signs and notices (not symbolic safety signs for which see SABS 1186)	White on Emerald Green (High Gloss)	White on SABS 1091 E14 BS 381C- 228

Area	Colour	Code No. [SABS 1091 and International No's]
Pipe lines		
a) Reclaim water piping	Aluminium	
b) Slurry pipe lines	Dark admiralty grey	SABS 1091-G12
c) Fire protection piping	Signal red	SABS 1091-A11
d) Washwater drain pipes	Light grey	SABS 1091-G29
e) Instrument air	White with Strong blue band	White and SABS 1091-F11
f) Plant air	White with Flag blue band	White and SABS 1091-FO4
g) Potable water	Grass green	SABS 1091-D14

Colour bands for pipes shall be 75 mm wide for pipe sizes up to 150 mm diameter and 100 mm wide for 150 mm and above. The colour bands shall be applied to the pipe flanges, valves, junctions, walls or structures etc. in such a manner that the pipe may be easily identifiable. On straight sections the maximum spacing shall be 100 x the pipe diameter.

5.5.4.2 *Field Touch-up Painting*

- i. Damaged and unpainted areas, fasteners, welds, etc. shall be cleaned by wire brushing with hand tool or power tool in a manner which will minimize damage to sound paint. Grinding will not be allowed. Rust spots shall be cleaned to bright metal. Thick edges of old paint abutting on bare metal surfaces shall be feathered by scraping and sanding.
- ii. Where welding is required on areas already coated with the coating system, the coat should be stepped back for ± 30 mm around the weld area.
- iii. The paint shall be applied to match the original coats in accordance with the manufacturer's recommendations for the specific paint system.
- iv. Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.
- v. Areas of damaged galvanizing shall be repaired with an approved cold galvanizing product or metal sprayed by the wire spraying process with Zinc, and then touched up with the specific paint system.

5.5.4.3 *General*

- i. All walkways, floors, maintenance platforms etc. must be painted with a durable, non-skid coating of the appropriate colour.
- ii. Exposed machined surfaces must be coated with a strippable corrosion inhibitor (e.g. Tectyl).
- iii. Where different materials will be in contact with each other and galvanic corrosion can occur the contact areas of the materials must be isolated from each other or the joints made water proof to prevent ingress of moisture.
- iv. All components must be designed with corrosion prevention in mind and specifically the following:
 - a. No entrapment of dirt, product, moisture etc.
 - b. No areas must be inaccessible for maintenance such as too narrow gaps etc.
 - c. Large flat areas rather than complicated shapes and profiles.
 - d. No sharp corners and discontinuous welds.
- v. Parts of equipment which are exposed to high temperatures must be coated with the following system:

Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (mM)
1	Two Component Self Curing Inorganic Zinc Ethyl Silicate	Dulux /Sigma- Sigma Mc60 International (Plascon) Interzinc 233 Stoncor (Chemrite Coatings) Carbo Zinc 11	65-75
2	Single Component High Temperature Moisture Curing Silicone With Aluminium Flakes	Dulux/Sigma Sigmatherm Silicate International (Plascon) Intertherm 50	– 40

		Stoncor (Chemrite Coatings) Carboline 1248	
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5.5.4.4 Maintenance Painting of Structures

Areas which are only lightly corroded must be cleaned by means of high-pressure water blasting or wire brushing by power tool and the following system applied:

Coat No	Generic Description	Approved Brand Products	Dry Film Thickness (mM)
1	Surface Tolerant Two Pack Epoxy Primer With Aluminium Pigments	Dulux/Sigma Aluprimer Stoncor (Chemrite Coatings) Carbomastic 15 International (Plascon) Intergard 468,	125-150
2	Same As First Coat Or Micaceous Iron Oxide (Mio) Epoxy	Dulux/Sigma – Sigmacover Cm Mio International (Plascon) Interseal 010 Mio Stoncor (Chemrite Coatings) Carboline 190 Hb M.I.O. Or Carboline 193 M.I.O.	125-150
3	Two Component Recoatable, Polyurethane Finish (Gloss)	Dulux/Sigma Sigmadur Gloss International (Plascon) Interthane 990 Stoncor (Chemrite Coatings) Carboline 134	65-75

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- i. Alternatively, the Noxyde paint system can be used, consisting of two to three coats of water based Noxyde paint to achieve a DFT of 350 to 400 microns. Where the Noxyde system is used on areas other than slightly corroded structural areas, the following additional requirements must be observed.
- ii. Very smooth surfaces (e.g. 3CR12, stainless steel or hot-dip galvanized components, bolts, nuts and fittings, and HT bolts): Parts must be thoroughly degreased using OptiDegreaser, washed down with potable water, and immediately when dry, a single coat of OptiPrimeAqua applied.
- iii. Paintable flexible sealant/mastic: Only sealant approved by the paint manufacturer may be used, and an initial coat of OptiPrimeAqua applied over it before the further coats of Noxyde are applied.
- iv. Bolted/riveted connections: After blasting or and/or cleaning as required, apply a coat of OptiPrimeAqua and an additional stripe coat of Noxyde, in contrasting colour, to all bolt/nut and plate edges and crevices.
- v. The adhesion of old coatings must be verified by doing a cross cut adhesion test on selected areas.
- vi. The compatibility of the new paint system on the old coating must be tested and guaranteed in writing by the paint supplier.
- vii. The work and coating system must be guaranteed for a minimum of 12 months.
- viii. All heavily corroded areas must be shot blasted to minimum SA2 and the three coat system indicated in clause 2.6 applied.
- ix. Areas where the old coating is still sound need only be high pressure cleaned with a suitable solvent and coated with one of the primers suggested in clause 10.2 (as tie coat) and then with one of the top coats suggested in clause 2.6 to get the appropriate colour and finish. The minimum dry film thickness of this tie coat must be 75 microns and top coat must be 50 microns, but the previous coating colour shall be completely obliterated to present a uniform colour.
- x. Note: Inorganic zinc primers shall not be re-covered with an inorganic primer, but only with an organic zinc primer.
- xi. Repairs to the insides of all the enclosed sections of the booms as well as the insides of the crane legs, sill beams, cross beams, pylon cross bracing members etc. shall be done as above but the top coat need not be applied.

5.6 TOLERANCES

The total overall DFT of a complete coating system shall not be greater than 100% of the specified maximum DFT in isolated places. Generally the manufacturer's guidance shall be followed with respect to maximum film thickness.

6. SPECIFICATION FOR STRUCTURAL STEEL

6.1 SCOPE

This specification covers the requirements for structural steel required for the walkways, fender supports and pontoon connections as part of the Marine Works for the new jetty development of East London Port, as well as for the tubular piles.

The following specifications apply in carrying out the work:

- (i) British Standards applicable to structural steel and welding
- (ii) British Standards 6349 Maritime Structure Series
- (iii) British Standard BS 5930 Code of Practice for Site Investigations, 1999

The following aspects are covered in this Specification:

- (i) Materials
- (ii) Production
- (iii) Execution

Reference shall also be made to the Steel Pile Specification and the Corrosion Specifications.

6.2 SUBMITTALS

6.2.1 *Quality Control Plans (QCP)*

A detailed Quality Control Plan (QCP) should be provided by the Contractor outlining the method of Work and how quality will be applied on site, for review and acceptance by the Engineer not less than 28 Days prior to commencing of the Work. The Work shall not commence until the QCP and all relevant method statements of working is approved by the Engineer.

The QCP shall include but not be limited to the following information:

- (i) Welding procedure details (WPS) and the approval thereof
- (ii) All procedures for applying non-destructive testing (NDT)

- (iii) Corrosion protection procedure and the quality control thereof
- (iv) Details of other quality related items that will apply during the construction phase together with the full details of the control and inspection and test documents (ITP's).
- (v) The compilation of the data reports and the relevant documentation that will be contained within the document and to be submitted to the Engineer at the handover of the project.

6.2.2 Method Statements

The erection method statement shall include the following, but not limited to:

- (i) Erection marking / sequencing / executing plans
- (ii) Routes for delivering steelwork and lay down areas
- (iii) Sequence and methods of erection of steelwork including calculations and details of temporary bracing/works to ensure stability.
- (iv) Method of lifting and handling the components, crane capacity, crane positions and working radius
- (v) Method of preventing damage to protective coatings on steelwork during handling
- (vi) Procedure for aligning, levelling and plumbing steelwork, including temporary supports and method of making beddings for bearings and measures to protect existing Works
- (vii) Bolted connections tightening sequence.
- (viii) Details of the corrosion protection system

The Contractor shall submit all test certificates, mill certificates, technical data sheets, source, supplier and manufacturer details to Company for approval. Manufacturer's test Certificates shall be submitted to Engineer not more than 7 Days after the steel has been delivered to the place of fabrication. All this documentation will be collated and filed in the data records to be submitted at the end of the project.

6.2.3 Plant & Equipment

The Contractor shall provide details of all plant and equipment used to carry out the

Work including independently certified Health and Safety documentation as required.

Shop drawing shall include but not necessarily be limited to the following:

- (i) Marking plans and details for holding down bolts and other embedded items,
- (ii) Fabrication drawings in accordance with BS 1192, welding symbols to BS 499,
- (iii) Connection details including calculations,
- (iv) Welding procedure details
- (v) Fabrication Method Statement, and
- (vi) Details of the quality assurance plan (CQP) for structural steelwork together with full details of the stage control and inspection documents.

6.2.4 Welding

Welder Certificates endorsed by an inspecting authority approved by Engineer shall be submitted to Engineer together with the approved WPS at least 3 weeks before fabrication of the Steel Works starts to show that each welder has been approved in accordance with BS 4872: Part 1. The extent of approval of the welder shall be appropriate to the categories of welds which he will carry out. The re-approval of welding operators shall be to BS 4872: Part 1, except that Engineer reserves the right to have any welding operator retested at any time.

The following particulars of the proposed welding procedures (WPS) shall be submitted to Engineer:

- (i) Welding procedures in accordance with BS EN 1011 for each type and size of weld.
- (ii) Documentation endorsed by an inspecting authority approved by Engineer to show that the welding procedure has complied with the procedure trial requirements (WPSQ) in previous fabrication used in the last 3 months prior to the start of fabrication. Failing this new WPSQ need to be performed.
- (iii) Details of procedure for magnetic particle (MP), ultrasonic (UT) and radiographic (RT) inspection shall be submitted to Engineer for approval 2 weeks prior to the commencement of inspection. No inspection shall take place other than to an approved procedure.

6.3 MATERIALS

6.3.1 *Structural Steel*

All structural steel for the walkways shall be new and comply with BS EN 10025 and BS EN 10210:1993 and with BS 5950 Part 2, Section 2.1. Steel shall be 250 grade for all steel sections unless otherwise noted.

Steel shall be delivered in good condition, undamaged and generally free from corrosion. Any bent or damaged steel shall not be used in the Works.

6.3.2 *Steel for Piling*

The steel plate used in the manufacture of the spirally welded piles will be made in accordance with EN 10025-2 using grade X52 steel to API specification 5L, product specification level PSL 1. Minimum yield strength to be 359 MPa and tensile strength 458 MPa. Alternatively grade S355JR to SANS 143 can be used by the Contractor.

6.3.3 *Bolts, Nuts, Washers and Direct Tension Indicators*

All bolts shall be grade 8.8 with grade 8.0 nuts to BS 3692 unless approved otherwise or specified otherwise in the drawings. All bolts and nuts will be galvanised as per Corrosion Specification. See section Particular Specification 5.5.2.7 for Galvanising of Bolts and Nuts.

6.3.4 *Welding Consumables*

Welding consumables used in metal-arc welding of grades of steel complying with BS EN 10025:1993 shall comply with BS EN 1011. Welding consumables and the procedures used shall be such that the mechanical properties of the deposited weld metal shall not be less than the respective minimum values of the parent metal being welded.

6.4 PRODUCTION

6.4.1 *Fixings*

The length of bolts complying with BS 3692 and BS 4190 shall be such that the end of the bolt will project above the nut by at least one thread, but by no more than one

nominal bolt diameter after tightening.

6.4.2 Corrosion Protection

Corrosion protection shall comply with the project corrosion specification. See particular specification 5: Corrosion protection.

6.5 EXECUTION

6.5.1 Steelwork and Connections

The Contractor shall allow for deformation due to permanent loads and the process and sequence of fabrication, erection, and construction such that steelwork is completed to within the specified tolerances. Compatibility of dimensions and setting-out data of steelwork shall be verified by the Contractor before fabrication of steelwork commences.

The Contractor shall carry out the fabrication and erection design of all connections, supports and details in accordance with this Specification. Welded connections in hollow sections should be according to BS 5950/ENV 1993-1-1 Annex K:

Fillet welds shall be of minimum size 6mm. The effective length of fillet welds shall be the full length less 25mm at each end. Intermittent welds shall not be used.

Butt welds shall be full penetration.

All pier truss member welds shall be full strength butt welds. If necessary, connecting members should be bevelled. There should be a smooth transition between the weld details of the connecting member.

Hollow section fabricated structures that are to be galvanised shall be provided with vent holes to allow the expanding air to escape and to enable surplus zinc to drain from the sections when the structures are withdrawn from the bath. All such holes shall be completely sealed after the galvanising process has been completed.

6.5.2 Handling, Storage and Transportation

Steelwork shall not be subject to rough handling, shock loading or dropping from a height.

During handling and transport of coated steelwork, the steelwork shall be separated from wires and lashings by rubber padding in such a manner that the coatings are not damaged or discoloured. Free ends shall be stiffened, measures shall be taken to

prevent permanent distortion and machined surfaces and faying surfaces shall be protected.

Steelwork shall not be lifted from the painting bed until the last applied coating is sufficiently dry or cured for handling. Coated steelwork shall be loaded and unloaded by hoisting equipment. It shall not be moved by sliding or skidding.

Softwood timber bearers with a sufficient contact area to prevent crushing shall be provided at all stages including transportation to Site. Bearers shall be level and sufficient in number to prevent distortion of members.

Special consideration shall be given to the arrangement of bearers if articulated vehicles, which allow differential movement of bearers, are used to transport steelwork. Vertical timber packings shall be used to separate members when required and to prevent chafing to coatings.

Steelwork shall be stored off the ground on level supports above rainwater splash zones in well-drained areas in a manner which will not result in damage or deformation to the steelwork or coatings or in contamination of the steelwork or coatings.

Steelwork shall be protected from exposure to conditions or deleterious agents that may affect the steelwork or coatings. Should any contamination occur, the contaminating agent shall be removed immediately by swabbing or brushing and the surfaces washed thoroughly with clean water.

All bolts, nuts and washers shall be protected and stored in dry conditions. Adequate precautions shall also be taken to ensure that threads are not damaged or contaminated with dirt.

6.5.3 Fabrication

Fabrication of steelwork shall comply with BS 5950: Part 2, Sections 3 and 4 as appropriate.

The ends of all beams shall be square where required and flanges neatly cut away or notched where necessary. All notches shall be kept as small as possible and shall be radiused in the inner corner.

Butt ends of compression members shall, except where bolts carry compressive loads, have their abutting faces machined after fabrication so that they are square to the member axes and in tight bearing contact when erected.

Where stiffeners are required to be fitted they shall be ground or machined and the surfaces on which the stiffeners bear shall be cleaned of all loose mill scale or any deleterious matter to allow tight bearing contact.

Baseplates and caps shall be accurately machined over the steel bearing surfaces and

shall be in tight bearing contact over the whole area of the machined end of the stanchion or column. The underside of baseplates bearing on concrete need not be machined.

All members of mass exceeding 5 tonnes shall have their mass marked by cold stamping and painting. Markings will be inspected and where necessary repaired or replaced upon delivery to Site and at regular intervals before erection.

6.5.4 Welding, Heating and Cutting

General

Welding shall be carried out by welders who possess a valid welding certificate for the appropriate category of welding. A welder shall cease to carry out welding if any of the circumstances stated in BS 4570, Clause 21.1, BS 4872 : Part 1, Clause 11 or BS 4872 : Part 1, Clause 6 as appropriate occurs.

Pre-setting, pre-bending, skip welding, back-step techniques and other measures shall be taken as necessary to counteract shrinkage or distortion due to welding, gouging, thermal cutting or heat treatment. Preheating shall comply in all respects with the requirements of BS 5135. No welding of mild steel shall take place where the ambient or plate temperature is 0°C or below. Where the combined plate thickness is equal to 50mm or over and ambient or plate temperature is under 10°C, welding shall only be allowed where special precautions approved by Engineer are taken to prevent too rapid a rate of cooling and loss of heat.

Butt welds shall be complete penetration butt welds made between fusion faces, and the ends of the welds shall have full throat thickness. On rolled sections, this shall be achieved by the use of extension pieces, cross runs or other means as approved by Engineer.

Butt welds in each component part shall be completed before the final assembly of built-up assemblies.

Temporary welded attachments shall not be used unless permitted by Engineer.

Coated surfaces to which welded attachments are to be made shall be cleaned to bare metal and all contaminants removed before welding can commence.

Structural Hollow Sections

Welding of hollow sections shall be to BS EN 1011.

The end of one hollow section shall be accurately shaped to fit the other. This shall be done by using properly prepared templates or equal approved methods. The correct fusion bevel shall then be cut.

If necessary, connecting members should be bevelled. There should be a smooth transition between the weld details of the connecting member.

Hollow section steelwork shall be assembled in jigs or on suitable surface plates on which shall be drawn out the whole section of the structure. Members shall be aligned e.g. by the use of scribing blocks, lines and squares and shall be held temporarily in position by the use of wedges and clamps. When correctly aligned the structure shall be tack welded to BS EN 1011.

Where bolted flanges for connections, etc., are welded to hollow section structures, steps shall be taken, either by pre-or post-heat treatment or by equal approved methods, to ensure the flanges are rendered flat at the completion of the welding.

Hollow section steelwork shall be continuously welded and the interior of all hollow sections shall be kept clean, dry and free from loose scale.

6.5.5 Mechanical Fixings

Nuts shall not be used with bolts or screws, which comply with a different standard

Washers shall be provided under both the nuts and heads of bolts to ensure no damage is done to painted areas. Where bolt heads or nuts bear on bevelled surfaces they shall be provided with square taper washers conforming affording a seating square with the axis of the bolt:

Bolts shall be tightened in such a manner that the contact surfaces of permanent bolted joints are drawn into close contact.

Defective components for steelwork shall not be used in the permanent Work unless repair of the defects is permitted by Engineer; if permitted, defective components shall be repaired by methods agreed by Company.

6.5.6 Approval of Fabricated Steelwork

Fabricated steelwork shall not be covered with protective coatings, concrete or other material, erected, or despatched from the place of fabrication, if fabricated off the Site until the steelwork, including any repaired areas, complies with the specified test and inspection requirements and has been approved by Company.

7. TIMBER SPECIFICATIONS

7.1 SCOPE

This specification covers the requirements for all timber used within the permanent works. This includes the timber cladding, frame and battens.

This specification is based on the following documents:

- (i) SANS 1707-1 Sawn Eucalyptus timber Part 1: Proof-graded structural timber.
- (ii) SANS 6000 Heartwood detection in timber of the Eucalyptus species.
- (iii) SANS 1707-2 Sawn Eucalyptus timber Part 2: Brandering and battens.
- (iv) SANS 6891 Timber Structures – Joints made with mechanical fasteners – General principles for the determination of strength and deformation characteristics.
- (v) SANS 51075 Timber structures – Test methods – Joints made with punched metal plate fasteners.
- (vi) SANS 10163 Structural use of timber Part 1 and 2.
- (vii) SANS 54545 Timber Structures – Connectors – Requirements.
- (viii) SANS 1783 Sawn softwood timber Part 1, 2, 3 and 4
- (ix) SANS 54250 Timber Structures – Product requirements for prefabricated structural members assembled with punched metal plate fasteners.

7.2 GENERAL

The work shall consist of furnishing and placing of treated timber and associated steel and stainless steel hardware for the decking, cladding and support frame as indicated in the construction drawings in accordance with the specifications mentioned below.

7.3 MATERIALS

7.3.1 *Eucalyptus Diversicolor (Karri)*

Karri wood shall be used on the deck, the front elevation and for the timber support frame towards the east end of the structure. The Karri timber to be used shall have the following properties:

Density (kg/m ³)	872
Modulus of elasticity (MPa)	16 230
Durability class	Class 2
Crushing strength (MPa)	65.4
Shearing strength (MPa)	11.8
Gum % content at 15% Moisture Content	17.3

7.3.2 Pine

SA Pine shall be used as batted below the deck planks on the structure. These members shall be of nominal dimensions 50 mm x 76 mm with tolerances meeting the requirements of SANS1783-1 and SANS1783-3.

7.4 SIZES AND SURFACE FINISH

Target sizes may be considered as the finished size subject to permitted tolerances to SANS1783-3 and SANS1707-1 or to those specifically specified by the architect or engineer (see construction drawings).

7.5 MOISTURE CONTENT

The moisture content of timber to be used on the structure shall be in accordance with the relevant requirements of SANS1783-3 and SANS1707-1.

7.6 CONNECTORS

All connectors shall comply with the requirements of SANS54545.

7.7 PRESERVATIVE

All timber shall be treated with an approved preservative to protect against marine borer attack. All ends cut on site shall be treated before fixing with an appropriate preservative or preservative concentrate. The application of the preservative shall be in accordance with SANS1228 and SANS10005

8. ROCK SPECIFICATION

8.1 Materials Specification

8.1.1 General

Rock for revetment shall be graded and tested in accordance with the current version of BS EN 13383-1 and BS EN 13383-2.

Testing shall be carried out by an accredited laboratory to the acceptance of the Supervisor.

8.1.2 Rock Grading

The following rock gradings are required in the works:

<u>CATEGORY</u>	<u>GROUP</u>	<u>DESIGNATION</u>
Revetment	Light Grading	40 kg – 200 kg

Class Limit	Definitions	% by Weight Smaller
ELCL	15 kg	< 2%
LCL	40 kg	0 – 10%
UCL	200 kg	70 – 100%
EUCL	3000 kg	>97%

8.1.3 Rock Quality

Rock shall be natural, hard, sound homogenous, non-argillaceous rock of good durability. It shall be free from laminations and weak cleavage planes and shall be of such character that it shall not disintegrate or erode when exposed to frost attack or the actions of air, water, wetting and drying, freezing and thawing, and impact due to wave action. The rock shall have a monolithic structure and shall not contain cellular, honeycombed or other voids and shall be free from cracks, seams or similar defects. The rock shall not contain harmful materials such as iron pyrites, coal, mica, laminated material or any materials in sufficient quantity to adversely affect the strength and durability of the material. It shall be capable of being handled and placed without undue fracture or damage. It shall be free from coating of clays or other deleterious material.

The rock shall be granite, basalt, carboniferous limestone, feldsparitic, greywacke, dolerite or other approved material. The revetment rock supplied for any single grade of coverlayer shall be from approved quarry.

8.1.4 Rock Properties

The properties of the rock coverlayer and underlayer are given in Table 8.8-1 in accordance with BS EN 13383.

Existing rock which has to be removed for the construction of the new revetment may be reused in the new structure providing it satisfies the grading and property requirements detailed in this Specification, as accepted by the Supervisor.

Table 8.8-1: Coverlayer and underlayer material properties

Property	Coverlayer	Ref to BS EN13383:Part 1	Sampled, tested and reported in accordance with:
Grading	See 8.1.2		
Shape	LTA	Table 6	BS EN13383 Part 2 – Clause 7
Crushed or broken surfaces	or RO5	Table 7	BS EN13383 Part 1 – Clause 4.4
Minimum particle density (t/m ³)	2.65	Table 8	BS EN13383 Part 2 – Clause 4 and Clause 8

Property	Coverlayer	Ref to BS EN13383:Part 1	Sampled, tested and reported in accordance with:
Resistance to breakage	CS60	Table 9	Test with EN 1926:1999 annex A
Resistance to wear	MDE20	Table 10	EN 1097 Part 1:1996 - Clause 7
Water absorption	WA0.5	Table 12	BS EN 13383 Part 2 – clause 8
Resistance to salt crystallisation	MS25	Table 14	EN 1367 Part 2 :1998 – clause 8

8.1.5 Rock Durability

Water absorption of rock (excluding fragments) shall be determined in accordance with the current version of BS EN 13383-1 Clause 7.3. If the water absorption does not comply with the requirements of this clause then determination of resistance to freeze/thaw in accordance with Clause 7.4 is required.

8.1.6 Rock Shape

The length of any single rock shall be defined as the greatest distance between two points on the rock (e.g. diametrically opposite corners of a cube block).
Blocks of quarried rock showing clear signs of significant edge or corner wear or severe rounding shall not be accepted.

8.2 Testing

8.2.1 General

Rocks shall be tested for the properties, both large scale and small scale, shown in Table 8.8-1 in accordance with BS EN 13383-1 and BS EN 13383-2.

8.2.2 Large Scale Testing

Large scale tests (block integrity) shall be carried out in accordance with the Drop Breakage test specified in Annex B of BS EN 13383-1. Tests shall be carried out on coverlayer Rock Grade 1 only. The drop breakage index shall be calculated in accordance with Box 3.20 of the Rock Manual (CIRIA C683). The production shall be acceptable if the breakage index is less than 5%.

8.2.3 Small Scale Testing Frequency

The small scale tests detailed in Section 8.6 shall be carried out on representative samples of the rock grades. The frequency of tests shall be as shown in Table 8.2.

Table 8.2: Test frequency of rock grades

Property	Test Frequency Coarse light and heavy gradings		Minimum number of tests
Grading	1 in the first 10,000t of production. 1 per 20,000t average		Minimum of two tests during the works
Shape	1 in the first 10,000t of production. 1 per 20,000t average		Minimum of two tests during the works
Crushed or broken surfaces	1 in the first 10,000t of production. 1 per 20,000t average		Minimum of two tests during the works
Minimum particle density	1 for source approval. 1 in the first 10,000t of production. Additional tests for any change of source.		-
Resistance to breakage	1 for source approval. 1 in the first 10,000t of production. Additional tests for any change of source.		-
Resistance to wear	1 for source approval. 1 in the first 10,000t of production. Additional tests for any change of source.		-
Water absorption	1 for source approval. 1 in the first 10,000t of production. Additional tests for any change of source.		-
Resistance to salt crystallisation	1 for source approval. 1 in the first 10,000t of production.		-

Property	Test Frequency Coarse light and heavy gradings		Minimum number of tests
	Additional tests for any change of source.		

The production test frequency may be varied by the Supervisor depending on the type, quality, reliability and source of the rock proposed by the Contractor and the results of the quarry source approval tests.

A new series of source approval tests shall be undertaken for each new source of rock and if there is a change in the nature of rock from any source.

The Contractor must supply the results of tests on the rock to the Supervisor, which demonstrate that it complies with the requirements of the Specification, before the production of rock for the works may commence at the quarry.

Particle size distribution tests for all bulk materials shall be carried out on samples taken from stockpiles near the works before placement in the works. This is required to ensure that the fines in the bulk material are controlled at the works during handling and transport of weaker materials which could degrade.

8.2.4 Recording and Reporting

All recording and reporting shall be presented in full accordance with the requirements of BS EN 13383 as appropriate.

The Contractor shall provide two certified copies of all test results for each of the tests listed in Table 8.8-1.

The Contractor shall keep records of the source of the rocks.

8.3 Geotextile

Filter fabric for placement underneath the revetment may be of woven or non-woven construction, and conforms to the following requirements:

Property	Units	Value	Test Method
Trapezoidal Tear Strength	N	>1 050	ASTM D4533-85
Tensile Strength	kN/m	>40	SANS 0221-88
CBR Puncture	kN	>6,0	SANS 0221-88
Pore size (apparent opening size) O_{95H}	· m	50 - 150	NFG 38.C17
Permeability	m/s	$>1 \cdot 10^{-5}$	SANS 0221-88
Porosity (non-woven fabrics)	%	>60	Calculation
Percentage open area (woven fabrics)	%	>5	Measurement

The rock revetment is provided in the form of unconfined stone laid in a single lift of a 0.8 m layer of 40 kg – 200 kg slope protection on filter fabric as shown on the drawings.

Prior to placing the slope protection, the filter fabric is made continuous either by firmly stitching together using double stitching with 500 mm overlap, or by providing overlaps of not less than 1 500 mm. The fabric is laid with care to avoid overstretching or puncturing of the

fabric during and after laying thereof. When un-stitched laps are used, acceptable measures are implemented to ensure that the 1 500 mm overlaps are maintained until the scour protection is in position.

8.4 Production and Handling of Quarried Stockpile and Imported Rock

8.4.1 General

Rock shall only be obtained from sources accepted by the Supervisor. The Contractor must supply the results of tests on the rock to the Supervisor, which demonstrate that it complies with the requirements of the Specification, before the production of rock for the works may commence at the quarry or when selecting rock from existing stockpile on Site.

Rock quality shall be carefully monitored throughout the quarrying process and the Contractor shall ensure that quarried materials are produced to the size, quality, weight and shape specified herein. The Contractor shall ensure that damage to the armour rock during stockpiling, transportation and handling is kept to a minimum.

When selecting rock from existing stockpiles on Site, the Contractor shall ensure that the selected material complies with the requirements of the Specification in terms of grading and quality and no damage to the selected rock occurs during transportation and handling on Site.

8.4.2 Information to be provided

The following information on the rock shall be provided by the Contractor prior to commencement of works:

- Name and location of quarry,
- Methods of production,
- Detailed geological description,
- Mass and shapes of rock available,
- Particle density,
- Resistance to breakage,
- Resistance to wear,
- Water absorption.

The small scale tests shall be in accordance with Section 8.6. Alternative test standards will be considered for preliminary acceptance. Alternative test methods for resistance to wear will be considered for preliminary acceptance.

Prior to any consignment of quarried stone arriving and being placed at the Site, the Contractor shall provide the name of the transport unit, the weight of the load and the expected delivery date, in addition to the information specified above.

8.5 Preparation and Placing

8.5.1 General

Placing of materials shall be in one continuous operation and each placed layer of rocks shall be protected by a subsequent layer as soon as possible after placement, leaving at any particular moment only a minimum length unprotected in order to minimise damage by waves or current flow during the construction period.

Placing shall commence at the toe and proceed upwards towards the crest. Rocks shall be placed with particular care to avoid damage to the surface below or the geotextile. Coverlayer rocks shall be lowered into place by a machine and not dropped or tipped into position. The rock coverlayer shall be placed to achieve a minimum 'three-point support' and shall not be placed so that they can move or obtain their stability on a plane solely by frictional resistance prior to placing further rock. The rock shall be placed so that the adjacent faces of abutting rocks are not parallel and that each rock is stable against wave action. The rock shall be placed to ensure that the larger rocks are uniformly distributed.

8.5.2 Trial Revetment and Method

A trial revetment panels shall be constructed within the works for each revetment cross section to confirm the suitability of the material, plant and operators to construct the works. The location for trial panel construction shall be agreed with the Supervisor. If the trial revetment panel is deemed by the Supervisor to be satisfactory, the constructed panel shall be incorporated into the works. Trial panels are required at the beginning of the works and after any change in source of rock or significant change of plant and operators.

The trial panel shall be 20m long and be surveyed at 5m centres along the revetment and 2 m centres across each profile. The survey shall be by both the 'highest point' method and the Contractor's preferred method.

The trial panel shall be used to determine the suitability of the proposed survey method and correlation or consistency with the 'highest point' survey method.

The void ratio achieved in the underlayer and coverlayer shall be determined for the trial panel.

8.5.3 Rock Placing Tolerances

Rocks shall be placed to the tolerances in the Site Specific Specification.

When rock is placed above or below the profile, care shall be taken to place subsequent adjacent rock pieces closer to the design profile so as to return to the design profile.

The tolerances on two consecutive mean actual profiles shall not be negative.

Notwithstanding any accumulation of positive tolerances on the excavated profile, underlayer and the coverlayer shall not be less than 80% of the nominal thickness shown in the Drawings when calculated using mean actual profiles.

No rock profile shall be covered by a subsequent layer until the former layer has been accepted by the Supervisor.

8.5.4 Survey Methods and Control

Levels shall be checked on sections at a maximum of 10m centres along the revetment and at 2m centres across each profile.

Rock levels and tolerances assume survey control by the 'highest point' method described in the Rock Manual (CIRIA C683). Alternative survey methods are acceptable. Use of GPS enabled plant to carry out the survey is required. The correlation between the Contractor's adopted survey method and the 'highest point' method shall be demonstrated on the trial panel.

Before placing rock, the Contractor shall submit to the Supervisor for acceptance, details of the survey methods to be adopted for setting out, alignment and level control during

construction of the rock structures. The Contractor shall give at least 24 hours' notice to the Supervisor of all surveys and shall provide facilities for his attendance during surveys. The Contractor shall carry out a survey of the revetment at the completion of each section of formation trimming and each layer of rock placement. The Contractor shall supply to the Supervisor an electronic record of such survey in an agreed format suitable for the production of a digital ground model and compatible with the data provided by the previous survey of the foreshore. The Contractor shall also supply, within 48 hours of such survey, the results neatly displayed as plans and cross-sections in an agreed format suitable for printing of hard copies. The survey results shall be clearly marked with location and dates.

9. SPECIFICATION FOR EARTHWORKS

9.1 Introduction

This part of the specification shall be read in conjunction with the Site Specific Specification and the Port of East London Marine Works Specification:

9.1.1 Scope

This section covers all excavation, filling and associated work other than dredging, reclamation and construction of revetments. The tables at the end of this Chapter summarise the classes of fill used in the *works*.

9.2 Classification

9.2.1 Acceptable Material

Acceptable material constitutes material excavated within the site or imported on to the site which meets the requirements of Table 9-1.

9.2.2 Unacceptable Material Class U1

Unacceptable material constitutes material which does not comply with the permitted constituents and properties in Table 9-1; or Material, or constituents of materials, composed of the following:

- peat, materials from swamps, marshes and bogs;
- logs, stumps and perishable materials;
- clay having a liquid limit exceeding 90% or plasticity index exceeding 65; and
- material susceptible to spontaneous combustion.

9.2.3 Unacceptable Material Class U2

Material Class U2 constitutes material containing hazardous chemical or physical properties requiring special measures for its excavation, handling, storage, transportation, deposition and disposal.

9.3 Definitions

Formation shall be either:

- a) The top surface of capping.
- b) Where no capping is required formation shall be the top surface of earthworks at the underside of sub-base.
- c) The top surface of earthworks under structural foundations.

Sub-formation is the top surface of earthworks at the underside of any capping.

9.4 General Requirements

The *Contractor* shall satisfy himself and shall be deemed to have satisfied himself with regard to the nature of the materials to be excavated (herein referred to as excavations), effects upon his operations, the methods of carrying out the excavations and all other particulars whatsoever and shall be deemed to have made such allowance in the rates for any contingencies that may arise with regard to the excavations during the execution of the *works*.

The *Contractor* shall operate within the restrictions set out in the Licenses for the works. All formations will be inspected and surveyed from time to time during the work by the *Project Manager* and shall be approved by him prior to any *works* being constructed thereon.

The *Contractor* shall employ only equipment and working methods which are suited to the materials to be handled and transferred.

Haulage of materials to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Excavations requiring backfilling shall remain open only for the minimum period necessary.

Materials arising from excavations shall if suitable be used for filling. Surplus and unsuitable material shall be disposed of off the Site by the *Contractor*. Material dredged or excavated from within the Site may be used as filling where it complies with the requirements for the various grades of fill given herein and the design requirements.

Where excavation reveals a combination of acceptable and unacceptable material the *Contractor* shall, unless otherwise agreed by the *Project Manager*, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent *works* without contamination by the other classes of material.

Existing topsoil material shall be stripped to the required depth. Trenches shall be the minimum width to enable the pipes, cables etc. to be properly laid and jointed. The trench bottom shall be prepared by tamping gravel or broken stone into soft spots and any hard spots shall be removed.

Where necessary, the *Contractor* shall support the sides of trenches and excavations by adequate shoring during the progress of the work, and the same shall be carefully removed as the excavations are filled in. All shoring shall be carried out under the supervision of a competent foreman. No permission or approval of the *Project Manager* shall relieve the

Contractor of his responsibilities for the sufficiency for any shoring used and the *Contractor* shall take sole responsibility for damage of any nature caused by insufficient shoring or by the method of its removal.

The *Contractor* shall provide for and be responsible for the construction and stability of all benching and shoring and shall make due provision when setting out the lines of any proposed excavations for the required benching or shoring in connection with the excavations. He shall also make sufficient allowance in the layout of such benching and shoring for any reasonable depth below the estimated foundations of the Work on account of variations in the levels of the foundations below those shown on the *Contractor's* Drawings.

If bad weather, tidal floods, landslips or any other cause whatsoever result in any sand, gravel, mud, or other material being deposited or accumulating in the excavated area, such material shall be removed so that the formation shall be clear prior to the construction of any permanent *works*. Similarly, the *Contractor* shall keep any of the *works* in progress free from all deposits of any description.

The *Contractor* shall be responsible for any effect or damage which the carrying out of any of the excavations may have upon any portions of the *works*, any existing structures or any surrounding property and any effect or damage that may be caused by the handling or disposal of excavated materials. The *Contractor* shall be responsible for any instability in the excavations and any injurious effects such as may have upon the *works*, adjoining properties or adjacent structures and shall make good at his own cost any damage caused thereby whether to the *works*, adjoining properties or adjacent structures to the satisfaction of the *Project Manager*.

The *Contractor* shall keep earthworks free of water with the exception of areas of tidal working. To this end the *Contractor* shall form and maintain cuttings and areas of fill with appropriate falls and sealed surfaces; provide where necessary temporary water courses, drains, pumping and the like.

Where materials are classified as U2 hazardous material the *Contractor* shall carry out special requirements for their handling. Where hazardous materials are encountered during the works the

Contractor shall make all necessary arrangements for their safe handling and disposal as class U2 material as directed by the *Project Manager*.

9.4.1 Use of Fill Materials

In addition to any grading requirements the maximum particle size of any fill material shall be no more than two-thirds of the compaction layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited beneath verges or reserves within 1.30m of the finished surface.

Materials with a water soluble sulphate content exceeding 1.9g SO₃/l shall not be deposited within 500mm of concrete or cement bound material forming part of the *works*.

Materials with a water soluble sulphate content exceeding 1.9g SO₃/l shall not be deposited within 500mm of metallic items forming part of the *works*.

9.5 Excavation

9.5.1 General

The ground shall be excavated to the lines and levels required. Excavations taken out to a greater depth than necessary shall be filled to the required level with material as directed by the *Supervisor*.

The excavation of cuttings may be halted at any stage providing at least 300mm of material as a weather protection is left in place above formation or sub-formation.

Final faces of cuttings which are not to receive top soil shall wherever possible be left without scars or damage from construction equipment and, to achieve a natural appearance, have the face left irregular within tolerances agreed with the *Project Manager*. The treatment of isolated areas of such faces that are unstable or of soft material shall be treated in a way agreed with the *Supervisor*.

Faces of cuttings which are to receive topsoil shall have isolated patches of soft or insecure material excavated and filled with a class of suitable material similar in characteristics to the surrounding material or as otherwise directed by the *Supervisor*.

9.5.2 Excavation for Foundations

The bottom of all foundation excavations shall be formed to the lines and levels required. Pockets of soft soil or loose rock shall be removed and the resulting voids and any natural voids shall be filled with concrete in accordance with the requirements.

No trimming of the side faces of the excavation shall be carried out for 24 hours after placing any blinding concrete as required.

The *Contractor* shall make good any additional excavation at or below the bottom of foundations with concrete in accordance with the requirements.

9.5.3 Water Courses

The clearance and modification of existing, or the construction of new watercourses, shall be as shown on the Drawings.

Clearance of existing watercourses shall include the removal of vegetation, vegetable matter and all other deposits within the watercourse profile. Materials resulting from this clearance shall be dealt with as unacceptable material.

New watercourses and cleared existing water courses shall be maintained in a clear condition.

Redundant watercourses shall be cleared before being filled with an acceptable fill. Where the surface is to remain exposed the material used shall be topsoil.

9.6 Construction of Fills

9.6.1 General

All fills shall be constructed to the lines and levels shown on the Drawings.

Fill shall, unless otherwise shown on the Drawings, be constructed evenly over its full width.

Unsupported areas of fill shall be constructed with suitable side slopes. Over steepening shall remain only for the minimum period necessary consistent with the safety of the permanent *works*.



9.6.2 *Fill to Structures*

The classes of permitted material to be used as fill to structures are stated on the Drawings.

9.6.3 *Fill Below Water*

Only classes 6A or 6AN material, as detailed in Table 9-1 and

Table 9-2, may be deposited into open water.

Fill shall be brought to level in layers up to 500mm thick when placed under water.

Fill placed under water shall be placed either:

- by grab and released as close as possible to previously placed material to avoid unnecessary disturbance and separation of fines; or
- by end tipping for materials with a low proportion of fine material in shallow water.

9.6.4 Fill Above Water

Fill shall be brought to level in layers up to 250mm thick when placed above mean sea level. The last 600mm depth of fill up to sub-formation level, or formation level as appropriate, shall, unless otherwise agreed by the *Project Manager*, be carried out for the full width between the outer extremities of the verges in a continuous operation. The *Contractor* shall then either:

- form the sub formation or formation followed immediately by construction of the capping or sub-base; or
- place an additional 300mm minimum compacted thickness of material above sub-formation or formation as appropriate to form a weather protection. This weather protection shall be of the same material as the sub-formation or formation and compacted.

9.6.5 Compaction of Fills

The *Contractor* shall take care to ensure that the compaction does not cause movement or displacement of adjacent structures.

Compaction shall be adequate to achieve the density specified or shown in the Drawings and this shall be demonstrated by regular routine testing. The surface of each layer shall be accepted by the *Supervisor* before the next layer is placed.

When circumstances allow, fill material shall be placed and compacted in the dry. Where this is not practicable the *Contractor* shall develop a specific method statement for hydraulically placed fill material to be accepted by the *Supervisor*.

The *Contractor* shall at least 7 days before commencement of end-product compaction make available the following to the *Supervisor*:

- a) the values of maximum dry density and the optimum moisture content obtained in accordance with modified AASHTO method as appropriate for each of the fills he intends to use which meet the requirements of the permitted Class or Classes (where within any Class of material the fill contains material having different maximum dry densities and optimum moisture contents the Class shall be further sub-divided, by extending the identification system, in order to monitor the compacted density);
- b) a graph of density plotted against moisture content from which each of the values in (a) above of maximum dry density and optimum moisture content were determined.

Once the information above has been made available to the *Supervisor* it shall form the basis for compaction.

The field dry density shall be measured in accordance with BS 1377: Part 9. Where nuclear methods are used, the gauge shall be calibrated in accordance with BS 1377: Part 9.

Landscaping, Class 4, material shall be sufficient to remove large voids and to produce a coherent mass whilst preventing over-compaction and any build-up of excess pore pressures.

Landscaping, Class 4, material shall be deposited in landscape areas after any adjoining embankment or other area of fill has been completed.

9.6.6 Finished Level of Fills

The finished level of filling shall be within a tolerance of ± 50 mm of the profile shown on the Drawings.

The finished level of formation or sub-formation shall be within a tolerance of +20mm - 30mm of the profile shown on the Drawings.

9.7 Capping

The classes permitted for capping material are shown on the Drawings.

Capping is only required if the fill at formation has a CBR of less than stated in the Site Specific Specification or as shown on the Drawings. The *Contractor* shall consult with the *Designer* on the required thickness of capping or alternative pavement thickness.

9.8 Testing

9.8.1 Provision of Samples

The *Contractor* shall submit for the *Designer's* prior approval, relevant test results from samples of all the filling materials required for the *works*. These must include test certificates for each of the samples as provided.

9.8.2 Quality Control of Fill Materials

Random samples shall be taken from deliveries to the site or from where filling has been placed, for inspection and testing in accordance with BS 1377-9:1990.

Should any of these samples be found not to meet the requirements of this Specification, two further samples will be taken from the same location as the original. If any of these further samples proves to be non-conforming the defective material must be removed and replaced.

9.8.3 Tests on Fill Materials

Tests for the qualities, characteristics, etc. referred to in BS 1377-9:1990 shall be carried out in accordance with BS 1377 where applicable and as stated in the table. Where called for the effective angle of internal friction shall be determined by 300mm shear box tests carried out in an approved materials testing laboratory.

The uniformity coefficient is defined as the ratio of the particle diameters at the 60% and 10% mass passing on the grading curve.

The Los Angeles coefficient shall be determined in accordance with BS EN 1097-2 when required. Where the material source is an uncontaminated natural aggregate the Los Angeles coefficient test is not required.



9.9 Tests on Fill Materials

Table 9-1: Material Classification

Class	General Material Description	Typical Use	Permitted Constituents	Material properties for acceptability Property	Defined and tested in accordance with	Acceptable limits	
						Lower	Upper
A1	Well graded granular material	General fill	Any material, or combination of materials other than chalk	grading	BS 1377-2	Tab. 2	Tab.2
				uniformity coefficient	see specification	10	
				optimum mc (omc)	BS 1377-4		
				mc	BS 1377-2	omc-2%	omc
				compaction	see clause 4.3.5	see site specific specification	
1B	Uniformly graded granular material		Any material, or combination of materials other than chalk	grading	BS 1377 - 2	Tab.2	Tab.2
				uniformity coefficient	see specification		10



Class	General Material Description	Typical Use	Permitted Constituents	optimum mc (omc) mc compaction	BS 1377-4 BS 1377-2 see clause 4.3.5	omc-2% see site specific specification	omc
				Material properties for acceptability Property	Defined and tested in accordance with	Acceptable limits	Upper
1C	Coarse granular material		Any material or combination of material other than chalk	grading uniformity coefficient Los Angles Coef.	BS 1377-2 see specification	Tab. 2 5	Tab.2
2A	Wet cohesive material	General fill	Any material or combination of material other than chalk	grading compaction	see clause 4.3.5 BS 1377-2	see site specific specification Tab. 2	Tab.2



				plastic limit(PL) optimum mc (omc) mc	BS 1377-2 BS 1377-4 BS 1377-2			
				undrained shear strength of remoulded material compaction	BS 1377-7 see clause 4.3.5	25MPa 90%		
2B	Dry cohesive material		Any material or combination of material other than chalk	grading	BS 1377-2	Tab. 2	Tab.2	
Class	General Material Description	Typical Use	Permitted Constituents	Material properties for acceptability Property	Defined and tested in accordance with	Acceptable limits	Lower	Upper
					BS 1377-2			
				plastic limit(PL) optimum mc (omc) mc	BS 1377-4 BS 1377-2	omc-2% omc-2%		PL - 4% omc



				undrained shear strength of remoulded material	BS 1377 - 7	25MPa	
			compaction	compaction	see clause 4.3.5	see site specific specification	
2C	Stony cohesive material	compaction		grading	BS 1377-2	Tab. 2	Tab.2
		compaction		plastic limit(PL)	BS 1377-2		
		compaction		optimum mc (omc)	BS 1377-4		
		compaction		mc	BS 1377-2	omc-2%	PL - 4% omc
		compaction		undrained shear strength of remoulded material	BS 1377 - 7	25MPa	
		compaction		compaction	see clause 4.3.5	see site specific specification	
2D	Silty cohesive material	Any material or combination of material other than chalk		grading	BS 1377-2	Tab. 2	Tab.2
Class	General Material Description	Permitted Constituents	Typical Use	Material properties for acceptability			



	Property	Defined and tested in accordance with	Acceptable limits	
			Lower	Upper
	optimum mc (omc)	BS 1377-4		
	mc	BS 1377-2	omc-2%	omc
	undrained shear strength of remoulded material	BS 1377 - 7	25MPa	
	compaction	see clause 4.3.5	see site specific specification	
3	Chalk			
4	Various Fill to landscape areas	Any material or combination of material other than chalk	grading	
			plastic limit	
			mc	PL - 4%
5A	Topsoil, or turf, existing on Site	Topsoil or turf designated as class 5A in the Contract	grading	
5B	Imported topsoil	Material complying with BS 3882	Topsoiling	
			Topsoiling	



5C	Imported turf	Turfing	Material complying with BS 3969	grading	BS 1377-2	Tab. 2	Tab.2
Class	General Material Description	Typical Use	Permitted Constituents	Material properties for acceptability	Defined and tested in accordance with	Acceptable limits	
				Property		Lower	Upper
6A	Selected well graded granular material	Below water	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete or any combination thereof	uniformity coefficient	see specification	10	
				plasticity index	BS 1377-2	Non-plastic	
				grading	BS 1377-2	Tab.2	Tab.2
6F1	Selected granular material (fine grading)	Capping	Any material or combination of material, other than unburnt colliery spoil and argillaceous rock and chalk.	optimum mc (omc)	BS 1377-4 (vibrating hammer method)		
				mc	BS 1377-2	omc-2%	omc
				Los Angles Coef.			60
				compaction	see clause 4.3.5	see site specific specification	
				grading	BS 1377-2	Tab.2	Tab.2



6F2	Selected granular material (coarse grading)		Any material or combination of material, other than unburnt colliery spoil and argillaceous rock and chalk.	optimum mc (omc)	BS 1377-4 (vibrating hammer method)	
				mc	BS 1377-2	omc-2%
Class	General Material Description	Typical Use	Permitted Constituents	Material properties for acceptability	Defined and tested in accordance with	Acceptable limits
				Property		Lower
				Los Angles Coef.		Upper
				compaction	see clause 4.3.5	50
						see site specific specification
6F4		Not used				
6F5		Not used		grading	BS 812-103	
6G	Selected granular material	Gabion filling	Natural gravel, crushed rock other than argillaceous rock, crushed concrete or any combination thereof	Los Angles Coef.		50
				grading	BS 1377-2	Tab.2
						Tab.2



6N	Selected well graded granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock and chalk, crushed concrete or any combination thereof	uniformity coefficient	see specification	10	
				Los Angles Coef.		40	
				effective angle of internal friction and effective cohesion (c'and ϕ')	BS 1377 - 7	ϕ' - see site specific specification $c'= 0$	
				optimum mc (omc)	BS 1377-4		
Class	General Material Description	Typical Use	Permitted Constituents	Material properties for acceptability			
				Property	Defined and tested in accordance with	Acceptable limits	
				mc	BS 1377-2	Lower omc-2%	Upper omc
				compaction	see clause 4.3.5	see site specific specification	
6AN	As 6N			grading	BS 1377-2	Tab.2	Tab.2



6P	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete or any combination thereof	uniformity coefficient	see specification	5	
				Los Angles Coef.	BS 1377 - 7	Φ' - see site specific specification $c' = 0$	60
				effective angle of internal friction and effective cohesion (c' and Φ')	BS 1377-4		
				optimum mc (omc)	BS 1377-2	omc-2%	omc
				mc	see clause 4.3.5	see site specific specification	
				compaction			



Table 9-2: Grading Requirements

Class	Size (mm)	Size (mm) BS Series	75	90	37.5	28	20	14	10	6.3	5	3.35	2	1.18	600	Size (microns) BS Series	300	150	Percentage by mass								
	500	300																									
1A		100																									
1B		100																									
1C	100	10-95																									
2A		100																									
2B		100																									
2C		100																									
2D		100																									
6A	100																										
6F1																											



	100	80- 10 0	65- 10 0	45- 100	15- 60	10- 45	0-25	0-12	
6F2									
6N			10 0					<15	
6P			10 0					<15	

10. ELECTRICAL WORKS

10.1 Transnet Specifications

All Design's undertaken, Plant's and Materials supplied by the Contractor in agreement with the Employer, with the intention to execute the works detailed in this document, shall comply in general with all associated Transnet Specifications listed below. It is understood that Transnet Specification requirements are more stringent than the SANS requirements, the Contractor is required to fully comply with the Transnet Specifications. In the case where SANS is stringent than Transnet Standard, the Contractor shall comply with SANS.

Specification No.	Description
TPD-001-EL&PSPEC	Specification for electrical installations to buildings other than dwellings houses
TPD-002-DBSPEC	Technical specification for low voltage distribution boards
TPD-003-CABLESPEC	Technical specification for the installation of medium and low voltage cables.
TPD-004-EARTHINGSPEC	Technical specification for earthing and the protection of buildings and structures against lightning.
TPD-010A-HIGHMASTSPEC-A	Specification for the design, supply and installation of high mast lighting
TPD-017-SCISSORMASTSPEC	Specification for the design, supply and installation of scissor mast lighting

10.2 Plant Service Condition

10.2.1 *Ambient/Environmental Conditions*

All Plant and associates to be supplied by the Contractor shall be designed and rated for continuous operation under the following conditions:

Altitude	0 to 1800m above Sea Level.
Ambient temperature	-5°C to +40°C (daily average +35°C)
Relative humidity	As high as 96%
Lightning conditions	Severe, with a maximum lightning ground flash density of 1.6 flashes per km ² per annum
Atmosphere	Salt laden and corrosive industrial chemical and dust laden nature. Frequent heavy rains driven by wind reaching speeds of 100 Km/h and above

10.2.2 *Electrical Conditions*

Low Voltage System

The Low Voltage system of supply will be three phase, 4 – wire system, 50Hz alternating current (AC) at a nominal voltage of 400V.

The voltage may vary within the range of 95% to 105% of the nominal and all equipment installed shall be suitably rated.

10.3 Detailed Work to be carried out by the *Contractor*

This works information shall be read in conjunction with the drawings listed in section 5 of the Works Information, SANS listed in section 2.4.1.1 of the Works Information, codes of practice listed in section 2.4.1.2 of the Works Information and Transnet specification listed in section 11.1 of the Particular Specification.

All works to be carried out shall be performed with full adherence to safe practice of electrical installations as stipulated in SANS 10142-1, and OHS Act 85 of 1993 (Electrical Installation Regulations).

10.3.1 Modification of the Low Voltage Panel in the Existing TNPA Substation.

The Contractor shall modify the existing electrical low voltage panel in the existing TNPA substation. The Contractor shall supply, deliver and install equal or similar approved to Schneider 250A, NSX 250F 36kA, MCCB with new tails termination to the existing busbar as shown on the drawing no: 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.

10.3.2 Low Voltage Cable Installation.

The Contractor shall supply, deliver, offload, install and terminate a 70mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable from the existing low voltage panel in the existing TNPA substation to the Latimer's Landing Kiosk 1. The 70mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable shall be installed in 110mm uPVC flexible sleeves with long radius bends. The 70mm² 600V/1000V, PVC insulated, ECC, SWA, 4 core LV cables shall be terminated, and glanded neatly and appropriately using suitable sized Cable Corrosion Glands. The typical cable route is shown on drawing number: 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram. The OEM bending radii requirements of the cable shall be adhered to.

The Contractor shall supply, deliver, offload, install and terminate a 25mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable from the Kiosk 1 to Kiosk 2. The 25mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable shall be installed in 110mm uPVC flexible sleeves. The 25mm² 600V/1000V, PVC insulated, ECC, SWA, 4 core LV cables shall be terminated, and glanded neatly and appropriately using suitable sized Cable Corrosion Glands. The typical cable route is shown on drawing number : 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram. The OEM bending radii requirements of the cable shall be adhered to.

The Contractor shall supply, deliver, offload, install and terminate a 4mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable from kiosk 1 to the medium mast lighting Poles (Pole 1 to Pole 5). The Contractor shall also supply, deliver, offload, install and terminate a 4mm², 4-core low voltage 600/1000V, SWA, ECC, PVC insulated copper cable from kiosk 2 to the medium mast lighting Poles (Pole 6 to Pole 9). The low voltage

cables shall be installed in a pipe and chamber system as shown in drawing number: 1125637-1-000-E-LA-0001-01 - Lighting Layout. The 4mm² 600V/1000V, PVC insulated, ECC, SWA, 4-core LV cables shall be terminated, and glanded neatly and appropriately using suitable sized Cable Corrosion Glands. The OEM bending radii requirements of the cable shall be adhered to.

10.3.3 Low Voltage Kiosks

The Contractor shall design, supply, deliver, offload, install and commission Low Voltage kiosk 1. The low voltage kiosk 1 shall be floor mounted and positioned as shown on drawing number : 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram. The low voltage kiosk 1 shall be manufactured from 3CR12 type material with a thickness of 1.6mm, IP65 and paint type shall be powder coated at 40 microns and shall allow for bottom cable entry for ease of connection. The low voltage kiosk 1 shall be installed complete with the appropriate sized din rail, cover, spare ways cover, Switchgear, 32A three phase 5-pin industrial plugs, 20A single phase sockets. The industrial plug shall be incorporated with the earth leakage unit protection device that has a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 300 mA. The low voltage kiosk1 shall also be fitted with any other necessary mechanical accessories for support as shown in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.

The Low Voltage Kiosk 1 shall contain the following signage;

- Name of the Distribution Board as indicated in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram ("**Low Voltage Kiosk 1**").
- The rated Voltage level of the Distribution Kiosk
- The rated Short Circuit Current in all different sections of the distribution Kiosk
- The rated current in different sections of the distribution Kiosk
- Description of circuits fed by the associated circuit breaker as indicated in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.
- Full description of the type of cable (Copper PVC insulated ECC, SWA), the size in mm² of the cable terminated in the associated circuit breaker and the cable run length to the load.
- Danger sign for electrical power exposure.

The Contractor shall design, supply, deliver, offload, install and commission Low Voltage kiosk 2. The low voltage kiosk 2 shall be floor mounted and positioned as shown on drawing number: 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram. The low voltage kiosk 2 shall be manufactured from 3CR12 type material with a thickness of 1.6mm, IP65 and paint type shall be powder coated at 40 microns and shall allow for bottom cable entry for ease of connection. The low voltage kiosk 2 shall be installed complete with the

appropriately sized din rail, cover, spare ways cover, Switchgear, 32A three phase 5-pin industrial plugs, 20A single phase sockets. The industrial plug shall be incorporated with the earth leakage unit protection device that has a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 300 mA. The low voltage kiosk 2 shall also be fitted with any other necessary mechanical accessories for support as shown in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.

The Low Voltage Kiosk 2 shall contain the following signage;

- Name of the Distribution Board as indicated in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram ("**Low Voltage Kiosk 2**").
- The rated Voltage level of the Distribution Kiosk
- The rated Short Circuit Current in all different sections of the distribution Kiosk
- The rated current in different sections of the distribution Kiosk
- Description of circuits fed by the associated circuit breaker as indicated in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.
- Full description of the type of cable (Copper PVC insulated ECC, SWA), the size in mm² of the cable terminated in the associated circuit breaker and the cable run length to the load.
- Danger sign for electrical power exposure.

10.3.4 Latimer's Landing Lighting

The Contractor shall design, supply, deliver, offload and erect 9 x 6m Fibre Glass Poles. The Contractor shall erect the Fibre Glass Poles in positions shown in drawing number: 1125637-1-000-E-LA-0001-01 - Lighting Layout. The 6m Fibre Glass Poles shall be constructed with a flange base in alignment with the Fibre Glass Poles Pole foundations which are included in this document. The Fibre Glass Poles shall be mounted on concrete base foundations and shall be constructed and manufactured in compliance to Transnet specification TPD-017-SCISSORMASTSPEC. The Mast Pole shall be equipped with a lightning protection system that complies with Transnet specifications TPD-004-EARTHINGSPEC and TPD-017-SCISSORMASTSPEC .

The Contractor shall supply, deliver, offload and install 18x similar or equal approved to Beka LEDLUME MIDI LED48/76W luminaires onto the fibre glass poles as per drawing number 1125637-1-000-E-LA-0001-01 - Lighting Layout. The Luminaires shall be supplied, delivered and installed complete with control gear, wiring, LED modules and optics.

Should the Contractor propose using alternate luminaires that are equal or similar approved to Beka LEDLUME MIDI LED48/76W, the Contractor shall submit a preliminary lighting design at tender stage. The Contractor shall thereafter conduct a lighting level simulation and design prior to commencing with any construction work. The Contractor shall submit the simulations in both portable document format (PDF) and a native document of a format of Relux Project (.rdf) accompanied with a photometric data of a luminaire of a format of

LumEdit EulumDat File (.LDT) to the Employer's Engineer through the Project Manager for acceptance. Only after approval has been received, may the Contractor commence with any construction work.

The Contractor is required to test the installation in the presence of the Employer's Engineers and issue electrical "Certificate of Compliance" (COC) for all work done to the satisfaction of the Employer's Engineers. The Contractor shall also issue a "RMD 9 certificate" shall be issued for all high masts that have been installed or refurbished.

The Contractor shall undertake a lighting survey at night to measure and record the lighting level in the area where work was undertaken in the presence of the Employer's Engineers. The Contractor shall notify the Employer's Engineer, seven days prior to the lighting survey.

10.3.5 Earthing and Lightning Protection

The Contractor shall supply and install 35mm² 1-core, PVC insulated, Copper earth protective cable with a green and yellow outer sheath from the Low Voltage Kioks to pile and clamped to the Reinforcing with suitable stainless steel clamp as shown in drawing number 1125637-1-000-E-LA-0002-01 - Power Layout and Single Line Diagram.

10.3.6 Testing and Commissioning

The Contractor shall conduct a Factory Acceptance Test (FAT) for all Plant's to be installed as part of the Works to be executed in this Contract prior to delivery to site. The FAT shall be conducted in the presence of the Employer's Engineer. The legal transfer of ownership from the Plant's supplier to the Contractor shall be held by the Contractor until the Plant is fully installed, tested commissioned on the Employer's designated site.

The Contractor shall conduct a Site Acceptance Test (SAT) for all Plant's supplied, offloaded, and delivered to the designated Employer's site. The SAT shall be conducted in the presence of the Employer's Engineer. The legal transfer of ownership from the Plant's supplier to the Contractor shall be held by the Contractor until the Plant is fully installed, tested commissioned on the Employer's designated site.

The Contractor shall test the entire installation, including but not limited LV installation and the lighting installation as per SANS 10142-1 and hand over all relevant test certificates to the Employers Project Manager for acceptance. The Contractor shall hand over all LV certificates of compliance as per the OHS Act of 85 and SANS 10142-1 for the installation.

The Contractor shall test and commission the entire Earthing and Lightning protection system as per Transnet Specification TPD-004-EARTHINGSPEC and SANS 10142-1 in the presence of the Employer's Engineer. The Contractor shall handover all test certificates to the Employer's Project Manager for acceptance by the Employer's Engineer.