



**TRANSNET SOC LTD**

**DCT BERTHS 203 TO 205 - RECONSTRUCTION, DEEPENING AND  
LENGTHENING**

**PORT OF DURBAN**

**SPECIFICATION – COPE, SERVICE TUNNELS, QUAY FURNITURE AND SERVICES**

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**1785-CO-000-C-SPC-0003 Rev T-01**

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## **1.0 SCOPE**

### **1.1 Project**

This specification is a project specific technical specification for the DCT Berths 203 to 205 Reconstruction, Deepening and Lengthening Project in the Port of Durban.

### **1.2 Scope**

The scope of this specification covers the *Employer's* requirements for the cope, service tunnels, rear crane rail beam, quay furniture and services, which includes the following:

- Reinforced concrete cope including quayside service tunnels to caisson quay wall.
- Reinforced concrete cope to steel cellular caisson return quay.
- Connecting cross service tunnels and tunnel links.
- Remedial works to existing quayside cope and tunnels.
- Rear crane rail beam.
- Fenders, bollards and other quay furniture.
- Crane Rails.
- Water and sewer services.
- Storm water drainage.
- Cable ducting for electrical and communications infrastructure.

## 2.0 NORMATIVE REFERENCES

### 2.1 Reference Documents

The *works* shall be carried out as specified in the following documents:

- a) This Specification.
- b) Industry Codes, Standards and Specifications as listed in Section 2.2.
- c) Employer's Project Specific Technical Specifications as listed in Section 2.3.
- d) Project Drawings:
  - 1785-CO-060 series of drawings – Caisson Quay Wall
  - 1785-CO-070 series of drawings – Return Quay
  - 1785-CO-090 series of drawings – Capping Beam and Service Tunnels
  - 1785-CO-100 series of drawings – Rear Crane Rail Piles and Beam
  - 1785-CO-110 series of drawings – Quay Furniture
  - 1785-CO-120 series of drawings – Water Supply
  - 1785-CO-130 series of drawings – Sewer
  - 1785-CO-140 series of drawings – Electrical and C&I Infrastructure
  - 1785-CO-150 series of drawings – Storm Water
- e) Method statement prepared by the *Contractor*, as described in Section 4.1.

### 2.2 Standard Specifications

The *Contractor* shall provide and maintain current copies of all the standard specifications referred to herein below on the site for reference by both parties.

#### 2.2.1 Concrete Capping Beams, Service Tunnels and Rear Crane Rail Beam

All concrete *works* shall be in accordance with specification 1785-CO-000-C-SPC-0001 – Concrete for Marine Construction.

All concrete *works* shall also comply with the following standard specifications:

- a) COTO – Standard Specifications for Road and Bridge Works for South African Road Authorities
- b) ASTM C1107 / C11 07M- 14a – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
- c) DNV-OS-H201 – Load Transfer Operations, April 2012.
- d) DNV-OS-H202 – Sea Transport Operations, October 2015, VMO Standard Part 2-2.
- e) DNV-OS-H203 – Transit and Positioning of Offshore Units, February 2012.
- f) SANS 2001-CC1:2012 - Concrete Works (structural).
- g) SANS 967:2014 - Unplasticized poly (vinyl chloride) (PVC-U) soil, waste and vent pipes and pipe fittings.

#### 2.2.2 Fenders

The governing specification for the design, supply and installation of the fender panels is PIANC – Report of Working Group 33 - Guidelines for the Design of Fenders Systems 2002.

The design, supply and installation of the fender panels shall also comply with the following standard specifications:

- a) BS EN 10025:2004 - Hot rolled products of structural steels.
- b) BS EN ISO 12944 - Paints and varnishes. Corrosion protection of steel structures by protective paint systems.
- c) ASTM 240/A 240M – 04a - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- d) ASTM A391/A391M-07 - Standard Specification for Grade 80 Alloy Steel Chain.
- e) BS EN ISO 1461:2009 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
- f) PIANC – Report of Working Group 33 - Guidelines for the Design of Fenders Systems 2002.

### 2.2.3 Bollards

All works associated with the bollards shall comply with the following standard specifications:

- a) ASTM A536 - 84(2014) Standard Specification for Ductile Iron Castings.
- b) BS 3692:2014 - ISO metric precision hexagon bolts, screws and nuts. Specification.
- c) BS EN ISO 1461:2009 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
- d) ASTM C1107 / C1107M – 14 a – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
- e) BS EN ISO 12944 - Paints and varnishes. Corrosion protection of steel structures by protective paint systems.

### 2.2.4 Crane Rails

All works associated with the crane rails shall comply with the following standard specifications:

- a) DIN536: 2:1991 - Crane Rails.
- b) BS EN 10025-2:2004 - Hot rolled products of structural steels. Technical delivery conditions for non-alloy structural steels.
- c) BS 3692:2014 - ISO metric precision hexagon bolts, screws and nuts. Specification.
- d) BS EN ISO 898-1:2013 - BS EN ISO 898-1:2013 Mechanical properties of fasteners made of carbon steel and alloy steel. Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread.
- e) BS EN 13811:2003 Class 45 - Sherardizing – Zinc diffusion coatings on ferrous products.
- f) BS EN 1563:2001 or ASTM A536.

### 2.2.5 Quay Furniture and Access Covers

All works associated with quay furniture and access covers shall comply with the following standard specifications:

- a) BS EN 10025:2004 - Hot rolled products of structural steels.
- b) BS EN 13811:2003 Class 45 - Sherardizing – Zinc diffusion coatings on ferrous products.
- c) BS EN ISO 12944-5:2007 - Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Protective paint systems.
- d) ASTM 240/A 240M – 04a - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications ASTM A536 - 84(2014) Standard Specification for Ductile Iron Castings.
- e) BS EN 1090-2:2008+A1:2011 Execution of steel structures and aluminium structures. Technical requirements for steel structures.
- f) AWS D1.1/D1.1M:2015, American Welding Society - Structural Welding Code – Steel.

### 2.2.6 Water

The governing specification for the water services shall be SANS 1200L – Medium Pressure Pipelines.

All works associated with water services shall also comply with the following standard specifications:

- a) SANS 1200 DB:1989 - Earthworks (pipe trenches).
- b) SANS 1200 LB:1983 - Bedding (pipes).
- c) ISO 4427:2007 - Plastics piping systems.
- d) SANS 1835:2009 - Ductile iron pipes, fittings, accessories and their joints, for use in high and low pressure systems for potable and foul water.
- e) SANS 1217:2015 - Internal and external organic coating protection for buried steel pipelines
- f) SANS 1123:2015 - Pipe flanges.
- g) BS EN 10025:2004 - Hot rolled products of structural steels.
- h) BS EN 13811:2003 Class 45 - Sherardizing – Zinc diffusion coatings on ferrous products.
- i) SANS 664:2011 - Wedge gate and resilient seal valves for waterworks.



- j) SANS 1128-1:2010 - Firefighting equipment Part 1: Components of underground and above-ground hydrant systems.
- k) ISO 4064-1:2014 - Water meters for cold potable water and hot water -- Part 1: Metrological and technical requirements.
- l) SANS 10268-2:2004 - Welding of thermoplastics - Welding processes Part 2: Electrofusion welding.

#### 2.2.7 Sewer

The governing specification for the sewer services shall be SANS 1200L – Medium Pressure Pipelines.

All works associated with sewer services shall also comply with the following standard specifications:

- a) SANS 1200 LD:1982 – Sewers.
- b) SANS 1200 DB:1989 - Earthworks (pipe trenches).
- c) SANS 1200 LB:1983 - Bedding (pipes).
- d) ISO 4427:2007 - Plastics piping systems.
- e) SANS 1835:2009 - Ductile iron pipes, fittings, accessories and their joints, for use in high and low pressure systems for potable and foul water.
- f) SANS 1123:2015 - Pipe flanges.
- g) BS EN 10025:2004 - Hot rolled products of structural steels.
- h) BS EN 13811:2003 Class 45 - Sherardizing – Zinc diffusion coatings on ferrous products
- i) SANS 664:2011 - Wedge gate and resilient seal valves for waterworks.
- j) ASTM 240/A 240M – 04a - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- k) SANS 10268-2:2004 - Welding of thermoplastics - Welding processes Part 2: Electrofusion welding.

#### 2.2.8 Stormwater Drainage

The governing specification for the stormwater drainage shall be SANS 1200LE – Stormwater Drainage.

All works associated with stormwater drainage shall also comply with the following standard specification:

- a) ASTM C-923-08(2013) - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

#### 2.2.9 Tunnel Dewatering

All works associated with tunnel dewatering shall comply with the following standard specifications:

- a) ISO 4427:2007 - Plastics piping systems.
- b) BS EN 10025:2004 - Hot rolled products of structural steels.
- c) BS EN 13811:2003 Class 45 - Sherardizing – Zinc diffusion coatings on ferrous products.

#### 2.2.10 Electrical Cable Ducts

The governing specification for the electrical cable ducts shall be SANS 1200LC – Cable Ducts.

All works associated with electrical cable ducts shall also comply with the following standard specification:

- a) SANS 61386-24:2005 / IEC 61386-24:2004 - Particular requirements - Conduit systems buried underground.

### 2.3 Employer's Project Specific Specifications and Standards

All works detailed herein shall also comply with the following Project Specific Specifications and Standards:

- a) 1785-CO-000-C-SPC-0001 – Concrete for Marine Construction.
- b) 1785-CO-000-C-SPC-0002 – Caisson Construction and Placement.
- c) 1785-CO-000-C-SPC-0007 – Paving.
- d) 1785-CO-000-C-SPC-0009 – Steel Sheet Piling.
- e) Project Environmental Specifications (PES) as contained in the Works Information and annexures.

### 3.0 DEFINITIONS

All definitions of responsibilities shall be in accordance with the NEC Engineering and Construction Contract (ECC) for the construction of the Works.

Where the standard specifications referenced in this specification refer the “Engineer”, replace this term with the term “Supervisor”.

For the purpose of this specification, the following definitions shall apply:

#### 3.1 Chart Datum Port

Chart Datum Port refers to the reference level used in the Port of Durban, which is 0,900 m below Mean Sea Level. All levels referred to in this document are relative to Chart Datum Port (CDP).

#### 3.2 Co-ordinate System

The co-ordinate system to be used for all setting out and survey shall be World Geodetic System 1984 (WGS84), LO31, referred to as WG31.

#### 3.3 Tidal Levels

The Astronomical Tide Predictions as defined by the SA Navy Hydrographer and Chart SAN 2006 are as follows:

**Table 3.1 – Tide Data**

Tide	Abbreviation	Level m, Chart Datum Port
Highest Astronomical Tide	HAT	2.287
Mean High Water Springs	MHWS	1.997
Mean Level	ML	1.097
Mean Low Water Springs	MLWS	0.197
Lowest Astronomical Tide	LAT	-0.013

#### 3.4 Method Statements

Method statements shall be compiled by the *Contractor* for all activities. The method statements shall be submitted to the *Supervisor* for acceptance three weeks in advance of the particular activity being undertaken. Full details of all proposed Equipment (including temporary works) and methods shall be provided for acceptance by the *Supervisor*.

No activity shall commence until the method statement has been accepted by the *Supervisor*. Any unforeseen clashes between services infrastructure are to be brought to the attention of the *Supervisor* immediately.

Further details of the requirements of particular method statements are provided in Sections 4 to 10.

#### 4.0 CONCRETE CAPPING BEAMS, QUAYSIDE TUNNELS AND REAR CRANE RAIL BEAM

##### 4.1 Materials

###### 4.1.1 Concrete

All concrete shall be in accordance with specification 1785-CO-000-C-SPC -0001 – Concrete for Marine Construction, as required to ensure durability in a marine environment.

###### 4.1.2 Cementitious Grout

Cementitious grout shall be in accordance with ASTM C1107 / C1107M - 14a - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

###### 4.1.3 Epoxy Seating Mortar

The epoxy shall be a high strength, flowable, self-levelling epoxy grout designed for applications such as machine bases and bridge bearing pads. The grout shall be solvent free, amine cured, flowable epoxy comprising a resin hardener system and pre-packed aggregates applied in accordance with the manufacturers recommendations, The mortar shall have a compressive strength of 45 MPa in seven days and be resistant to aliphatic solvents, oils, petrol, diesel fuel, and chemical attack.

###### 4.1.4 Joints and Seals

###### 4.1.4.1 General

4.1.4.1.1 All materials used in forming, constructing and sealing permanent joints shall be subject to the acceptance of the *Supervisor*.

4.1.4.1.2 The *Contractor* shall submit test certificates issued by an approved, independent testing authority to confirm that the respective materials comply with the specified requirements, or a certificate by the patent holder or supplier certifying that manufactured item or material complies in all respects with the relevant product specifications.

###### 4.1.4.2 Joint Filler

4.1.4.2.1 Joint filler shall consist of sheets or strips of rigid forms of expanded polyethylene, polyurethane or polystyrene complying with BS 4840 or BS 3837. Wherever polystyrene or similar material susceptible to damage is used for forming joints, it shall be lined with 6mm hardboard on the side to be concreted. The hard surface shall be sufficiently resilient, to ensure that the joint and surfaces can be formed free of defects.

###### 4.1.4.3 Sealants

4.1.4.3.1 Thermosetting chemically curing sealant shall comply with the requirements of ASTM C.920 or BS 4254. The final BRHD hardness of the sealant shall be  $20 \pm 5$ .

4.1.4.3.2 Preformed elastomeric compression seals shall comply with the requirements of SABS 1023. The seals shall be manufactured in accordance with an extrusion process from elastomeric material consisting entirely of polychloroprene which is subsequently vulcanised.

4.1.4.3.3 Silicone Sealant shall be a one component material. The silicone sealant shall be a one-component material with low-modulus properties which comply with the following requirements:

- Tensile stress at 150% expansion determined in accordance with ASTM D 412 (Matrix C) after seven days curing at  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ : - 0,31 MPa max.
- Extrusion rate, tested with a pneumatic caulking gun with a 3,18 mm nozzle at a pressure of 0,62 MPa:
  - Material temperature -  $18^{\circ}\text{C}$ : min 75 g/min
  - Material temperature -  $38^{\circ}\text{C}$ : max 250 g/min
- Relative density determined in accordance with ASTM D 794 Method A: 1,01 to 1,515.

- Durometer hardness determined in accordance with ASTM D 2240 at -18°C after 7 days' curing at 23°C ± 2°C and relative humidity 50% ± 5%: 8 - 20 Shore A.
- Shelf life: at least 6 months after manufacture.
- Ozone and UV resistance determined in accordance with ASTM D 793-75: no pulverisation, cracking or loss of bond after 5 000 hours.
- Adhesion to cement-mortar briquettes determined in accordance with COTO Chapter 20 QA Clause A20.1.5.6 d) Tests on Silicone Sealants: 0,34 MPa min.
- Non-adhesion period determined in accordance with COTO Chapter 20 QA Clause A20.1.5.6 d) Tests on Silicone Sealants: max 90 min.
- Deformation capability and adhesion in accordance with COTO Chapter 20 QA Clause A20.1.5.6 d) Tests on Silicone Sealants: no adhesion or cohesion after 10 cycles at -18°C.
- Colour: Grey.

#### 4.1.4.4 Waterstops

4.1.4.4.1 Waterstops shall be of extruded, plasticized, flexible PVC and of the type specified or shown on the drawings and shall have an elongation at break of 300%.

4.1.4.4.2 Flexible rubber waterstops shall comply with the requirements of CKS 389.

#### 4.1.4.5 Bond Breakers

4.1.4.5.1 Polyethylene tape, coated paper, metal foil or similar material may be used where bond breakers are required.

#### 4.1.5 Ducts Cast into Reinforced Concrete

4.1.5.1 Duct pipes shall be manufactured from unplasticised polyvinyl chloride (uPVC) and shall comply with the following:

- Ducts up to 200 mm SANS 967
- Ducts 200 mm and larger SANS 966 class 4

### 4.2 Methods and Procedures

#### 4.2.1 Cope Plank Manufacturing, Transport and Lifting

4.2.1.1 The Lot 10 yard shall be used for construction of the precast cope panels. The *Contractor* shall be responsible for establishing all casting beds required for the casting of the cope panels.

4.2.1.2 Precast cope panel formwork shall comply with the provisions of specification 1785-CO-000-C-0001 – Concrete for Marine Structures.

4.2.1.3 The *Contractor* shall provide all cranes and barges for lifting, transporting and placing cope panel units.

4.2.1.4 The Equipment for shall comply with the requirements of DNV-OS-H201, H202 and H205.

4.2.1.5 The provisions of SANS 2001-CC1:2012 Section 4.8 - Precast Concrete and Section 4.10 Handling and erection of precast concrete units shall apply.

4.2.1.6 The infill panels shall be transported to site via a waterside operation. Landward transport of the units is not permitted.

4.2.1.7 The loadout operation (transfer of infill panels from land onto a barge) shall be planned and undertaken in accordance with DNV-OS-H201 with particular reference to Section 3.

4.2.1.8 The tow route shall be as per the route for the caissons as described in specification 1785-CO-000-C-SPC-0002 – Caisson Construction and Placement.

4.2.1.9 Towing shall be planned and undertaken in accordance with DNV-OS-H202 with particular reference to Section 4 and 5.

4.2.1.10 Lifting and positioning operations shall be planned and undertaken in accordance with DNV-OS-H205.

#### **4.2.2 Caisson Capping Beam Construction**

4.2.2.1 All activities relating to the capping beam and service tunnel construction shall only be undertaken once the compaction of the caisson fill and reclamation fill material in the area has been completed and has passed the performance test such that the fill material provides adequate support and that settlement of the fill during compaction does not damage the superstructure or the services.

4.2.2.2 All works for the capping beam construction shall be done in accordance with specification 1785-CO-000-C-SPC-0001 - Concrete for Marine Structures.

4.2.2.3 Prior to placing the cope planks, the *Contractor* shall cast an in situ levelling slab to take up any differences in level associated with caisson placement tolerances to ensure the cope planks are set at the defined design level. The thickness of the levelling slab will vary depending on the final placed level of the caisson after settlement due to backfill has occurred. If the level is such that the thickness of the slab is less than 50 mm, the levelling slab shall be made from cementitious non-shrink grout. For thickness greater than 50 mm, the slab shall be 45 MPa mass concrete.

4.2.2.4 Prior to constructing the levelling slab, the top of the caisson walls shall be chipped back to expose the aggregate and leave a sound irregular surface. The surface shall be treated with a wet to dry epoxy prior to casting.

4.2.2.5 The levelling slab shall be recessed as shown on the drawings to allow for the seating of the precast cope planks.

4.2.2.6 To accommodate possible soffit irregularities in the precast cope plank, the cope plank shall be lowered onto a layer of seating epoxy. The cope plank shall be propped until the epoxy has hardened into a wedge.

4.2.2.7 The *Contractor* shall design and install temporary supports for the cope planks which shall be designed to support the weight of the cope plank until the cope plank has become integral with the in situ capping beam after the 2<sup>nd</sup> capping beam in situ cast. The *Contractor* shall remove the temporary supports after the 2<sup>nd</sup> in situ cast and shall make good with an approved epoxy mortar all attachment points.

4.2.2.8 The in-situ capping beam shall be cast in 3 layers, with horizontal construction joints as shown on the drawing.

4.2.2.9 The *Contractor* shall determine the position of the vertical construction joints in the capping beam to suit his construction sequence and pour sizes. The vertical construction joints shall not be located at cope plank joints.

4.2.2.10 Vertical and horizontal construction joints in the capping beam and service tunnels shall be formed in accordance with section 4.7.12.1 of SANS 2001-CC1:2012.

#### **4.2.3 Return Quay Cope Beam Construction**

4.2.3.1 The cope beam to the top of the steel sheet piles of the return quay shall only be constructed once dredging in front of the cope has taken place. The cope beam shall follow the deformed shape of the steel piles.

4.2.3.2 All works for the capping beam construction shall be done in accordance with specification 1785-CO-000-C-SPC-0001 - Concrete for Marine Structures.

4.2.3.3 The cope beam shall be cast in situ.

4.2.3.4 The formwork for the in situ cope beam shall be water tight. Prior to casting, the interior of the forms shall be dewatered of all seawater by pumping. The interior shall then be filled and flushed with fresh water which shall then also be removed by pumping prior to placing concrete.

4.2.3.5 The in situ cope beam shall be cast in single layers without horizontal construction joints.

4.2.3.6 The *Contractor* shall determine the position of the vertical construction joints in the cope beam to suit his construction sequence and pour sizes.

4.2.3.7 Vertical joints in the cope beam shall be formed in accordance with section 4.7.12.1 of SANS 2001-CC1:2012.

#### 4.2.4 Joints

4.2.4.1 Waterstops and seals shall be cast-in in strict accordance with the supplier's installation specification.

4.2.4.2 Waterstops are to be fully tied to the re-bar to eliminate possible displacement during the concreting and vibrating process. Waterstops shall be clipped to the reinforcing and not punched to ensure that the material does not tear during concreting.

4.2.4.3 The concrete around the waterstops shall be carefully and thoroughly compacted in order to eliminate any voids or honeycombing in that area.

4.2.4.4 The *Contractor* shall provide sufficient support to the waterstops to ensure that they remain stable and do not fold during concreting works.

4.2.4.5 Any waterstop found to be leaking will be declared a defect and the *Contractor* shall repair the defect in accordance with the Contract.

#### 4.2.5 Access Manholes and Cast-in Items

4.2.5.1 The following items are to be cast-in during cope plank, capping beam and service tunnel construction. Material and fabrication details of the cast-in items are provided in section 5.0, 0, 7.0 and 8.0 and on the 1785-CO-090, 1785-CO-100, and 1785-CO-110 series of drawings:

- Pipe Slot, cable slot and access manhole frames
- Wharf ladder anchor sockets
- Bollards holding down bolts
- Fender anchor sockets
- STS crane tie-down anchors
- STS crane storm pin anchors
- Electrical manhole frames
- Water / fire hydrant manhole frames
- STS crane turn over funnels
- Sole plate holding down bolts

4.2.5.2 Cast-in items shall be sufficiently secured such that they are not displaced during concrete placement and vibration. If stainless steel bolts or cast-in items make contact with other dissimilar metals (including reinforcement), they shall be electrically insulated to prevent bi-metallic corrosion.

### 4.3 Compliance with Requirements

#### 4.3.1 Tolerances

4.3.1.1 Deviations shall be within the limits listed in Table 11 of SANS 2001-CC1 for Degree of Accuracy II, unless stated otherwise on drawings or elsewhere in the Works Information.

4.3.1.2 Crane rail recesses and cast-in anchors for STS cranes shall be Degree of Accuracy I.

4.3.1.3 The Contractor shall ensure that cumulative tolerances meet with tolerance requirements as defined within this specification.

## 5.0 FENDERS

### 5.1 Standards and Specifications

- 5.1.1 The governing specification for the design, supply and installation of the fender panels is PIANC – Report of Working Group 33 - Guidelines for the Design of Fenders Systems 2002.

### 5.2 Design and Performance Criteria

- 5.2.1 Fenders shall be designed and supplied by a reputable manufacturer able to demonstrate a satisfactory supply record over a number of years for the type of fender being proposed.
- 5.2.2 The fenders shall be able to absorb the required berthing energy (namely largest energy stipulated) under the combinations of direct and angular compression indicated below.
- 5.2.3 The fenders shall have a design life of 20 years with a factor of safety for abnormal berthing = 2.0.
- 5.2.4 The fenders shall be designed for the following design vessel:
- Design ship New Panamax – Partial laden
  - Displacement 190,000 m<sup>3</sup>
  - Bow flare radius 160 m @ 14.5 m draft
  - Overall length 366 m
  - Beam 51.2 m
  - Draft 14.5 m (partially laden 11,000 TEU)
  - The fenders are not required to be designed for belted vessels.
- 5.2.5 Berthing requirements
- Berthing speed 0.10 m/s
  - Maximum design berthing angle 10°
  - Permissible hull pressure 200 kPa
  - Maximum quay reaction limit 250 tonnes
  - Quay type - Caisson type with composite precast and in situ cope reinforced concrete beam.
- 5.2.6 Fenders shall be cylindrical or cone shaped rubber fenders with steel fender panel. V-Shaped fenders are not permissible.
- 5.2.7 The fender position and panel size shall be as follows:
- The level of the top of the fender shall be at least as high as the top of the coping (+4.25 m CDP) and the level of the bottom of the fender shall be at least as low as the bottom of the coping or at -0.5 m CDP, whichever is the lower.
  - Maximum fender projection – 2,000 mm.
- 5.2.8 The steel fender panels shall be stiffened closed box panels, structurally designed by appropriately qualified structural engineers to accepted Codes of Practice. Panels shall be structured with suitable stiffening members. It shall be appropriately designed to resist the reaction forces imposed by the fender and its supporting chains (if any), and keep in equilibrium with the vessel berthing force.
- 5.2.9 The steel panels shall be sized to exert a hull pressure not more than 200 kPa. It shall be located to accommodate all possible contact elevations of the various vessels, intending to use the facility, under the given geometry of tidal levels and quay structure.
- 5.2.10 Panels shall have a minimum overall depth of not less than 300 mm and shall be sealed and pressure tested. Plate thickness shall not be less than 10 mm for all external plates and 8 mm for internal stiffening plates. All panel edges shall be chamfered.
- 5.2.11 Correction factors are to be taken into account in accordance with PIANC –Report of Working Group 33. The minim and maximum temperatures to be considered are 0°C and 40°C respectively.

### 5.3 Materials

#### 5.3.1 Rubber Fender Units

- 5.3.1.1 Rubber fender units shall be compression moulded from natural or synthetic or both rubber compounds in compliance with Appendix A of “Procedure to Determine and Report the Performance of Marine Fenders”, Section 7.3 of PIANC “Guidelines for the Design of Fenders Systems 2002: Report of Working Group 33”.
- 5.3.1.2 The rubber shall be fully vulcanised and homogeneous with no foreign particles, and free from voids, cracks and cuts. Steel plates shall be fully embedded and fully adhered to the rubber during the vulcanisation process to avoid separation between the rubber and the steel.
- 5.3.1.3 The rubber compound of the fenders shall comply with the specifications stipulated in the Table 5.1.
- 5.3.1.4 Rubber fenders shall be tested in accordance with the requirements of Appendix A of the PIANC guideline.

#### 5.3.2 Steel Fender Panels

- 5.3.2.1 Fender panels shall be fabricated from mild steel supplied in accordance with EN 10025 Grade S355J2 or S355J0.
- 5.3.2.2 Structural steel panels shall be corrosion protected with C5M-J class paint systems in accordance with ISO 12944 or approved equal.

#### 5.3.3 Fender Attachments

##### 5.3.3.1 Panel facings

- 5.3.3.1.1 Low friction pads materials shall be of synthetic resin, such as Ultra High Molecular Weight Polyethylene (UHMW-PE) having a thickness of at least 50 mm.
- 5.3.3.1.2 Edge pads shall be chamfered to match the chamfered panels, and pads planed to ensure that there are no steps in excess of 1 mm between pads.
- 5.3.3.1.3 Panel facings are to be fixed to the steel panels using stainless steel studs or bolts of at least 20 mm diameter.

##### 5.3.3.2 Bolts and fixings

- 5.3.3.2.1 All anchor sockets, bolts, nuts and washers shall be stainless steel UNS Designation S31603 (Type 316L) to ASTM 240/A 240M – 04a or such other stainless steel having an equivalent or higher Pitting Resistance Equivalent Number (PREN). Positions of cast-in anchor bolts to be confirmed with supplier and approved by the *Supervisor* before commencement of concrete casting of cope panels.
- 5.3.3.2.2 Thread clearances and lubrication shall be used to avoid galling of threads.

##### 5.3.3.3 Chains attachments

- 5.3.3.3.1 If necessary, fender restraint chains shall be provided for vertical and lateral restraint.
- 5.3.3.3.2 The chains shall be Grade 80 Alloy Chain in accordance with ASTM A391/A391M-07 and shall be supplied hot dip galvanised to BS EN ISO 1461.

#### 5.3.4 Material Testing and Certification

- 5.3.4.1 The fender manufacturer shall supply:
  - Quality certificate of ISO 9002 or equivalent.
  - Supply history of the offered fenders.
  - Type Approval Testing and Verification Testing Reports and Certification in accordance with PIANC – Guidelines for Design of Fender Systems: 2002: Appendix A. Testing reports with fender performance curves, clearly specifying the Rated Performance Data (RPD), shall be supplied for each different fender type/size at the time of delivery. Verification testing of fender performance and rubber material properties are to be third party witnessed.



- Rubber properties certificate - Physical properties of rubber certificate shall be supplied at the time of delivery.
- Mill certificate for steel attachments - A mill certificate for steel panels, chains and bolts should be supplied at the time of delivery in accordance with ASTM 240.
- Certification of corrosion protection in accordance with ISO 12944.

#### **5.4 Installation**

- 5.4.1 Concrete embedments, including anchor bolts, anchor bolt inserts and chain anchors, shall be no closer than 250 mm to the edge of the concrete. If stainless steel bolts or fender anchors make contact with other dissimilar metals, they shall be electrically insulated to prevent bi-metallic corrosion.
- 5.4.2 Comprehensive shipping, handling, storage, and installation procedures shall be prepared and submitted to the *Supervisor* for review and approval and shall be in strict accordance with the manufacturer's instructions.

#### **5.5 Spare Fenders**

- 5.5.1 In addition to the fenders to be installed, the *Contractor* shall supply two additional sets of fenders complete with all components, chains, fixings and anchorages. Spare fenders are to be delivered to the *Employer's* store.

#### **5.6 Compliance with Requirements**

##### **5.6.1 Tolerances**

- 5.6.1.1 The fenders shall be installed within 20 mm, vertically and horizontally of the prescribed position. The individual anchor sockets shall be precision installed relative to one another to permit the fixing of bolts without stressing or distortion of the fender attachment.
- 5.6.1.2 The *Contractor* shall ensure that cumulative tolerances meet with tolerance requirements as defined within this specification.

##### **5.6.2 Testing**

- 5.6.3 Factory testing and certification of the fenders is covered in section 5.3. No further site tests are required for the fenders.

Table 5.1

Property	Testing Standard	Condition	Requirement
Tensile strength	ASTM D412 Die C; S 180.2; BS 903.A2; ISO 37; JIS K6301 Item 3, Dumbell 3	Original	16 MPa (Min)
		Aged for 96 hours at 70°C	12.8 MPa (Min)
		Original	15 N/mm <sup>2</sup> (Min)
		Aged for 168 hours at 70°C	12.75 N/mm <sup>2</sup> (Min)
Elongation at break	ASTM D412 Die C; BS 903.A2; ISO 37; JIS K6301 Item 3, Dumbell 3	Original	400% (Min)
		Aged for 96 hours at 70°C	320% (Min)
		Original	300% (Min)
		Aged for 168 hours at 70°C	280% (Min)
Hardness	ASTM D2240; BS 903.A6; ISO 815; JIS K6301 Item 5A Tester	Original	78° (Max) Shore A
		Aged for 96 hours at 70°C	Original Value + 6° points increase
		Original	75° (Max) Shore A
		Aged for 168 hours at 70°C	Original Value + 5° points increase
Compression set	ASTM D395; BS 903.A6; ISO 815; JIS K6301 Item 10	Aged for 22 hours at 70°	30% (Max)
	DIN 53517	Aged for 24 hours at 70°	40% (Max)
Tear resistance	ASTM D624; BS 903.A3; ISO 34.1; JIS K6301 Item 9, Test Piece A	Die B	70 kN/m (Min)
	DIN 53507		80 N/cm (Min)
Ozone resistance	ASTM D1149; BS 903.A43; DIN 53509; ISO 143/1	1 ppm at 20% strain at 40°C for 100 hours	No cracking visible by eye
Seawater resistance	DIN 86076, Section 7.7	28 days in artificial seawater at 95°C ±2°C	Hardness ±10° (Max) Shore A Volume + 10/-5% (Max)
Abrasion resistance	BS 903.A9	Method B, 1000 revolutions	0.5 cc (Max)
	DIN 53516		100 mm <sup>3</sup> (Max)
Bond strength steel to rubber	BS 903.A21	Method B	g) N/mm (Min)

## 6.0 BOLLARDS

### 6.1 Design and Performance Criteria

- 6.1.1 Bollards shall be designed and supplied by a reputable manufacturer able to demonstrate a satisfactory supply record over a number of years for the type of bollard being proposed.
- 6.1.2 The *Contractor* shall supply bollards of new material produced by an approved and authorised manufacturer. The *Contractor* shall submit for review and acceptance by the *Supervisor*, all the manufacturer's catalogue data and information, for the proposed type of bollards.
- 6.1.3 Bollards shall be new Double T-head 300 tonne cast steel bollard as shown on the drawing 1785-CO-110-C-DWG-003-01.
- 6.1.4 Bollards shall have a designated load capacity of 300 tonnes in the direction of  $-10^{\circ}$  to  $+70^{\circ}$  in the vertical plane and  $0^{\circ}$  to  $160^{\circ}$  in the horizontal plane.
- 6.1.5 Each bit shall have a designated load capacity of 150 tonnes.
- 6.1.6 The theoretical point of loading for the line pull shall be the intersection of the bollard vertical axis centreline and the horizontal axis running through the centre of the horns.
- 6.1.7 The bollard shall include a full set of anchor bolts and their accessories, supplied by the bollard manufacturer.
- 6.1.8 Bollards shall be designed with a minimum factor of safety against failure of 3.0 for Spheroidal Graphite Cast-Iron Grade 65-45-12.
- 6.1.9 Holding down bolts shall also be designed with a minimum factor of safety of 3.0.
- 6.1.10 The supplied bollards shall include all test certificates issued by a specialised laboratory for their compliance with the performance and standards. Approval by the *Supervisor* shall not, in any manner, relieve the *Contractor* from full responsibility for the bollard's performance and quality as specified.

### 6.2 Materials

- 6.2.1 Bollard material shall be stress-relieved ductile cast iron (spheroidal graphite) conforming to ASTM A536 Grade 65/45/12.
- 6.2.2 Holding down bolts shall be Gr. 8.8 to BS 3692, hot dip galvanised to BS EN ISO 1461.
- 6.2.3 Mill test reports shall be submitted to the *Supervisor* certifying that materials meet the specified standards.
- 6.2.4 Grout used around base of bollard shall have a minimum 40 MPa compressive stress and a maximum aggregate size of 10 mm and shall be in accordance with ASTM C1107 / C1107M - 14a - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

### 6.3 Installation

#### 6.3.1 Shipping and Storage

- 6.3.1.1 The bollards, with all anchor bolts and accessories, shall be stored neatly and in orderly manner, at the storage areas. The anchor bolts and their accessories shall be stored in boxes.

#### 6.3.2 Holding Down Bolts and Grouting

- 6.3.2.1 Holding down bolts are to be supplied by the bollard manufacturer to ensure proper fit.
- 6.3.2.2 The *Contractor* shall prepare templates with the exact location of the anchor bolts according to the type and size of the bollard. The anchor bolts shall be fixed in their location in the forms with the assistance of the template.
- 6.3.2.3 The anchor bolts shall be perpendicular to the top plan of the forms and shall be tied to them in such a manner that they shall not move from their place during all the casting procedure. The anchor bolts shall not be tied to the cope beam reinforcement.

- 6.3.2.4 After the casting-in of the anchor bolts they have to be protected until the installation of the bollards.
- 6.3.2.5 Bollard bases shall be levelled on top of a grout bed. Nuts shall be hand tight before grouting of base.
- 6.3.2.6 After grouting has cured for seven days, nuts shall be tightened using full manual effort with a 1 m long spanner extension to approximately 200 Nm.
- 6.3.2.7 Areas around nuts in bollard base shall be filled with a non-shrink grout so as to prevent standing water.
- 6.3.2.8 To prevent damage to vessel mooring lines, no sharp edges around bolting area shall exist after installation.

### 6.3.3 Protective Coating

- 6.3.3.1 The bollards shall receive a protective coating system that shall protect the bollards against marine, highly corrosive environment class C5M in accordance with ISO 12944-5.
- 6.3.3.2 The paint system shall be A5M.06 or A5M.07 to BS EN ISO 12944-5:2007 with coats and dry film thickness as shown below in Table 6.1.
- 6.3.3.3 The surface preparation, primer coat and intermediate coat shall be applied in the factory. The final/top coat shall be applied on site after bollard installation.
- 6.3.3.4 The top coat shall be colour 'Safety Yellow' (BS5252 Code – 08 E 51).
- 6.3.3.5 Any exposed nuts are to be wrapped in DENSO tape or similar approved corrosion protection measure.

Table 6.1: Bollard Coating System

Application	System	Dry Film Thickness (DFT)( $\mu\text{m}$ )
Surface Preparation	Abrasive Blasting Degree of cleanliness – Sa 2 ½ to ISO 8501-1 Roughness – Grade Medium G (50 $\mu\text{m}$ to 75 $\mu\text{m}$ ) to ISO 8503	
Primer Coat	1 Coat of two-component zinc rich epoxy primer	$\geq 80$
Intermediate Coat	2 Coats of two-component polyamide adduct-cured epoxy paint	$\geq 220$
Top Coat	1 Coat of two-component, polyurethane top coat	$\geq 20$

### 6.4 Spare Bollards

- 6.4.1 In addition to the bollards to be installed, the *Contractor* shall supply two additional sets of bollards complete with all anchorages. Spare bollards are to be delivered to the *Employer's* store.

### 6.5 Testing and Records

- 6.5.1 The bollards shall be supplied with the following documentation pack:
  - Drawings of the bollard and associated anchors with installation details.
  - Engineering calculations and analysis demonstrating load capacity.
  - Installation procedure.
  - Chemical analysis test reports and certificates.
  - Mechanical test reports and certificates.
  - Dimensional as-built reports.
  - Coating test reports and certificates.

## 7.0 CRANE RAILS, TEMPORARY STOP BLOCKS, SOLE PLATES AND RAIL CLIPS

### 7.1 General

- 7.1.1 The crane rails and rail clips shall be sourced from a reputable manufacturer able to demonstrate a satisfactory supply record over a number of years for the type of rail and rail clips proposed.

### 7.2 Materials

#### 7.2.1 Rails

- 7.2.1.1 Rails shall comprise type A150 crane rails and shall comply with the relevant sections of the specification or standard to which they are made, e.g. British crane and bridge rails to CES2: 1987, German A section rails to DIN536: 2:1991.
- 7.2.1.2 Rails shall be from the same rolling to obviate difference in height. Particular care shall be taken to ensure the ends are straight as this has an impact on the ease and efficiency of welding. Rails shall be free from all paint, oil, grease, dirt, loose rust and loose mill scale.
- 7.2.1.3 The *Contractor* shall take due care in the removal of the existing crane rails and shall be responsible for storing the rails on behalf of the *Employer* until such time as the *Employer* takes ownership thereof. Existing crane rails shall not be reused as part of the completion of the *works*.

#### 7.2.2 Pads

- 7.2.2.1 The type of resilient pad to be used shall be a reinforced resilient pad for continuously supported rails, such as Gantrex MK6 pad or approved equal.
- 7.2.2.2 The width of the pad shall be nominally 5 mm less than the bottom flange width of the rail.

#### 7.2.3 Sole Plates and Holding Down Bolts

- 7.2.3.1 Steel soleplates shall be Grade S355JR to BS EN 10025-2:2004.
- 7.2.3.2 Holding down bolts shall be Grade 8.8 to BS 3692:2014 and BS EN ISO 898-1:2013.
- 7.2.3.3 All steelwork shall be free from paint, oil, grease, dirt, loose rust, loose mill scale and sharp burrs.
- 7.2.3.4 Sole plates and holding down bolts shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45. Sherardizing shall take place after fabrication of the complete element.

#### 7.2.4 Rail Clips and Studs/Bolts

- 7.2.4.1 Rail clips shall be adjustable rubber nosed boltable crane rail clips with self-locking cam or similar and shall be used in accordance with the supplier's recommendations.
- 7.2.4.2 The components shall be of the following material:
- Self-locking Cam                      Ductile cast iron to BS EN 1563:2011 or ASTM A536
  - Clip    Ductile cast iron to BS EN 1563:2011 or ASTM A536
  - Stud/bolt                                  Grade 8.8 to BS 3692:2014 and BS EN ISO 898-1:2013
  - Pressure Block (Nose)                Synthetic Rubber
- 7.2.4.3 Rail clips, bolts and studs shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45.

### 7.2.5 Grout

- 7.2.5.1 The grout to the underside of the sole plates shall be flowable epoxy grout – Type Gantrex K3 or similar approved.
- 7.2.5.2 The epoxy shall be a high strength, self-levelling, epoxy grout designed specifically for precision grouting of crane runway systems.
- 7.2.5.3 The grout shall be solvent free, amine cured, comprising a resin hardener system and pre-packed aggregates applied in accordance with the manufacturer's recommendations.
- 7.2.5.4 The mortar shall have a compressive strength of 85 MPa in seven days and be resistant to aliphatic solvents, oils, petrol, diesel fuel, and chemical attack.

## 7.3 Installation

### 7.3.1 General

- 7.3.1.1 The installation of the holding down bolts, sole plate, rail pad, crane rail, rail clips and sole plate grouting shall all be undertaken in strict accordance with the Supplier's recommendations and specifications.
- 7.3.1.2 The installation sequence shall be:
  - Cast-in sole plate holding down bolts.
  - Install sole plate to level and bolt down.
  - Install, fasten and align crane rail including crane rail welding.
  - Grout sole plate.

### 7.3.2 Sole Plate Holding Down Bolts

- 7.3.2.1 Sole plate installation shall be in accordance with the Supplier's recommendations.
- 7.3.2.2 The *Contractor* shall cast in the sole plate holding down bolts during capping beam (seaside) and crane rail beam (landside) construction.
- 7.3.2.3 The *Contractor* shall use a template during casting-in of the bolts to ensure the bolts are cast in to within tolerance. No onsite cutting/slotting of bolt holes in the sole plate will be permitted if holding down bolts are incorrectly cast in.
- 7.3.2.4 The anchor bolts shall not be tied to the crane rail beam reinforcement.

### 7.3.3 Welding of Crane Rails

- 7.3.3.1 Details of the crane rail welding requirements are covered under specification 1785-CO-000-C-SPC-0005.

### 7.3.4 Sole Plate Grouting

- 7.3.4.1 Epoxy shall be poured from one side of the sole plate until the epoxy level rises above the sole plate invert on the opposite side.
- 7.3.4.2 Voids under the sole plate are to be avoided.

### 7.3.5 Temporary Stop Blocks

- 7.3.5.1 Ten (10 No) temporary stop blocks (5 No blocks per rail) are required on the existing crane rails at the Berth 205 and Berth 204 interface during Phase 1.
- 7.3.5.2 Ten (10 No) temporary stop blocks (5 No blocks per rail) are required on the existing crane rails at the Berth 204 and Berth 203 interface during Phase 2, as well as ten (10 No) blocks at the newly completed Berth 205 end (5 No blocks per rail).
- 7.3.5.3 Ten (10 No) temporary stop blocks are required at the newly completed Berth 204 end (5 No blocks per rail) during Phase 3.

7.3.5.4 Therefore, a maximum of twenty (20 No) temporary stop blocks are required (4 sets of 5 blocks per set) for the duration of the project.

7.3.5.5 All temporary stop blocks to be maintained and handed over to *Employer* on completion of the *works*.

7.3.5.6 The positions of temporary stop blocks are indicated on the relevant phasing drawings.

#### 7.4 Compliance with Requirements

##### 7.4.1 Tolerances

7.4.2 The *Contractor* shall supply and install Ship-To-Shore (STS) crane rails, clips and accessories in accordance with the STS Crane requirements and tolerances as shown on the drawings. An acceptance survey will be carried out before handover of any rails.

7.4.3 The *Contractor* shall ensure that cumulative tolerances meet with tolerance requirements as defined within this specification.

### 8.0 MISCELLANEOUS QUAY FURNITURE AND ACCESS COVERS

#### 8.1 Materials

##### 8.1.1 General

8.1.1.1 The required material types and corrosion protection for the various quay furniture and fixture items are shown in Table 8.1.

Table 8.1

Item	Material	Corrosion Protection
Access manhole frames and covers	Ductile Cast Iron	-
Access Ladders	Stainless Steel	-
STS Tie-Down Anchors	Mild Steel	Thermal Diffused
STS Storm Pin Anchors	Mild Steel	Thermal Diffused
STS Crane Turn-over Funnels	Stainless Steel	-
STS Crane Cable protector	Mild Steel	Thermal Diffused & Painted

##### 8.1.2 Mild Steel

8.1.2.1 Where mild steel is specified for quay furniture, fixtures and fittings, it shall be S355JR in accordance with BS EN 10025 unless otherwise shown on the drawings.

8.1.2.2 All mild steel elements shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45. Sherardizing shall take place after fabrication of the complete element.

8.1.2.3 Where painting is specified, the painting system shall be A7.13 to BS EN ISO 12944-5:2007 Table A.7 – Epoxy primer + Epoxy, Polyurethane.

##### 8.1.3 Stainless Steel

8.1.3.1 Where stainless steel is specified for quay furniture, fixtures and fittings, it shall be Type 316L to ASTM 240/A 240M – 04a.

#### **8.1.4 Ductile Cast Iron**

- 8.1.4.1 Where ductile cast iron /spheroidal graphite is specified for quay furniture, fixtures and fittings, it shall be Grade 65/45/12 to ASTM A536 – 84 (2014) or equivalent grade to BS EN 1563:2011.

#### **8.1.5 Chemical Anchors**

- 8.1.5.1 All anchors shall be Hilti-HSL3 Heavy Duty Anchors or similar approved.

#### **8.1.6 Access Covers**

- 8.1.6.1 All access covers are to be proprietary heavy duty covers designed specifically for container yards with wheels loads in excess of 20 tonnes – ‘Gatic Type F900 – DMR recessed’ or similar approved.
- 8.1.6.2 Covers to be certified to a test load of 900 kN.
- 8.1.6.3 Covers to be made from ductile cast iron.
- 8.1.6.4 Units to be coated with black bituminous solution for protection during transit.
- 8.1.6.5 Covers to be recessed type to receive concrete infill.
- 8.1.6.6 Concrete to infill and to surround/rebate to be strength grade 45 MPa.

#### **8.2 Fabrication and Installation**

- 8.2.1 All steel work shall be fabricated in accordance with BS EN 1090-2:2008 Execution of steel structures and aluminium structures.
- 8.2.2 Welding shall be in accordance with BS EN 1090-2:2008 Chapter 7 – Welding or alternatively in accordance with the requirements of AWS D1.1/D1.1M:2015.
- 8.2.3 The Service Category, Production Category and Execution Class determined in accordance with BS EN 1090-2:2008 Clause 4.1.2 and Annex B – Guidance for the determination of execution classes, shall be as follows:
- The Service Category for the structure shall be SC2.
  - The Production Category for welds to the sheet piles shall be PC2.
  - The Execution Class for the structure shall be EXC3.

### **9.0 SERVICES**

#### **9.1 Water/Medium Pressure Pipelines**

##### **9.1.1 Supporting Specification**

- 9.1.1.1 The governing standard shall be SANS 1200L as amended and added to below.

##### **9.1.2 Materials**

###### **9.1.2.1 Pipes, Couplings and Fittings**

- 9.1.2.1.1 Existing pipelines comprise 375 mm diameter asbestos concrete and 225 mm diameter PVC pipes outside and inside of the service tunnels respectively.
- 9.1.2.1.2 All pipes for water supply to be:
- HDPE PE 100
  - Pressure Class 16
  - Standard Diameter Ratio (SDR) = 11
- 9.1.2.1.3 All couplings are to be PE 100 electrofusion couplings with a Pressure Class of 16.



- 9.1.2.1.4 All pipes and couplings shall conform to ISO 4427:2007 - Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply.
- 9.1.2.1.5 Fittings shall be ductile cast iron flanged typed in accordance with SANS 1835:2009. External and internal surfaces of all fittings shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating to a minimum thickness of 300 µm in accordance with SANS 1217.
- 9.1.2.2 **Flanged Connections, Back-up ring, Bolts and Nuts**
  - 9.1.2.2.1 Flange connections shall comply with SANS 1123 Table 15, drilled to suit mating flanges and shall be installed square to the axis of the pipeline. Reaming of bolt holes to oversize dimensions in order to make a particular piece fit will not be permitted.
  - 9.1.2.2.2 Back-up rings shall be mild steel Grade S275JR to BS EN 10025 coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45.
  - 9.1.2.2.3 Bolts, nuts and washers shall comply with ANSI B16.5 or the relevant sections of SANS 1700 as applicable, in sizes appropriate to the class of pipe or special and of Grade 316 stainless steel. The length of the bolt shall be such that, after the bolt has been tightened, the end of the bolt projects a minimum of one thread above the nut and to a maximum of three full threads.
  - 9.1.2.2.4 All buried flange connections shall be further protected by means of a protective paste / primer (Denso Mastic or similar approved) and then wrapped with two layers of an approved impregnated tape (Denso Tape or similar approved).
  - 9.1.2.2.5 *Contractor* is to carefully excavate around existing pipeline connections for physical inspection by the *Supervisor* and *Employer* prior to commencement of construction for new temporary and permanent pipelines.
- 9.1.2.3 **Gate Valves, Hydrants and Water Meters**
  - 9.1.2.3.1 All gate valves shall be Class 16, double flanged, resilient seal, cast-iron waterworks pattern valves, with non-rising spindles, conforming to SANS 664:2011.
  - 9.1.2.3.2 Gate valves shall be flanged to SANS 1123 Table 15 and shall be fitted with valve caps per SANS 664.
  - 9.1.2.3.3 The direction of closing shall be CLOCKWISE and clearly indicated on the valve body.
  - 9.1.2.3.4 Quayside hydrants shall be cast-iron gate-valve outlet bends with a bayonet type outlet according to SANS 1128-1:2010.
  - 9.1.2.3.5 Water meters shall be cast-iron, double flanged Woltman type according to ISO 4064-1:2014.
  - 9.1.2.3.6 External and internal surfaces of valves and hydrants shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating of minimum thickness of 300µm in accordance with SANS 1217.
- 9.1.2.4 **Brackets**
  - 9.1.2.4.1 Supporting brackets and frames shall be fabricated from mild steel Grade S355JR in accordance with BS EN 10025 unless otherwise shown on the drawings.
  - 9.1.2.4.2 All mild steel elements shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45. Sherardizing shall take place after fabrication of the complete element.
- 9.1.3 **Construction**
  - 9.1.3.1 **Trenches and bedding**
    - 9.1.3.1.1 Excavation for pipe trenches and bedding for the pipes shall be in accordance with SANS 1200 DB and SANS 1200 LB respectively.

#### 9.1.3.2 On-Site Storage

- 9.1.3.2.1 The *Contractor* shall be responsible for all materials stored on site until such time that the water main has been tested and handed over to the main *Contractor*.
- 9.1.3.2.2 Pipes should be stored on level ground that is free from stones and sharp objects, and should be so stacked (in a stack of cross formation) that the load on each pipe is uniform throughout its length.
- 9.1.3.2.3 Socketed pipes should be stacked that the sockets are at different ends in each alternate layer and protrude from the stack.
- 9.1.3.2.4 The height of the stack should not exceed 1 m, and pipes of different diameters and class should not be stacked together. Protective packing should not be removed until immediately before use.

#### 9.1.3.3 Electrofusion Welding

- 9.1.3.3.1 All joints and connections shall be done using electrofusion couplings with electro-fusion coupling/welding done in accordance with SANS 10268-2:2004 – ‘Welding of thermoplastics – Welding processes Part 2: Electrofusion welding’.

#### 9.1.3.4 Decommissioning of Existing Pipelines and Temporary Connections

- 9.1.3.4.1 Existing pipeline within the service tunnels that is to be decommissioned shall be drained, dismantled and removed. Dismantled pipe lengths are to be as long as is practicably possible to allow for possible future re-use by the *Employer*.
- 9.1.3.4.2 Existing buried pipelines that are to be decommissioned shall be drained, sealed and abandoned.
- 9.1.3.4.3 The *Contractor* is to provide a methodology after surveying and confirmation of underground tunnel geometry in the work area. The temporary watermain diversion may be located subsurface and by coring through tunnel sides, or above ground with temporary fixings and protection as required, subject to approval by the *Supervisor*.

#### 9.1.4 Testing

- 9.1.4.1 Testing shall be in accordance with SANS 1200L clause 7.
- 9.1.4.2 The pipeline shall be tested between gate valves and pipe termination points at a pressure of 20 Bar.
- 9.1.4.3 Testing shall be undertaken at the completion of each phase prior to handover of each berth.

#### 9.2 Sewer

##### 9.2.1 Supporting Specification

- 9.2.1.1 The governing standard for the sewer raising mains shall be SANS 1200L as amended and added to below. Other sewer related infrastructure shall be in accordance with SANS 1200 LD.

##### 9.2.2 Materials

###### 9.2.2.1 Pipes, Couplings and Fittings

- 9.2.2.1.1 All pipes for water supply be:
  - HDPE PE 100
  - Pressure Class 10
  - Standard Diameter Ratio (SDR) = 11
- 9.2.2.1.2 All couplings are to be PE 100 electrofusion couplings with a Pressure Class of 10.
- 9.2.2.1.3 All pipes and couplings shall conform to ISO 4427:2007 - Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply.

9.2.2.1.4 Fittings shall be ductile cast iron flanged typed in accordance with SANS 1835:2009. External and internal surfaces of all fittings shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating to a minimum thickness of 300 µm in accordance with SANS 1217.

**9.2.2.2 Flanged Connections, Back-up Ring, Bolts and Nuts**

9.2.2.2.1 Flange connections shall comply with SANS 1123 Table 15, drilled to suit mating flanges and shall be installed square to the axis of the pipeline. Reaming of bolt holes to oversize dimensions in order to make a particular piece fit will not be permitted.

9.2.2.2.2 Back-up rings shall be mild steel Grade S275JR to BS EN 10025 coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45.

9.2.2.2.3 Bolts, nuts and washers shall comply with ANSI B16.5 or the relevant sections of SANS 1700 as applicable, in sizes appropriate to the class of pipe or special and of Grade 316 stainless steel. The length of the bolt shall be such that, after the bolt has been tightened, the end of the bolt projects a minimum of one thread above the nut and to a maximum of three full threads.

9.2.2.2.4 All buried flange connections shall be further protected by means of a protective paste / primer (Denso Mastic or similar approved) and then wrapped with two layers of an approved impregnated tape (Denso Tape or similar approved).

**9.2.2.3 Gate Valves and Non-return Valves**

9.2.2.3.1 Gate valves shall be Class 10, double flanged, resilient seal, cast-iron waterworks pattern valves, with non-rising spindles, conforming to SANS 664:2011.

9.2.2.3.2 Non-return valves shall be Class 10, double flanged, swing door checked type, cast-iron with an external lever arm and counter-weight conforming to SANS 664:2011.

9.2.2.3.3 All valves shall be flanged to SANS 1123 Table 15 and shall be fitted with valve caps per SANS 664.

9.2.2.3.4 The direction of closing shall be CLOCKWISE and clearly indicated on the valve body.

9.2.2.3.5 External and internal surfaces of valves shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating to a minimum thickness of 300 µm in accordance with SANS 1217.

**9.2.2.4 Brackets**

9.2.2.4.1 Supporting brackets and frames shall be fabricated from mild steel Grade S355JR in accordance with BS EN 10025 unless otherwise shown on the drawings.

9.2.2.4.2 Valve straps shall be stainless steel grade 316L to ASTM 240/A 240M – 04a.

9.2.2.4.3 All mild steel elements shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45. Sherardizing shall take place after fabrication of the complete element.

**9.2.2.5 Concrete**

9.2.2.5.1 All concrete work for the sewer pump stations shall be in accordance with specification 1785-CO-000-C-SPC-0001.

**9.2.3 Plant**

9.2.3.1 Foul sewer pump manhole

9.2.3.1.1 Each foul sewer pump manhole shall be equipped with 2 Robot DWP4 - 32 BR submersible sewage pumps with 10 m cable for D.O.L. starting Klixons and Probes included.

9.2.3.1.2 The pumps shall be supplied with:

- 100 mm diameter wire embedded rubber pulp and slurry pipe (length dependent on sump depth) fitted with quick release coupling.

- Mercury operated float switches.
- Electrical control panel housed in waterproof free standing kiosk, manufactured from 3CR12 and housing all required associated electronics.
- Flashing alarm light and screen.
- Stainless steel lifting chains.

9.2.3.1.3 The electrical supply to the kiosk will be by Others.

9.2.3.1.4 The pump shall be commissioned in accordance with the Supplier's recommendations.

#### **9.2.4 Construction**

##### **9.2.4.1 Trenches and Bedding**

9.2.4.1.1 Excavation for pipe trenches and bedding for the pipes shall be in accordance with SANS 1200 DB and SANS 1200 LB respectively.

##### **9.2.4.2 On-Site Storage**

9.2.4.2.1 The *Contractor* shall be responsible for all materials stored on site until such time that the water main has been tested and handed over to the main *Contractor*.

9.2.4.2.2 Pipes should be stored on level ground that is free from stones and sharp objects, and should be so stacked (in a stack of cross formation) that the load on each pipe is uniform throughout its length.

9.2.4.2.3 Socketed pipes should be stacked that the sockets are at different ends in each alternate layer and protrude from the stack.

9.2.4.2.4 The height of the stack should not exceed 1m, and pipes of different diameters and class should not be stacked together. Protective packing should not be removed until immediately before use.

##### **9.2.4.3 Electrofusion Welding**

9.2.4.3.1 All joints and connections shall be done using electrofusion couplings with electro-fusion coupling/welding done in accordance with SANS 10268-2:2004 – Welding of thermoplastics – Welding processes Part 2: Electrofusion welding.

##### **9.2.4.4 Decommissioning of Existing Sewer Pipelines**

9.2.4.4.1 Location of existing pipelines are to be verified by the *Contractor* on site prior to commencement of demolition works.

9.2.4.4.2 Existing pipelines that are located within the service tunnels that are to be decommissioned shall be flushed, drained, dismantled, removed and disposed of by the *Contractor* at a registered disposal site of the *Contractor's* choice.

9.2.4.4.3 Existing buried pipelines that are to be decommissioned shall be flushed, drained, sealed and abandoned.

#### **9.2.5 Testing**

9.2.5.1 Testing shall be in accordance with SANS 1200L clause 7.

9.2.5.2 The pipeline shall be tested between gate valves and pipe termination points at a pressure of 12.5 Bar.

9.2.5.3 Testing shall be undertaken at the completion of each phase prior to handover of each berth.

#### **9.3 Stormwater Drainage**

##### **9.3.1 Supporting Specification**

9.3.1.1 The governing standard shall be SANS 1200LE – Stormwater Drainage as amended and added to below.

### 9.3.2 Materials

#### 9.3.2.1 Pipes

- 9.3.2.1.1 The storm water pipes shall be class 100D precast reinforced concrete pipes conforming to SANS 677 with "Spigot and Socket" joints and rubber collars throughout.

#### 9.3.2.2 Filter Fabric

- 9.3.2.2.1 The filter fabric to be used to wrap pipe joints shall be per the filter fabric specified in specification 1785-CO-000-C-SPC-002 for the caisson joints.

#### 9.3.2.3 Connection to Caisson

- 9.3.2.3.1 The storm water pipes shall be connected to the caissons using a flexible connector to allow for hinging due to settlement of the back fill.
- 9.3.2.3.2 The connector shall be proprietary type Z.LOK STM or similar approved.
- 9.3.2.3.3 The connector shall be in accordance with ASTM C-923-08(2013) - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

#### 9.3.2.4 Prefabricated Chambers and Shafts

- 9.3.2.4.1 The types of manholes to be constructed are indicated on the drawings. No masonry manholes are permitted.

#### 9.3.2.5 Slot Drains

- 9.3.2.5.1 Slot drains shall comprise of a precast concrete top set on a cast in-situ reinforced concrete base on a bed of mortar in accordance with the drawings.

#### 9.3.2.6 Concrete

- 9.3.2.6.1 All concrete work for the slot drains and storm water manholes shall be in accordance with specification 1785-CO-000-C-SPC-0001.

### 9.3.3 Construction

#### 9.3.3.1 Joints

- 9.3.3.1.1 The caisson connector shall be installed strictly in accordance with the supplier's specification.
- 9.3.3.1.2 All joints are to be wrapped with filter fabric.

#### 9.3.3.2 Decommissioning of Existing Stormwater Pipelines

- 9.3.3.2.1 Existing stormwater manholes and pipes located at Berth 205 requiring demolition for the completion of *works* associated with reclamation shall be demolished as required and made good after completion of the reclamation *works*.

#### 9.3.3.3 Management of Stormwater during Construction

- 9.3.3.3.1 The existing storm water system will remain operational as far as possible during construction. Switch-over from existing to newly constructed facilities to be assessed and approved by the *Contractor* and *Supervisor* respectively after completion and acceptance of the *works* by the *Supervisor*.

## 9.4 Tunnel Dewatering System

### 9.4.1 Plant and Materials

#### 9.4.1.1 Sump Pumps

- 9.4.1.1.1 Two types of sump pumps are to be supplied and installed at the positions shown on the drawings.
- 9.4.1.1.2 The three phase pump shall be Type FLYGT - BS 2071.010 or similar approved.

- 9.4.1.1.3 The single phase pump shall be Type FLYGT – BS 2008.212 (Ready 8 MT 1)
- 9.4.1.1.4 Pumps are to be supplied with automatic controls with float switches in combination with magnetic starter type controls.
- 9.4.1.1.5 The electrical supply to the pumps will be by Others.
- 9.4.1.1.6 The pump shall be commissioned in accordance with the Supplier's recommendations.

**9.4.1.2 Pipes and Couplings**

- 9.4.1.2.1 All pipes for water discharge be:

- HDPE PE 100
- Pressure Class 10
- Standard Diameter Ratio (SDR) = 11

- 9.4.1.2.2 All couplings are to be PE 100 electrofusion couplings with a Pressure Class of 10.

- 9.4.1.2.3 All pipes and couplings shall conform to ISO 4427:2007 - Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply.

**9.4.1.3 Steelwork**

- 9.4.1.3.1 Supporting brackets, frames and plates to the sump shall be fabricated from mild steel Grade S355JR in accordance with BS EN 10025 unless otherwise shown on the drawings.

- 9.4.1.3.2 All mild steel elements shall be coated with a zinc coating applied by thermo-diffusion coating (Sherardizing) in accordance with BS EN 13811:2003 Class 45. Sherardizing shall take place after fabrication of the complete element.

**9.5 Electrical Cable Ducts**

**9.5.1 Supporting Specification**

- 9.5.1.1 The governing standard shall be SANS 1200LC – Cable Ducts as amended and added to below.

**9.5.2 Materials**

**9.5.2.1 Buried Cable Ducts**

- 9.5.2.1.1 Buried ducts shall be HDPE ducts to SANS 61386-24 (Resistance to compression - Type 450N, Resistance to impact- Normal, Resistance to bending - Rigid) with sleeve type couplings.

- 9.5.2.1.2 All ducts shall be installed with draw wires. Polyester yarn with a minimum breaking strength of 400 kg or galvanised wire (nominal diameter 2.5 mm) shall be used as a draw wire.

**9.5.2.2 Concrete**

- 9.5.2.2.1 All concrete work for the slot drains and storm water manholes shall be in accordance with specification 1785-CO-000-C-SPC-0001.

## **10.0 REMEDIAL WORKS FOR EXISTING CAPPING BEAM AND SERVICE TUNNELS**

### **10.1 Scope**

10.1.1 Repairs and remedial works to the existing capping beam and service tunnels include the following:

- Sealing existing abandoned anchors and chambers
- Sealing existing crane rail slots
- Sealing existing busbar tunnels
- Extending/raising various existing tunnel access points, pipe slots and cable slots

### **10.2 Materials**

10.2.1 Where shown on the drawings, hydraulic, cementitious non-shrink grout shall be used for sealing slots and small voids.

10.2.2 Cementitious grout shall be in accordance with ASTM C1107/C1107M - 14a - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

10.2.3 Concrete and steel shall be as specified in 8.1 above.

### **10.3 Construction**

10.3.1 Where existing steel chambers are to be filled with mass concrete or non-shrink grout, the steel surface is to be cleaned with an approved de-greasing agent and wire brushed prior to filling.

10.3.2 Where crane rail slots and concrete chambers are to be filled, the concrete surface is to be scabbled to expose the aggregate and cleaned to remove all loose particles and dust. A wet to dry epoxy shall be applied to the surface prior to filling.

10.3.3 The existing busbar tunnels shall be closed in accordance with the details shown on the drawings. The existing steel covers shall be recovered and delivered to the *Employer's* store.