BALTIC HUB T5 OFFSHORE WIND TERMINAL PROJECT

Technical Volume 2

Part 2.1 Employer's Requirements
Section 3 - Civil and Marine Works

Client: Istrana

Reference: PC1063-RHD-T5-ZZ-RP-PM-0003
Status: S3/P06
Date: 23 January 2024

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Document title: Technical Volume 2

Document short title: Part 2.1 Employer's Requirements
Reference: PC1063-RHD-T5-ZZ-RP-PM-0003
Status: P06/S3
Date: 23 January 2024
Project name: Baltic Hub T5 Offshore Wind Terminal Project
Project number: PC1063
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Date: 23/01/24

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Date: 23/01/24

Classification
Restricted

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3 MARINE AND CIVIL WORKS

3.1 GENERAL

In the following text the Employer's Requirements for particular elements of the Marine and Civil Works are set out as follows:

- Work Scope
- Materials/Function
- Definition
- Design
- Workmanship
- Surveys and Testing/Monitoring

The layout of this document is intended to provide a progressive approach to achieving the required finished product, and all items within each section shall be taken into account both individually and in combination.

It shall be noted that notwithstanding any descriptions given in the following sections the Contractor shall allow for all clearance, demolition, dredging, excavation, piling through, ground treatment in, removal and disposal off site of any material encountered, together with any additional site investigation that the Contractor considers necessary for his chosen design.

For the avoidance of doubt, "any material" means any material of any nature whatsoever (whether the same be naturally occurring or manmade) which may be encountered during or otherwise affect the execution of the Works including (without limitation) polluted materials, mud, silt, sand, clay, rock, boulders, corestones, vessel, car or other wrecks, chains, anchors, cables, existing structures and services, bombs or shells.

In executing the Works the Contractor is deemed to have allowed for all necessary measures to overcome all Site-found conditions including, but not limited to, modifications and substitutions in labour, Contractor's Equipment, methodology, sequencing and the like in respect of Temporary and Permanent Works.

3.2 T5 TERMINAL LAYOUT

The Terminal T5 development project involves further dredging and land reclamation to the north-east of the existing Terminal T1. The Terminal T5 development will increase the overall footprint by 21.5 hectares and will operate initially as an Offshore Wind Supply Base (10 – 15 years), before being converted into a container terminal.

The layout of Terminal T5, as shown on the Layout Drawing PC1063-RHD-T5-OW-DR-Z-1200 has been developed by the Employer and no changes shall be made to the arrangements and dimensions shown. For the avoidance of doubt this shall include, but not be limited to, the following elements:

- Overall investment boundary and extents of Terminal T5.
- Environmental Decision Boundary.
- Minimum dredging extents for vessel berthing alongside the quay (berth pocket) and vessel navigation.
- Overall length of quay and berthing line.
- Finished pavement/surface levels and minimum/maximum slope gradients.

3.3 SITE CLEARANCE AND DEMOLITION

3.3.1 WORK SCOPE

It is the Contractor's responsibility to visit the site, make themselves familiar with any elements that need to be demolished and to include for any structures he considers need to be demolished to construct the Works or may have been overlooked in the preparation of the Contract Documents.

The demolition and site clearance works include, but are not limited to, the following;

- Demolition and clearance of dolphin and walkway to the north of Terminal T1 (Demolition of this dolphin to be programmed as late as possible, so that it can remain operational for Terminal T1 during construction).
- Part of the T1 wave wall as shown on the Drawings
- Approximately 20m of the T3 Northern Return Wall as shown on the drawings.
- Clearance and disposal of any debris and the like prior to construction, including reclamation, and the route of dredging discharge water channels and settlement lagoons;
- Demolition and removal of miscellaneous areas of paving, kerbing, crest wall, service chambers, plinths, and the like at the interface with the existing Terminal 1 as shown in the Disclosed Data;
- Redundant services shall be removed or fully grouted with cement/ PFA mixture where approved by the Engineer. For the avoidance of doubt, this includes stopping up with concrete plugs pipelines at the boundary of the Site where they are to remain in place outside of the Site.

The Contractor shall obtain all the required permits, decisions, arrangements, and opinions, in particular regarding demolition works or demolished elements.

3.3.2 FUNCTION

Areas of existing paving, kerbing, crest wall etc. are to be demolished as necessary to allow construction of the Works at the interface with the existing Terminal T3 and Terminal T1.

3.3.3 DEFINITION DIMENSIONS

The extent of the demolition works shall be determined by the Contractor based on the as-built drawings included in the Disclosed Data and the Drawings. Additional demolition and clearance required to enable construction of the Works but not shown in the Disclosed Data shall be carried out by the Contractor at no additional cost.

Where piles or structures conflict, with services, drains and the like, the piles or structures shall be demolished to a lower level to avoid conflict, and to provide a minimum vertical clearance of 1.0m to the invert of services, drains or underground chambers.

3.3.4 DESIGN METHOD

The Contractor shall examine all available drawings of structures to be demolished and thoroughly survey the structures to ascertain construction details and to determine the method of demolition to be used. The

Contractor shall submit detailed method statements and analyses to the Engineer before commencement of the demolition works.

Demolition shall not begin until consent has been given to the Contractor's proposed method for demolishing the entire structure.

3.3.5 WORKMANSHIP

All demolition work shall be carried out in accordance with the codes of practice and standards approved by the Engineer (referenced in Section 2 of the Employer's Requirements), including any relevant Polish Standards and Local / Municipal Guidelines. Attention shall be paid to the safety of Port workers, etc. and the provisions of fencing, barriers and signs for this purpose.

In undertaking demolition and Site clearance works, the Contractor shall comply with all environmental legislation and regulations applicable to the works, including that the debris/waste materials are disposed only to approved dumping sites.

Particular care shall be taken with regards to the safe and proper demolition and disposal, as required by existing regulations, of hazardous waste/materials.

The Contractor shall place particular emphasis on the recovery and re-use of construction materials arising from the site clearance and demolition. All hard, clean, non-organic, non-deleterious inert materials arising from the demolition works, such as concrete and paving blocks shall be retained on Site wherever feasible. Such materials shall only be crushed to an appropriate grading for use as capping/sub-base/fill, and for no other purpose, unless consented otherwise by the Engineer. These processes shall require the materials to be stored on Site until they can be re-used. The Contractor shall make appropriate provisions for the storage of this material.

The Contractor shall safely identify, disconnect and remove electricity, water, telephone, and communications services and any other obsolete installations prior to demolition and/or alterations, or relocation work. This work shall not compromise the delivery of these services from and to other parts of the Port including those parts of the Site which are to remain operational during phasing of the Works.

The Contractor shall mark and protect existing services that are to remain or are to be extended. Drains that are still in use shall be protected, ensuring that:

- Manholes, gullies, etc are not damaged
- Manholes, gullies, drains are kept clear of debris, waste and loose material coming from the site at all times;
- Any damage caused during demolition operations is made good and drains are left in a clean and working order.

All material coming from demolition works shall be removed from the Site (including onshore and offshore areas). If this material is to be used for the Works, it requires the approval of the Engineer.

Arrangements shall be made for dealing with storm-water flows emanating from the existing site and other areas of the Port that are affected by the Works (such drains may require temporarily extending through fill or other areas pending completion of other parts of the Works).

All reinforcing steel and structural steel and other metallic components shall be disposed of off-site.

3.4 QUAY AND RETAINING WALL STRUCTURES

3.4.1 WORK SCOPE

The scope of work includes in particular the quay and retaining wall structures, provision for OWSB operations, provision for future STS quay crane rails and associated fixtures and fittings, provision for future crane cable slots and protective coverings, cable and other services pits, fendering, mooring bollards, ladders, life-saving equipment, navigation aids and the like.

All elements of Works not specified directly in the Employer's Requirements or/and in other Contract Documents, but necessary to execute the Employer's Requirements shall be considered as included in the Contractor's Scope of Works.

The Contractor shall obtain all necessary decisions, arrangements, and opinions for the Works.

3.4.2 FUNCTION

The main outbound quay structure and fittings are required to:

- Provide for safe berthing and mooring of the largest OWSB vessels in the range 5,000 DWT to 21,500 DWT and provision for container vessels in the range of 1,000 DWT to 250,000 DWT when the terminal is converted to handle containers.

- Provide access for vessel berthing and mooring operations, in particular furnish the quay with all required elements such as bollards, fenders, life-saving equipment, ladders and berthing aid system (BAS);

- Provide access for supplying stores to vessels as well as potable water bunkering;

- Provide access for emergency vehicles, and emergency escape routes;

- Incorporate the same facilities, pits, ducts, cable slots and manholes for the following:
    - Potable water
    - Fire-fighting system and fire hydrants (preferred system is based on sea water)
    - LV power supply for pumps and lights
    - MV power supply for, OWSB equipment cable pits and their fittings, in particular connectors and cable couplers in accordance with the manufacturer's manual, power supply for heaters, lights and pumps in the cable pits as well as other required plant and fittings, and MV power supply, including plant and cable connections with safety interlocks between cable pits and substation.
    - MV "cold ironing" cable pits (pits only)
    - Provision for future STS crane STS Pits
    - Provision of a fixed buried fuel bunkering pipe and bunkering pits.

- Facilitate the fitting of all required covers,

- Provide for drainage of the quay and incorporate drainage outfalls as required
- Provide adequate lighting levels and markings/signage for safe operations over the quay, and low voltage power supplies

The main inbound quay structure and fittings are required to:

- Provide for safe berthing and mooring of the largest OWSB supply vessels in the range 8,500 DWT to 14,387 DWT
- Provide access for vessel berthing and mooring operations, in particular furnish the quay with all required elements such as bollards, fenders, life-saving equipment and ladders
- Provide access for emergency vehicles, and emergency escape routes;
- Incorporate the same facilities, pits, ducts, cable slots and manholes for the following:
    - Fire-fighting system and fire hydrants
    - LV power supply for pumps and lights
    - MV power supply for, OWSB equipment cable pits and their fittings, in particular connectors and cable couplers in accordance with the manufacturer's manual, power supply for heaters, lights and pumps in the cable pits as well as other required plant and fittings, and MV power supply, including plant and cable connections with safety interlocks between cable pits and substation.
- Facilitate the fitting of all required covers,
- Provide for drainage of the quay and incorporate drainage outfalls as required
- Provide adequate lighting levels and markings/signage for safe operations over the quay, and low voltage power supplies

Eastern interface wall structures are required to:

- Retain fill in the reclaimed/filled area behind the quay structure;
- Support a crest wall protecting terminal areas from wave overtopping to within allowable limits, and acting as a vehicle restraint barrier.

The Ro-Ro Berth is required to:

- Provide a safe berthing and mooring facility by the installation of piled dolphin structures in the location indicated on the Layout Drawings to allow for Ro-Ro Vessels up to 9,000dwt.
- Provide access and egress to the dolphin platforms for staff to operate the mooring equipment.
- Provide adequate lighting levels and markings/signage for safe operations over the dolphins, and low voltage power supplies.

3.4.3 STRUCTURAL FORM

The quay and retaining wall structures shall be designed by the Contractor and submitted to the Engineer for approval. The Contractor is responsible for the design, arrangements and all relevant decisions, including in particular statutory decisions.

The quay and retaining wall structures shall be fit for its purpose and take account of, in particular, all the loads and structure durability and operational activities of the Employer.

The quay structure shall be of uniform construction method over its length. Whatever form of construction is used, the back-filled material and the underlying ground, shall be improved to the required consolidation parameters to reduce the effects of settlement.

The Contractor shall remove silt as necessary during the construction of the quay structures prior to back-filling with approved material.

The quay structure shall be designed to accommodate movements arising from berthing and mooring loads and environmental conditions and shall:

- Permit uninterrupted passage of terminal vehicles across the width of the quay;
- accommodate the safe operations of all OWSB equipment and operational loads
- permit the smooth transition to the future container terminal operations and STS crane installations without the need for any unnecessary abortive and post OWSB demolition of installed structures.
- Apply solutions that shall enable integration of the T4 developments in the future without significant demolitions

3.4.4 DESIGN DIMENSION AND LAYOUT

The requirements for the quay and retaining wall structures, and associated fixtures and fittings, shall be as specified in the Employer's Requirements and as shown on the Layout Drawings. The Contractor shall abide by the dimensional and setting out requirements as shown in these Employer's Requirements where mentioned.

3.4.5 DESIGN METHOD

The quay and retaining wall structures, and any other associated elements, shall be in compliance with existing law, obtained permits, decisions and opinions, including the codes of practice and standards approved by the Engineer.

Effects on submerged structural elements, in particular hydrodynamic effects in retained ground and on submerged faces shall be fully accounted for in the design.

Foundation structures shall be designed according to best modern practices and in accordance with the codes of practice and standards approved by the Engineer.

Where piped services, cable runs and ductwork enter or pass through the quay structures the Contractor shall allow for the effects of twice the permissible settlement.

3.4.6 FENDERS

Fenders shall be installed in accordance with the manufacturer's recommendations/ instructions, from the installation of cast-in sockets to the final tensioning of fixing chains (if any).

Fender panel shall not to extend above the cope level. Chamfers to be provided on four sides of the panel. Fender panel in one piece - assembly of the steel panel from several elements is not allowed.

Fenders shall be manufactured using materials to relevant ISO and ASTM standards as approved by the Engineer and tested in accordance with the requirements of PIANC WG 33 and ASTM or other appropriate standards as approved by the Engineer.

All weigh and load chains (and shear chains if applicable) should be equipped with chain tensioners.

Fender steel panels made as a single plate – fixed panels made of segments are not allowed.

Anchoring points on the cap (cones, chains) should be done using the same template allowing replacement between different fenders without any modifications.

All bolted connections (cones, spools, chains, chain tensioners, front panel pads) should be protected against self-loosening.

The surface onto which the fender rubber is fixed shall be vertical, flat and continuous to provide full bearing for the area of the fender rubber.

Tolerances on fender panel installations shall be compatible with tolerances on concrete structures to which they are affixed. In no circumstances shall fenders be installed to dimensions which exceed the tolerances stated herein.

Fender alignment shall be such as to provide, with recommended tolerances, a straight line parallel with the berthing face.

Individual fender panel installations shall meet the required tolerances for position (relative to the specified level for the top of the unit), and for verticality (measured at the four corners of the fender panel in planes both parallel to and perpendicular to the berthing face).

A suitable fender system shall be selected to absorb the design berthing energy. The fender design reaction force and energy shall consider the following:

- Manufacturer's tolerances
- Velocity factors as suggested by the manufacturer
- Temperature factors as suggested by the manufacturer
- Angular performance due to bow flare, bow radius and berthing angle
- Energy sharing between fenders may be considered depending on the vessel geometry

Fender installation tolerances shall be:

- Position (top level of the unit) ± 25mm
- Alignment (at centre line of rubber cell) ± 30mm
- Verticality (elevation and sectional) ± 25mm
- Equal distance between fenders of max 15m

All fenders shall have a 10-year warranty

3.4.7 BOLLARDS AND OTHER QUAY FURNITURE

The Contractor shall design and construct mooring bollards to be installed along the capping beam, spaced at equal intervals no greater than 15m and with a 200-tonne minimum capacity.

The Contractor shall design and construct bollards in accordance with the codes of practice and standards approved by the Engineer. As part of the Contractor's execution design, they shall carry out a dynamic mooring analysis (DMA) and other associated calculations to verify the capacity requirements for the bollards, expected downtime at the berth and any mitigation measures that may need to be implemented by the Employer to ensure safe mooring of the design vessels. The scope of the DMA study shall be provided in advance for the approval of the Engineer. The scope of the DMA shall be as per Section 3.4.8.

Bollards and the quay surface immediately to seaward of each bollard shall be clearly marked with sequential numbers starting at '1'. Marking types, starting point, details, and materials to be approved by the Engineer.

Emergency escape ladders shall be installed against the quay wall, spaced evenly at no greater than 30m centres. Ladders to extend 1m below design low water level. The ladders are to be recessed so as not to protrude beyond the cope line and protected by vertical bollards to allow safe evacuation. Ladder handgrips shall be provided at deck level in a way to avoid ropes snagging.

The 2 No. most north easterly existing bollards on Terminal T1 shall be retained and operational throughout the construction period.

3.4.8 DYNAMIC MOORING ANALYSIS

The Contractor shall undertake a DMA, with the following scope:

1. **Goal of the study**
   A clear goal of the study must be described.

2. **An overview of the software package(s) and their theoretical basis**
   An overview of the proposed software to be used must be presented. Generally accepted DMA software packages include, but are not limited to, aNySim and OrcaFlex. To ensure proper hydrodynamic analysis (vessel hydrodynamic input files), these packages are usually combined with diffraction software (e.g. Diffrac, Aqwa). In case a lesser-known software package is used, additional documentation regarding the theory and application of this software as well as project references of the use of this software must be provided for approval of the Engineer.

3. **An overview of the vessel characteristics**
   The vessels which are to be modelled must be indicated and all relevant parameters must be provided. This information must include general dimensions, wind areas, draughts, displacements, stability parameters and deck plan information (such as positions of winches, fairleads, mooring bits and pedestal fairleads). When unavailable, relevant assumptions must be made and supported.

4. **An overview of the typical mooring configuration for the vessels**
   A realistic choice of mooring line configuration must be made. For large container vessels, simply filling out IACS equipment number formulas does not result in a realistic choice of the number of mooring lines (current 24,000 TEU container vessels already typically use 16 mooring lines).

   The following information must be incorporated:
   - Line Minimum Breaking Load (MBL)
   - Line material and the load elongation curve that will be used

- If tails are applied, these should also be specified
- Proposed pre-tension for the mooring lines.
- A top view of the moored vessel highlighting which lines connect to which bollard, fairlead and winch
- Please also enclose an overview of the bollard and fender positions and specifications as determined in the design.
- For all above, a motivation for the choices that have been made

5. **Overview of safe mooring and operations criteria**
   An overview must be presented of the criteria below which the vessel is considered to be safely moored at the quay. This includes maximum fender deflections, maximum line forces and maximum bollard forces. Additionally, moored vessel motions must be checked against operational thresholds/criteria as to determine expected operational downtime. All choices must properly motivated.

6. **An overview of the environmental conditions which are to be considered**
   To ensure the design meets the Employer Requirements and to give the required downtime insights, the influence of multiple wind, wave and current conditions must be assessed. An overview of the planned simulations along with a proposed methodology for the downtime determination must be provided.

3.4.9 NAVIGATION AIDS

Navigation aids shall include lights or lighted beacons designed to provide safe access of vessels to and from the new berth, complying with and located in accordance with the requirements of the regulatory authorities, which shall include the Employer.

Navigation lights may be solar or battery powered with automatic bulb changing (min 5 bulbs). Batteries (6V or 12V) shall have a minimum life expectancy of 10 years.

Yellow pulsating navigation lights to be provided at either end of the T5 quay.

The Contractor shall submit to the Engineer for final approval all details of navigation aids to be supplied under the Contract together with copies of written approvals from the relevant authorities regarding the locations, colours and lamp flash characteristics of the proposed navigation lights.

3.4.10 BERTHING AID SYSTEM

The Contractor shall design, procure and install a berthing aid system (navigation monitoring system) to monitor the berthing velocity of vessels approaching the quay and water currents in accordance with, in particular, the regulation of the Ministry of Transport and Maritime Economy of 1 June 1998 on the technical specifications, which marine structures and their location shall comply with. The system shall allow the real time monitoring and visual display of the berthing velocities by the ship’s pilot and captain.

The IT system shall allow the recording of the monitoring system data which shall be accessible on a daily basis.

System should be automated – start and stop of vessel monitoring should take place automatically. System should provide immediate information/alarm in case of any incident like exceeding the permissible vessel approach velocity.

Laser chambers should be designed to provide no obstacle on mooring path.
All the BAS equipment should be designed/protected in a way to ensure failure-free operation also in winter conditions (icing, low temperatures).

Reference shall be made to Section 2 of these Employer's Requirements for the location of the measurement lasers and display boards to be provided. The Contractor shall submit to the Engineer for final approval all details of the berthing aid system to be supplied under the Contract.

3.4.11 MATERIALS

The Contractor shall carry out all concrete and steelwork in accordance with the Employer's Requirements outlined in Sections 3.12 and 3.13, and the Contractor's specification to be approved by the Engineer.

3.4.12 FIXINGS FOR QUAY FITTINGS

All fixings for quay fittings, including fenders and fender facings, but excluding fender chains and bollards, shall be stainless steel according to the existing standards. Anchorages to fixings, other than fender chain anchorages, shall comprise either:

- Cast-in stainless steel sockets and all accessories, washers and the like, (grade A4-80); or
- Proprietary resin sockets with integral encapsulated stainless steel nuts and all accessories, washers and the like (grade A4-80); or
- Stainless steel (grade A4-80) threaded studs and all accessories, washers and the like, polyester-resin-grouted into percussion-drilled holes and all accessories, washers and the like.

Fender chains and associated fixings and anchorages shall be hot-dip galvanized with a minimum zinc thickness of 150 microns.

All fixings shall be fitted with isolation washers where connections are made to dissimilar metals.

3.4.13 SEABED REINFORCEMENT AND PROTECTION

The berthing pocket for the T5 outbound quay shall be designed to remove soil risk and avoid operational limitation so that the jack up spud legs of the WIVs do not penetrate into the native seabed soil by more than 1m. To achieve this, the Contractor is to assess the requirement to remove all unsuitable soil from the sea bed and replace the material with suitable fill and treated to meet the Employer's Requirements. As an alternative option the Contractor shall also assess and design for the installation of a rock mattress to protect the berthing pocket to meet the Employer's Requirements. The Contractor shall provide a provisional sum in the Pricing Schedule to cover for the option of installing the rock protection over the Outbound Quay Berthing area in order to have controlled jacking conditions for the WIVs whilst alongside the Outbound berth and to limit the leg penetration to 1m maximum for a loading of 100t/m2. The purpose-made rock bed to limit the leg penetration must consider that any rockfill or stone-bed shall not be placed higher than -17.42mEV (-17.5mKR), and that the design depth, if lower than -18.92mEV (-19.0m Kr), has to be considered.

The quay wall shall also be designed for a maintained dredge level of -17.5m Kr with an additional allowance for dredging tolerances and any scour protection requirements determined by the Contractor in accordance with requirements outlined in Section 2 Design Criteria.

The return structures shall also be designed to the maintained dredge level to be determined by the Contractor with an additional allowance for dredging tolerances and any scour protection requirements determined by the Contractor. It is preferred that not loose rock protection shall be required and the design of the quay wall and return structures shall be self-sufficient to prevent undermining due to scour.

Dredged side slopes shall also be designed to be stable under the action of waves, ship wash, currents and propeller and bow-thruster scour, to ensure both short term and long-term conditions do not undermine the stability of the quay and return structures.

3.4.14 OVERTOPPING REQUIREMENTS

The crest of the quay structure shall be configured to limit wave overtopping. Overtopping limits under operational and extreme conditions are selected to:

1. allow operational activity to the quay,
2. prevent damage to the crest,
3. prevent damage to the quay paving.

Overtopping limits for the quay are defined at the useable boundary line as follows:

Table 3-1 Wave overtopping limits for the quay crest

Condition	Overtopping Limit [l/s/m]	Reason for Limit
Operational (1 year)	< 1	To allow operations to continue in the lee side of the quay
Extreme (100 year)	<10	To limit damage to paving

The proposed maximum allowable wave overtopping discharge rates at the quay wall are based on the recommendations of the EurOtop manual [33]

3.5 MOORING DOLPHINS

3.5.1 WORK SCOPE

A berth for Ro-Ro vessels shall be designed and constructed as shown on the Layout Drawings. The Ro-Ro berth is to be provided in the form of a series of piled berthing and mooring dolphins.

3.5.2 FUNCTION

The dolphin structures are isolated structures or strong-points used to berth and moor the design OWSB vessels.
The dolphins are designed to take the berthing impact of the design vessel and to hold the vessel against the action of wind and current loads. The dolphins shall also be designed for mooring the design vessels by the installation of mooring bollards on the top of the dolphin platform.

3.5.3 STRUCTRAL FORM

Dolphins can be designed structurally as flexible dolphins or rigid dolphins. Flexible dolphins shall comprise only vertical piles built into a concrete cap or braced frame and deck whereas a rigid dolphin comprises a group of raking piles, with or without vertical piles, connected to a concrete cap. The flexibility of the structure should be considered in relation to the soil conditions, its function and type of operations to be carried out at the berth.

For flexible dolphins, the soil conditions shall be assessed by the contractor, and he shall satisfy himself that the existing soil conditions can be capable of providing fixity with a reasonable embedded length. There shall be no permanent deflection after application of a berthing load.

For flexible dolphins, berthing loads applied at the corner of the structure will result in torsion. The torsion may be reduced by judicious positioning of the fenders or be made use of by providing torsional strength in the piles to increase energy absorption. The piles, however, shall be adequately embedded to obtain adequate lateral and shear resistance.

For rigid dolphins, the rake of the piles should be as large as possible for maximum efficiency in resisting lateral loads. However, raking piles shall not project into locations where they may be struck by vessels.

Where down drag on the raking piles may occur due to soil settlement, the resulting stresses set up in raking piles may be very large and should be taken into account in the pile design. The elastic centre of the pile group should lie as close to the resultant applied load as possible to reduce the likelihood of rotation and torsional loading on the pile. If the applied load induces a considerable moment about the elastic centre of the pile group, pile axes should preferably be arranged so that they intersect in groups at least at two locations on plan which should be as widely spaced as possible. The resultant applied load should pass between these locations.

Fenders must be provided at berthing dolphins, but fenders shall also be provided at mooring dolphins to avoid damage from accidental impact.

The deck level of all dolphins shall not be higher than +3.08m EV and not lower than +2.58m EV

3.5.4 Access Walkways

Steel access walkways shall be provided from the landside of the terminal to the dolphins. They shall be positioned to avoid damage by vessels. The dolphins shall also be equipped with access ladders on a face away from berthing vessels. Dolphins should be provided with a platform of adequate working space for operational and maintenance purposes. A clear space should be left at the ends of walkways and heads of ladders. Railings and fences should be provided as appropriate. The type of installations on dolphins, such as navigation lights, should be agreed with the Port Authority.

3.6 DREDGING

3.6.1 WORK SCOPE

Dredging works shall be carried out to provide the minimum navigable areas as shown on the Layout Drawings.

There are 2 different scenarios regarding the dredging at the berths. In the 1st scenario, where a rock blanket, or stone bed is required to maintain controlled jacking conditions and to limit the leg penetration of the jack up vessels, then the level of the top of surface of the rock blanket should be maintained at -17.42m EV. Thus, any future dredging below the rock blanket, or stone bed during the operation of the berth for the container terminal shall be avoided by the dredging of the existing seabed down to the required levels to install the thickness of the rock mattress as designed by the Contractor. However, the final level of the rock mattress cannot be higher than -17.42mEV or lower than -18.92m EV.

Alternatively, the 2nd scenario is applicable if the contractor confirms that a rock blanket alongside the seabed adjacent to the outbound berth is not required for the operation of the OWSB berth. In this case, no additional dredging it is required for the operation of the OWSB berths.

The dredging spoil that is suitable for back-filling may be used for the reclamation works and any unsuitable material shall be removed to a disposal site.

The existing terminal shall be fully operational for the whole period of the Works. Any obstruction, interference, lack of access to the existing terminal shall be agreed with the Engineer and the Employer a minimum of 14 days prior to their occurrence.

All elements of Works not specified directly in the Employer's Requirements or/and in other Contract Documents, but necessary to execute the Employer’s Requirements shall be considered as included in the Contractor’s Scope of Works.

The work scope shall entail:

- Designing, agreeing on and obtaining all necessary decisions, opinions, consents and permits for the dredging works to the extent necessary.
- Dredging and reclamation works together with the dredging of the seabed slopes in the basin.
- The removal of all materials of any nature in the dredging area adjacent to the new quay wall and navigation areas, to the lines and levels required by the design and shown on the Layout Drawings, and the construction of stable side slopes.
- The Contractor shall determine the stable slope length at the western end of the quay to accommodate the change in levels whilst maximising the length of the berthing pocket dredged to the required maintained dredge level.
- The removal of all contaminated materials, and/or material unsuitable for back-filling, in particular, in accordance with the requirements of the soil contamination survey, and also in relation to the information included in the report on the impact of the dredging and reclamation works on the marine environment, and any other necessary permits, decisions, approvals and opinions.
- The removal of all unsuitable and/or contaminated materials, within any area as necessary for the functioning of the Contractor’s design (‘unsuitable’ means any materials which are undesirable if left in place and/or which may give rise to unacceptable ground movements, rates of settlement, differential settlements, etc.)

- The removal of the spoil to disposal sites approved by the appropriate authority. In the case of contaminated materials, their disposal shall be carried out in accordance with the existing regulations, standards and requirements of the appropriate authorities.
- The disposal, and the monitoring of the disposal, of dredged material unsuitable for back-filling, to a disposal site shall be carried out in accordance with necessary decisions, permits and opinions issued by relevant authorities and organisational units.
- The dredging and transport of any accumulated unsuitable material or debris, wrecks or the like, that occurs both inside and outside the dredged area as a result of the Contractor's operations, shall be carried out in accordance with the decisions and opinions of relevant authorities, including the decisions and opinions of Regional Curator of Monuments.
- The removal and disposal of any accumulated unsuitable material or debris, wrecks or the like, that occurs outside the Site as a result of the Contractor's operations, shall be carried out in accordance with the decisions and opinions of relevant authorities, including the decisions and opinions of Regional Curator of Monuments.
- The execution of maintenance dredging works as may be necessary to maintain the required seabed levels up to the date of issue of the Final Taking-Over Certificate.

3.6.2 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall provide any necessary designs and make arrangements for obtaining all necessary consents for any design, which shall be subject to the prior written approval of the Engineer.

In addition to the responsibilities stated in the Employer's Requirements Section 1, the following shall also apply.

The Contractor shall comply with all environmental legislation, decisions and regulations applicable to the Works, including that the debris/waste materials are disposed only to approved dumping sites.

The Contractor shall be responsible for ensuring the short- and long-term stability of the dredged slopes and of the adjacent structures in accordance with the design standards and norms set out in the Disclosed Data.
The Contractor shall be responsible for:

- Obtaining all necessary consents, in particular from the Harbour Master, each time he enters the harbour basin and carries out works.
- Dredging works if required, shall be carried out in compliance with the regulations and bye-laws in force within the area of the Port of Gdansk Authority (ZMPG).
- Radio communications in accordance with Section 1 of these Employer's Requirements;
- Harbour Dues and Pilotage, and other costs regarding manoeuvring of the vessels within the area of the port.
- Records of dumping at sea in accordance with the decisions, arrangements and opinions of relevant authorities, including, in particular, Maritime Office in Gdynia.

The volume of all dredging in the area shall be determined and reported to the Port of Gdansk Authority (ZMPG).

The Contractor is advised that any requirement for maintenance dredging outside of the Site, caused by the Contractor's method of working, may require a disposal license to be obtained by the Contractor before

such dredging can take place. The application for a maintenance disposal license and obtaining the consent shall be the Contractor's responsibility.

Geological and geotechnical Site Data has been provided as included in the Disclosed Data. The Contractor shall undertake any additional investigations which may be deemed necessary for his design and/or execution of the Works in accordance with the existing regulations, standards, decisions, arrangements and opinions, and the Employer's Requirements.

The Contractor shall be fully responsible for compliance with the requirements of the dredge disposal license, notwithstanding any assistance provided by the Employer in approving disposal operations or assisting in the securing of permits for such sites, and the dumping of dredged spoil therein.

The Contractor shall ensure that any dredging/reclamation activities associated with the construction of Terminal T5 does not result in the infilling of the shipping channel or neighbouring areas. Should infilling occur due to the dredging/reclamation activities of the Terminal T5 construction, it shall be the responsibility of the Contractor to dredge these areas to reinstate their original depth.

Should infilling of neighbouring areas/shipping channel occur the Contractor shall be required to submit evidence that it was not the construction of Terminal T5 that was the cause. The Contractor shall, as a minimum:

- Undertake frequent siltation monitoring and surveys
- The Contractor shall contact the Port Authority and Maritime Office of Gdansk to understand the requirements at the start of the Works in terms of what is required to prevent and track siltation.

The Employer shall not be responsible for any siltation in the surrounding area/shipping channel.

3.6.3 FUNCTION

The function of the dredging in case it is required, is to provide the minimum navigable depths for the vessels turning and berthing at the quay, while simultaneously to avoid any additional dredging after the installation of the rock blanket at the quay during the operation of the OWSB vessels. Dredging shall also be performed to de-cap and remove any unsuitable seabed material.

3.6.4 DEFINITION DIMENSIONS AND LAYOUT

The dredged level is defined as the level above which no part of the base of the dredged area protrudes at the time of the Final Taking-Over Certificate.

The Contractor shall determine, design and construct stable side slopes to the boundaries of each area to achieve the lines and levels defined in the Layout Drawings required to meet the Employer's Requirements.

Dredging works in the vicinity of the quay and return structures shall be carried out so as to provide a stable foundation for the construction of these structures as designed by the Contractor.

These dredging works shall not destabilise any other structure within or in the vicinity of the Works.

3.6.5 REMOVAL OF SILT AND UNSUITABLE MATERIAL

This Section covers the removal of non-bearing soils unsuitable for back-filling, including the silts, and removal to a disposal site in accordance with the decisions, arrangements and opinions, and, in particular, as directed by the appropriate authorities.

Removal of unsuitable material shall be carried out before the placement of suitable fill material as required by the Contractor's design.

The removal of unsuitable material shall be carried out in such a manner as not to leave significant amounts of fine sediment to be incorporated with the suitable material. Similarly, the Site-sourced granular material shall not include excessive amounts of material unsuitable for back-filling.

Double handling of the silt material (e.g. by placing on the seabed with a cutter dredger for subsequent removal by a trailer) shall not be permitted.

Where it is necessary to produce a homogeneous, dispersive material suitable for transport or back-filling, it is likely that some or all of the following measures shall be required:

- Extra mechanical dis-aggregating of the material as it is dredged;
- Loading through screens;
- Passing (and re-passing) through pumping systems on board hopper dredgers whilst sailing to the disposal site;
- Addition and incorporation of extra water to the dredged mixture;
- Pumped disposal at the site and/or controlled opening of hopper doors;
- Monitoring of Material condition prior to back-filling

If it becomes clear that the dredged spoil disposal conditions are not being met, immediate measures shall be taken to correct the situation otherwise the disposal operation shall be stopped, with all delays to the Contractor's account.

The programme of the removal of materials unsuitable for back-filling shall be coordinated with the rate of their disposal at the approved disposal sites.

The Contractor may decide for himself the necessity to remove any silt, and low bearing strength soil in the seabed over the entire footprint of the site. However, suitable and effective ground treatment design will need to be considered and designed by the Contractor to compensate for the inclusion of any deemed unsuitable low strength material which cannot meet the Employer's Requirements by itself. The duration and construction timing of any ground treatment works will also need to be considered to ensure that the project milestones are achieved, and the Contractor shall take full responsibility of the decision to retain any weak and unsuitable material on site.

3.6.6 DESIGN METHOD

For the avoidance of any doubt, the Contractor shall determine if required, the design and construct stable side slopes to the boundaries of each area to achieve the minimum dredge lines and levels defined on the Layout Drawings.

The geotechnical design of side slopes shall include consideration of slope stability and potential liquefaction risk in accordance with the requirements of Eurocode 7 (EC7) and Eurocode 8 for seismic design. The slope stability analysis shall be undertaken using limit equilibrium methods.

The minimum factor of safety to be achieved against overall stability in the permanent static condition shall be 1.5.

Geotechnical Site Data is provided in the Disclosed Date. The Contractor shall undertake any additional investigations, which may be necessary for his design and / or construction works.

Details of dredging requirements behind the front face of the proposed quay wall shall be determined, designed and constructed by the Contractor. These dredging works shall not destabilise any other structures within or in vicinity of the Works.

3.6.7 DREDGING ADJACENT TO EXISTING PORT STRUCTURES

Prior to the commencement of dredging adjacent to existing structures in case it is required, written, photographic and video records of these shall be prepared to the satisfaction of the Engineer and two copies provided to the Engineer. Also prior to commencement of dredging, the Contractor shall install control points at locations as directed by the Engineer for monitoring any movement of structures during dredging.

The Contractor shall take all necessary measures to prevent damage or excessive movement to any structure or feature adjacent to dredging areas.

In the event of any adverse effect on any structure, dredging work in that area shall immediately be suspended and shall not be resumed until agreed by the Engineer. The Contractor shall perform remedial work as directed by the Engineer for the arrest or rectification of such effects and shall be entitled to payment for the work only if such effects are due to causes other than his failure to comply with the requirements of the Contract.

3.6.8 WORKMANSHIP

In case dredging works are required, these shall be carried out in accordance with the requirements set out in EN 6349: Part 5 – Code of practice for dredging and land reclamation, and the requirements of this document. Where there is a conflict the requirements of this document shall be followed.

Agitation dredging or water injection or ploughing, shall not be permitted.

The maximum over-dredging tolerance below the dredged level shall be 0.3m, within 110m of the new main quay structure. The tolerance above the required dredged level shall be zero. Over-dredging below the maximum over dredge depth, within 25m of existing structures, shall be back-filled with approved granular material back to the original levels.

The Contractor shall make full allowance for the possibility of encountering hazardous materials and shall take suitable precautions. Hazardous materials may include, in particular, weapons, bombs, shells, grenades, rockets, depth charges, mines, torpedoes.

The Contractor shall allow for dredging in and disposal of any materials encountered during dredging, and all dredging activities shall be supervised by an approved archaeologist. The items that are encountered in the dredging area shall be cleared and disposed of off-site to an approved location. This shall be carried out

in accordance with the decisions, opinions and approvals of relevant authorities, and, in particular, the requirements of a relevant Curator of Monuments. These may include sunken vessels, chains, anchors, vehicles, cables, etc. All items of geological or archaeological interest that may be discovered belong to the Polish state, but the Contractor shall take initial responsibility for the care of such items. This may include having to stop work while the relevant authority determines the safe actions to preserve the item and any similar items that might subsequently be found. Any costs and delays shall be to the Contractor's account.

In undertaking the dredging and disposal of the material to a disposal site, the Contractor shall comply with, in particular, all legislation and regulations applicable to the protection of the environment, and any other necessary regulations, decisions and opinions. The Contractor shall not commence dredging works without the written consent of the Port Authority and the appropriate statutory authorities to the proposed method of operation.

The Contractor shall comply with any regulatory requirements for environmental monitoring in respect of his dredging and disposal operations.

The Contractor shall comply with any other requirements in respect of method of working, movement of floating equipment, safety, third party approvals, access, co-ordination, control of pollution and communications.

3.6.9 SURVEYS

All surveys including in-surveys and out-surveys shall be carried out in accordance with Polish Regulations, in particular Regulation of the Minister of Transport and Maritime Economy of 23 October 2006 on the conditions of marine structure control, and as a minimum the requirements of this Section.

Prior to commencement of dredging operations, the Contractor shall carry out a bathymetric survey by the use of his own means. The survey shall be by sounding of the area of the Site defined on the Layout Drawings. The Contractor shall give the Engineer and the Port Authority notice of his intention to undertake the survey and shall make arrangements for personnel from these organisations to be present at the survey should they so wish. The period of notice shall be in accordance with the requirements of the Port Authority but not less than seven days. At least 28 days before commencing the survey, the Contractor shall submit a method statement for the survey to the Engineer, which shall demonstrate the methods and accuracy of the proposed survey.

The in-survey shall be plotted on plan sheets at a scale of 1:1000 and shall be signed by the Contractor as representing the area at commencement of dredging.

Not more than twenty-eight days prior to the expected date of taking-over of the relevant Section or part of the Works, an out-survey of the dredged area shall be carried out by the Contractor to confirm that the area is to the required level and no maintenance dredging is required. The Contractor shall give the Engineer and the Port Authority notice of his intention to undertake the out-survey and shall make arrangements for personnel from these organisations to be present at the survey should they so wish. The period of notice shall be in accordance with the requirements of the Port Authority but not less than seven days. The out-survey shall be carried out not more than 14 days prior to the Final Taking-Over Certificate

The out-survey shall be plotted on plan sheets at a scale of 1:1000 and shall be signed by the Contractor as representing the area at completion of dredging.

The surveys shall extend to the proposed quay face and (where possible) 100m beyond any dredged area.

The Contractor shall be responsible for setting up his own position fixing system for the surveys and any necessary floating equipment.

Details of survey equipment (user manuals) shall be available for reference on request of the Engineer. The Contractor shall establish a tide gauge with agreement of the Engineer, by survey for the duration of the Works. If an electronic tide gauge is established, the accuracy of the gauge is to be verified manually and the results submitted to the Engineer for information.

Before commencing any surveys of the seabed, the Contractor shall conduct trials of the equipment and methods to be used, including calibration procedures, in the presence of the Engineer. Calibration bar checks shall be carried out at the beginning and end of each day's surveying over the full range of anticipated depths.

No bathymetric surveying shall be undertaken where wave heights exceed Hs = 0.2m without a heave compensator being fitted to the recording instrument. No surveying shall be undertaken where wave heights exceed Hs = 0.7m.

Sounding shall be carried out by means of a recording dual-frequency trace echo sounder with sufficient sensitivity to permit accurate measurement of seabed levels and any loose material that might be present above bed level. In/out survey frequencies of 33Hz and 210kHz shall be recorded. The 210kHz frequency shall be used for verifying compliance with the Employer's Requirements. The trace produced by the echo sounder shall be spot checked at random in-situ using a sounding chain with base plate or other approved means.

Digital and hard copies of all surveys shall be provided to the Engineer. Digital copies shall be provided in the format approved by the Engineer prior to commencement of works. Electronic copies of echo sounder data shall be reduced to EV2007 Datum and be submitted to the Engineer.

The spacing between adjacent parallel survey lines shall not be more than 20m to a deviation tolerance of ± 4m. Depths shall be plotted at 5m intervals along the survey lines and contours drawn at 1m intervals on the plans. Where the echo sounder traces show slopes steeper than 1 in 4 and/or a vertical step in excess of 0.5m, the plotting interval shall be reduced, allowing the contours to be drawn accurately. Additional survey lines may be required in such areas and these lines shall be run at 90 degrees across the feature to obtain a continuous trace of the feature. Main survey lines shall be perpendicular to the berthing line and shall be set to the satisfaction of the Engineer.

Soundings perpendicular to the main survey lines shall be carried out at intervals of 50m and shall include lines coincident with the ends of the main survey lines. The minimum overlap for survey lines running at different angles shall be 25m.

The Contractor shall, in conjunction with the out surveys, prove that no part of the dredged area is above the required dredged level, by carrying out bar sweeps of the dredged area or by other approved means such as swath or multibeam surveys. All out-surveys and bar sweeps shall be witnessed and approved by the Port Authority.

If the out-survey and bar sweep do not prove that no part of the dredged area is above the required dredged level, the Contractor shall be responsible for the dredging/removal of debris and further bar sweeps as necessary to prove that no part of the dredged area is above the required level.

Prior to the taking-over of the relevant part of the quay structure the Contractor shall prove that no part of the berth pocket or the approach to that part of the berth is above the relevant dredge level, nor has it been dredged below the dredge tolerance, by carrying out surveys and bar sweeps of each dredged area. The Contractor shall be responsible for the removal of debris and further bar sweeps as necessary, to prove that no part of the main quay berth pocket is above dredged level.

Interim surveys intended to support interim evaluations shall be undertaken in accordance with the requirements for in- and out-survey.

3.6.10 DREDGED SIDE SLOPES

Dredged side slopes shall be designed to be stable under the action of waves, ship wash, currents and propeller and bow-thruster scour, to ensure both short term and long-term conditions do not undermine the stability of the quay and return structures.

3.7 RECLAMATION

3.7.1 WORK SCOPE

The Contractor shall be wholly responsible to source, transport and place the reclamation material

The scope of the reclamation and filling includes:

- Reclamation within the new terminal area bounded by the new quay and retaining wall structures shown on the Layout Drawings.
- Ground improvement by surcharging and /or other approved means to achieve specified settlement criteria. The precise extent of areas for ground treatment will be defined in the design
- Soil replacement after the removal of any unsuitable non-bearing soils from the site.
- The design shall ensure that the settlement requirements set out in these Employer's Requirements are satisfied. The design will be allowed to incorporate run – off slabs where it is necessary and practical in order to limit total settlements immediately adjacent to the structures.

The design shall include as a minimum an analysis of stability, time-dependent settlement and sub-grade properties, parameters and pavement design of the terminal. It shall also include proposals for stabilization measures where necessary and a proposed specification for fill material.

The Contractor shall be fully responsible for the sourcing, procurement and maintenance of fill material that complies with the design, as approved by the Engineer.

Granular material obtained from dredging at the Site may be used for reclamation purposes if it complies with the design requirements.

The Contractor shall be responsible for identifying external sources of suitable granular material for the balance of the reclamation volume including the sourcing, supplying and use of any material required for the Works, including the responsibility to supply material that complies with the Employer's Requirements.

The Contractor shall be responsible for the reinstatement of any fill or surcharge materials washed away by waves, sea currents or weather conditions.

All the elements of the Works, not listed directly in the Employer's Requirements and / or other Contract Documents, but necessary to satisfy Employer's Requirements shall be treated as included in the scope of Contractor's Works.

All Works and parts of the Works shall be done in accordance with the existing law, obtained permits, decisions and opinions, including the standards listed in the Disclosed Data.

3.7.2 RECLAMATION WORKS WITH THE USE OF SUITABLE DREDGED GRANULAR MATERIAL FROM SITE

Reclamation includes for the use of granular material that is to be placed on the Site to form a containment for the reclamation works in a form of a containment bund, if required. The Contractor shall ensure that the material placed within the bund complies with the requirements for short term and long-term stability of the quay structure as set out in his design. The Contractor shall only use the dredging methods agreed on and approved by the Engineer, the Port Authority and by the appropriate statutory authorities. The Contractor shall be responsible for obtaining all necessary approvals and consents in respect of the method of dredging.

Any granular material that has to be dredged from the Site to achieve the design profiles but which will be surplus to the requirements of the Works shall be stacked up in areas of the Site not immediately required for the Works, approved by the Engineer and in accordance with all water management permits and other environmental regulations applicable to the Site. Such surplus material may be used by the Contractor in his works at the discretion of the Engineer but shall remain the property of the Employer. The Contractor is not entitled to remove it from the Site or to use it for any purpose other than for the Works.

Mooring and pipeline arrangements for the reclamation works shall be subject to the approval of the Engineer and the Port Authority (ZMPG) and shall not present any obstruction to ships or their tugs operating at the existing container terminal.

Contractor shall be wholly responsible to source, transport and place the suitable granular material for the reclamation.

3.7.3 RECLAMATION WORKS WITH THE USE OF SUITABLE GRANULAR MATERIAL FROM EXTERNAL SOURCES

For completion of the reclamation works, the Contractor will use granular material from external sources. The Contractor will be responsible for locating the source of a suitable granular material, and for obtaining all approvals for its use, and paying all costs and royalties which may be due. Imported reclamation material is to comply with the grading specifications included in the Contract documents and the Contractor's approved design and specification. The volume of granular material used for the reclamation shall be monitored for record purposes only. The volume will be determined from vessel hopper measurement, taken by sounding in at least 10 points before and after discharge into the reclamation, and deducting the rest load volumes.

Mooring and pipeline arrangements for the reclamation works will be subject to the approval of the Engineer, and the Authority, and must not present any obstruction to ships or their tugs operating anywhere in the area of the Contractor's operations.

Contractor shall be wholly responsible to source, transport and place the suitable granular material for the reclamation.

3.7.4 MATERIALS

3.7.4.1 BACKFILL MATERIAL BEHIND QUAY WALLS

Fill material shall be durable, well-graded granular material obtained by specified dredging, selected from stockpiles, or imported from external sources. The grading and compaction of the fill shall be such that it will achieve the requirements scheduled in the Contractor's design and approved by the Engineer.

Fill material shall consist of naturally occurring or processed material which at the time of deposition is capable of being compacted in accordance with the specification to form stable areas of fill.

Fill Material shall not contain any of the following:

i) material susceptible to volume change, including marine mud, swelling clays and collapsible soils;
ii) peat, vegetation, timber, organic, soluble or perishable material;
iii) dangerous or toxic material or material susceptible to combustion; and
iv) metal, rubber, plastic or synthetic material.

Fill material shall not be gap graded. Gap graded soils are defined as coarse soils composed of a mixture of fine and coarse particles with some intermediate sizes missing so that the finer particles can move within the soil matrix under hydraulic action.

The material shall be free from organic matter and shall have the following properties:

- Maximum particle size 100mm
- Maximum silt content dispersed in the granular material (material passing a 63 micron sieve) 10%
- Plasticity Index <6%

Any fill Material imported from other sources shall be well compacted, free from organic matter and shall also comply with the following:

- Aggregate Impact Value (BS EN 1097-2) (dry) <30%
- Aggregate Impact Value (BS EN 1097-2) (saturated) <40%
- Magnesium Sulphate Soundness (EN 1367-2) <30%
- Water Absorption (BE EN 13383 - 2) <6%
- Specific Gravity >2.3 Mg/m3

Fill material shall, in addition, be tested by means of shear tests to prove that it will achieve, in its final state of compaction, a minimum internal angle of friction equal to or greater than that adopted in the Contractor's design.

The fill material shall also be tested to determine the compaction characteristics in accordance with the standards outlined in these Employer's Requirements.

3.7.4.2 REPLACEMENT FILL TO THE BERTHING POCKETS

All replacement fill to the berthing pockets of the T5 terminal quay walls shall comply with Section 3.7.4.1 and have the following minimum properties:

- Minimum angle of internal soil friction= 30 Degrees
- Soil density = 19kN/m3
- Bearing capacity of minimum 995 kPa

3.7.4.3 RECLAMATION FILL FOR THE REST OF THE TERMINAL

The preference for the reclamation fill properties relating to the rest of the T5 terminal is to match that shown in Section 3.7.4.1. However, if the Contractor can demonstrate that it is necessary to utilise unscreened fill material to satisfy the programme and or significant cost reductions, then it maybe be acceptable upon approval of the Engineer.

Please note the unscreened fill material proposed still needs to meet the following parameters:

Fill Material shall not contain any of the following:

i) material susceptible to volume change, including marine mud, swelling clays and collapsible soils;
ii) peat, vegetation, timber, organic, soluble or perishable material;
iii) dangerous or toxic material or material susceptible to combustion; and
iv) metal, rubber, plastic or synthetic material.

Fill material shall not be gap graded.

The material shall be free from organic matter and shall have the following properties:

- Maximum particle size 100mm
- Maximum silt content dispersed in the granular material (material passing a 63 micron sieve) 10%
- Plasticity Index <6%

The unscreened fill material particle size distribution curves must fall within the following limits:

Unscreened Material Sieve Size Constraints		
Sieve Size mm	**Percentage passing upper limit**	**Percentage passing lower limit**
0	0	0
0.063	10	0
0.2	26	0
0.63	70	8
2	98	35
6.3	100	45
10	100	87
20	100	100
37.5	100	100
63	100	100

3.7.5 DEFINITIONS, DIMENSIONS & LAYOUT

The limit of the areas required to be reclaimed are defined on the Layout Drawings.

3.7.6 SETTLEMENT CRITERIA & METHODOLOGY

Settlement criteria shall be as specified in these Employer's Requirements.

The design shall be carried out in accordance with the existing law, obtained permits, decisions and opinions, including the codes of practice and standards approved by the Engineer.

The calculations submitted shall include, but not be limited to, the following:

- A contents sheet;
- Detailed written methodology setting out the design philosophy, construction programme and design assumptions;
- A summary of the geotechnical parameters adopted for the design together with supporting interpreted factual data and geological sections;
- Any assumptions made in developing the geotechnical design parameters shall be reported and justified. Copies of references used to justify the design parameters and assumptions shall be supplied with the calculations;
- The design calculations shall be logically structured and appropriately annotated.
- The properties of the fill Material and any ground improvement required by the design, and how the attainment of these properties shall be assessed in the field for Material both above and below water level;
- Copies of the relevant Standards and Codes of Practice used in the design shall be included with the calculations;
- What action could be taken should the monitoring indicate that the fill material or ground improvement will not achieve either the Contractor's design requirements or the performance requirements in the Employer's Requirements.

3.7.7 FILL MATERIAL TESTING FREQUENCY

The Contractor shall carry out testing of fill material to determine its suitability prior to placement in accordance with the following schedule:

Routine Monitoring Tests on Fill Material	
Test	**Min. Frequency (one test per..)**
Grading	7,500 m³
Aggregate Impact Value	20,000 m³
Magnesium Sulphate Soundness	20,000 m³
Water Absorption	20,000 m³
Density	*
Shear Tests	*
Compaction Tests	*

** Testing frequency as required but at least five of each test, to determine material properties where material is not of consistent quality or from one source.*

In addition, initial tests on each type of material proposed for use as fill shall be conducted on a minimum of five randomly selected samples selected from separate locations.

3.7.8 COMPACTION TRIALS

Prior to placing any fill material 'in the dry', the Contractor shall carry out trials to demonstrate the adequacy of the proposed placing and compaction methods to achieve the requirements of the Contractor's design, and to examine the sequence of operations.

The trial shall take place at a location to be agreed with the Engineer. Each trial shall be carried out over an area not less than 40m x 20m and shall be undertaken 'in the dry'. Each trial shall comprise at least four layers of fill.

Trials shall comprise filling the areas using the equipment, methods and sequence of construction proposed by the Contractor. Following placing and compaction of a layer of fill material, the Contractor shall undertake four in-situ density tests (sand replacement method or water replacement method, as appropriate), approved by the Engineer, together with four associated compaction tests conducted on material taken from around the in-situ density test, also approved by the Engineer, to demonstrate the attainment of the degree of compaction required by the Contractor's design for the fill Material placed or moved in the dry. The in-situ density test shall be conducted in the lower half of the compacted layer.

The Contractor shall submit a proposal for the compaction trials which shall include, but not be limited to, the following:

- Full details of the objectives and methodology of the trials
- Method of fill placement and specification of equipment to be used
- Method of monitoring layer thickness
- Compaction procedures and the specification of equipment to be used
- Details of the tests to be conducted on the compacted fill Material to demonstrate compliance with the Employer's Requirements and Contractor's design requirements.

The results of the trials shall determine a method to be used.

Separate trials will be required for each principal area of fill and, if the material for filling varies significantly during the progress of the Works, additional trial(s) will be required.

On completion of each compaction trial, the Contractor shall submit a report or reports covering the scope and outcome of the tests in respect of the following aspects:

- Full material description with associated laboratory testing;
- Layer thickness variation;
- Compaction equipment specification;
- Compactive effort (number of compaction equipment transfers) used per layer;
- Results of all tests conducted during the trial;
- Full documentation of Site activities;
- Weather records;
- Interpretations of the data from the trial in graphical form with supporting text;
- Conclusions and recommendations;

- Copies of the relevant Standards or Codes of Practice (Technical Requirements, Execution and Acceptance of the works) used in the trials if other than those stated in this Document.

3.7.9 IN-SITU TESTING OF FILL

Tests shall be carried out on fill above mean sea level, and on all material placed 'in the dry' to determine the degree of compaction achieved, at the rate of one test for each 1000m^2 of each layer. Compacted layers shall not be covered without approval.

The density of individual compacted layers shall be determined in the lower half of the layer using the sand replacement method or water replacement method, as appropriate, in accordance with the provisions and standards approved by the Engineer.

If fill material quality varies, or the in-situ density test results are inconsistent, additional testing shall be carried out.

In-situ CBRs shall be carried out to demonstrate achievement of the CBR used in pavement design. CBR tests shall be carried out in accordance with the provisions and standards approved by the Engineer.

3.7.10 TESTING OF AREAS OF GROUND IMPROVEMENT

Areas of ground improvement shall be considered to encompass both natural soil deposits left in situ, and fill material placed where mechanical compaction cannot be applied in the dry.

Areas of ground improvement shall be tested by undertaking Cone Penetration Tests at a rate of at least one full depth profile per 500m^3 of treated area, to demonstrate compliance with both the Employer's Requirements and the Contractor's design requirements and the results shall be submitted to the Engineer.

In areas of ground improvement the Contractor shall define in the Documents to be submitted in accordance with the Employer's Requirements, his proposals for verifying and demonstrating that the fill material placed below water, and natural soil deposits left in situ, will achieve both the Employer's Requirements and the Contractor's design requirements.

It is anticipated that this submission shall include, but not be limited to, the following:

- Method of fill placement;
- Fill placement quality control and specification;
- Details of the form of ground improvement to be adopted, along with supporting calculations and the method of assessing the attainment of the required ground improvement, together with the attainment criteria;
- Copies of Standards and Codes of Practice used in the design.

3.7.11 MONITORING

Monitoring of filled areas and ground improvement shall include, but not be limited to the following:

- Sufficient number of data at depth to be agreed with the Engineer to provide coverage of the areas of ground improvement and fill.

At a rate of at least 1 per every 5,000m³ of ground improvement and fill, the following instrumentation shall be installed:

- Pneumatic or hydraulic piezometers installed at depths and locations to allow the Contractor to validate design assumptions and predict long-term settlement behaviour of the ground.

At a rate of at least 1 per every 2,500 m³ of ground improvement, the following instrumentation shall be installed:

- Prior to placing any fill material, rod settlement gauges shall be installed which extend from the base of the fill material to the top of the fill material/surcharge to monitor settlement of the materials below the fill material during fill placement and throughout the surcharge period. The rod settlement gauges shall be extendable in one metre increments as layers of fill material are placed and compacted.

- On completion of filling, a surface settlement marker shall be installed adjacent to each rod settlement gauge to allow the surface settlement to be monitored throughout the surcharge period.

All instrumentation shall be monitored daily as fill material is placed and twice weekly during the period of surcharge.

The Contractor shall submit a report to the Engineer on the instrumentation every month. The report shall include but not be limited to the following:

- A plan showing instrumentation locations.

- Plots for each instrument showing settlements and excess pore water pressures (as appropriate) relative to time and thickness of the fill. These shall be superimposed on predictive plots showing the theoretical variation in settlement and excess pore water pressures against time and thickness of the fill through to the anticipated completion of any surcharge period, and shall take due account of the rate of fill placement.

Using the monitoring data the report shall include a prediction of when the surcharge can be removed (if appropriate) and an estimate of settlement after 2, 8 and 30 years post construction.

Long-term monitoring of the subsequently paved, reclaimed and filled areas and other areas of ground treatment shall be carried out as stated elsewhere in the Employer's Requirements.

3.7.12 GROUND SETTLEMENT

The following criteria for total and differential settlements are to be used for the design.

Total Maximum Settlement Criteria

- 100mm residual settlement after 2 years everywhere else
- 150mm residual settlement after 8 years everywhere else
- 300mm residual settlement after 30 years everywhere else

Tolerances for Surfacing

- Change in level caused by differential settlement = Slope measured between two points, 1m apart, to be no steeper than 1 in 50
  Differential settlement adjacent to structures = 15mm

3.7.12.1 Quay Areas (Pre-Assembly Area, Inbound Area, Ro-Ro Area)

The surface of the area where the foundation of the full tower frame is located and the crawler crane working area should be levelled with a maximum slope of 0.3 deg (equal to 0.5%). Minor differential settlement during project execution I allowed but not exceeding the slope of 0.3 deg;

3.7.12.2 Storage areas

The surface of storage areas and roads should have a maximum slope of 1.5% (+/- 0.5%). A maximum differential settlement of 1.0 % during project executing is allowable.

During the storage and handling of the OWSB components on the terminal, the weight of components will induce significant load to the ground. The layout and ground bearing solutions must be prepared to fulfil the related inclination and settlements constraints, absolute and differential.

3.8 EARTHWORKS

3.8.1 WORK SCOPE

All earthworks shall be executed in accordance with the relevant regulations, standards, knowledge and engineering practice, and in particular with health and safety regulations and the construction law.

All earthworks, in particular excavation, shall be carried out in compliance with the scope, requirements and parameters regarding the levels and profiles as defined in the Employer's Requirements and Layout Drawings or/and as required by the Contractor's design to the approval of the Engineer.

Earthworks shall be carried out in such a way as to avoid disturbance to the surrounding ground and particular care shall be taken to maintain stability when excavating in close proximity to existing works or structures.

Sides of excavations shall be adequately supported to ensure the safety of those working within the excavations, and of adjoining or adjacent structures as well as the work generally. The Contractor shall retain full responsibility and liability for safety under the Contract.

In excavations that are to remain open, exposed faces shall be accurately trimmed to the slopes and profiles required for stability. Open excavations shall be maintained in stable condition and shall be protected against any deterioration due to the effects of inclement weather and shall be fenced in accordance with the relevant regulations.

Any organic soil/unsuitable material arising from excavations shall be disposed of off-site. Suitable material may be re-used in the Works when it shall be placed directly in such Works or set aside for use as and when required in stockpiles and locations as approved by the Engineer.

Suitable material which is surplus shall remain the property of the Employer and the Contractor is not entitled to remove it from the Site or to use it for any purpose other than for the Works.

Excavations shall be kept free of water from whatever source and the Contractor shall provide such pumping capacity and other measures as may be necessary for this purpose.

The Contractor shall be responsible for providing adequate drainage of the whole Site both for the Permanent and Temporary Works. Prior to undertaking any Earthworks the Contractor shall submit to the Engineer for approval a design of Site drainage.

The location of drainage outlets shall be agreed with the Engineer, taking into account all water management permits and other environmental regulations applicable to the Site and adjacent areas.

The Contractor shall notify the Engineer within 24 hours of the encounter, in the course of excavations, of any layers of unsuitable material or abnormal ground conditions, in particular if they may have a significant effect on the execution of the Works.

3.8.2 EXCAVATION BEYOND TRUE LINES AND LEVELS

If any excavations have been carried out without compliance with their required line or/and level other than on the instructions of the Engineer, the Contractor shall make good to the required line and level of such earthworks with the appropriate parameters of fill to be contained in the true excavation, or with concrete or other approved material in such a manner as the Engineer may direct.

3.8.3 APPROVAL OF EXCAVATIONS

When excavations have been carried out accurately to the profiles and dimensions required for the given stage of the Works, the Contractor shall, prior to proceeding with the next stage of the work, inform the Engineer that he may carry out an approval inspection. The Contractor shall demonstrate to the Engineer that the formation of the excavation satisfy the bearing capacity required by the design.

If, after his inspection, the Engineer requires extra excavation to be carried out, the Contractor shall do so as directed by the Engineer.

The Contractor shall obtain approval of excavations before proceeding to the next stage of the Works.

The Contractor shall notify the readiness for approval and obtain written approval of the Engineer for each element of the Permanent and Temporary Works including the laying-in of services, the construction of consecutive layers of all structures and other covered works which require approval.

3.8.4 EXCAVATIONS BY HAND – EXISTING SERVICES

In the vicinity of existing services excavation shall be carried out by hand and every care shall be taken to avoid damage to any elements of such services including providing temporary supports where necessary. Existing services shall have been first located by hand digging on an appropriately-close grid or by other means such as electronic scanning.

Any damage to any existing service caused by the Contractor’s activities shall be immediately notified to the Engineer and the Contractor shall at his own cost take immediate action to repair or reinstate the service.

3.8.5 TRENCH EXCAVATIONS

The Contractor shall carry out trench excavation in a safe manner such that the sides of trenches are adequately supported and stable. Trench excavation shall be performed by the use of hand tools and approved mechanical equipment, in such a manner as to minimize disturbance of the sides and bottom of the excavation.

The Contractor shall not permit the passage of Contractor's equipment, nor the storage of material at the sides of or alongside excavations and shall retain such clearance as is necessary depending on the depth of the excavation to ensure the continuing stability of the sides of the excavation.

Trenches shall be excavated to the lines and levels required by the Contractor's design, allowance having been made for working space, stability of sides and for bedding and surrounds.

The geometrical dimensions of trenches shall be sufficient to allow proper and efficient laying-in of services carried out in clean, dry and safe conditions. The maximum width measured between undisturbed soil in the trench sides shall not exceed the outside diameter of the pipe being laid plus 550 mm for pipes up to and including 800 mm in diameter and plus 750 mm for pipes over 800 mm in diameter.

The widths of trenches crossing roads or at other locations as may be directed by the Engineer shall be as narrow as practically possible.

Trenches shall not be excavated more than 50m in advance of pipe/duct laying.

The bottoms of all trenches shall be trimmed to grade and level and thoroughly compacted by ramming before the next stages of the Works are undertaken.

Except where otherwise described in the Contract, trenches for pipes shall be excavated to a sufficient depth to ensure a minimum cover of 900mm on top of the pipes in non-trafficked areas and 1200mm for all trafficked areas.

3.8.6 FORMATION ON EXCAVATED AREAS

The formation shall satisfy the design requirement, if not, or if the material below formation level is unsuitable, then the material shall be removed to the extent directed by the Engineer and disposed of off-site by the Contractor.

The resulting void shall be back-filled with suitable approved material compacted in layers, to achieve at least the required design requirement.

3.8.7 DISPOSAL OF EXCAVATED MATERIALS

The Contractor shall obtain all necessary permits for disposal of surplus or unsuitable excavated materials to disposal sites approved by the relevant authorities.

Disposal of any material into the sea or contamination of the sea or any other existing watercourses shall not be permitted. Suitable drainage and other measures shall be provided to prevent erosion and/or leaching of ground.

3.8.8 DEFINITION OF FILLING

Filling refers to the placement of material from excavations, stockpiles, borrow pits, dredging operations or other approved sources, in any area of the Works, including areas excavated for foundations, services, etc. and other areas requiring fill to raise levels to formation.

The requirements for the reclamation areas of the Site as well as the issues of ground improvement and settlement monitoring are covered within Section 3.7 of the Employer's Requirements. Filled areas shall comply with the settlement criteria within the Employer's Requirements.

3.8.9 MATERIAL FOR FILLING

Material for filling shall generally be as described in Section 3.8.9 of the Employer's Requirements but use shall be made of suitable excavation material as well as material generated by site levelling operations and, as required, material obtained from a borrow pit.

Prior to commencement of filling, the Contractor shall submit to the Engineer for approval his proposals for carrying out the work together with the relevant Quality Assurance Plan. The proposals shall include the compaction equipment and methods for adjusting the material to the required parameters.

The Contractor's proposal for the sourcing of fill material shall be submitted at a sufficiently early stage to allow all the necessary testing to be completed and approvals given such that construction is not delayed. No filling shall be carried out until all proposals and intended material is approved by the Engineer.

Filling to trenches requires particular attention by way of measures to limit the adverse effects of settlement and differential settlement.

The use of cement-stabilised material or high-slump, low strength concrete shall be considered for filling to areas in which compaction is difficult to execute, e.g. adjacent to foundations and structures.

3.8.10 BACKFILL TO STRUCTURES

The Contractor shall not place back-fill to structures until the structural elements have attained adequate strength and the approval of the Engineer has been obtained. Unless otherwise directed, the back-fill material shall be non-cohesive (sand, gravel or sand and gravel mix) with a good compactability and water permeability properties and shall be thoroughly compacted in layers not exceeding 150 mm deep, to achieve a density of at least 95% of the maximum dry density. The values of maximum dry density, on-site ground density and optimum moisture content shall be in accordance with the relevant standards.

Where back-fill is to be placed on more than one side of a structure, placing of the fill shall be sequenced so that the stability of the structure is not threatened. Unless otherwise directed, the differential level of fill on opposite sides of a structure shall not exceed 1 metre.

The application of other standards is permitted subject to their approval by the Engineer prior to commencement of the Works.

3.8.11 PLACING AND COMPACTION

All fill material shall be transported, laid and compacted without drying out or segregation.

The compaction of fill shall be by means of vibrating roller unless otherwise specified or approved by the Engineer.

The Contractor shall undertake compaction trials as part of the Works and shall propose the equipment and number of passes suitable for each type of fill used.

Once approved by the Engineer, the compaction methods which achieve the required parameters shall be used for the Works.

Where working space is restricted and prevents the use of approved compaction equipment, the methods and equipment used shall be modified in order to achieve the specified degree of compaction. Such modification shall be confirmed by field trials.

Particular care shall be taken to avoid damage to, when compacting fill around, over, or in the vicinity of, new and existing pipework, ducts, cables, structures

The values of maximum dry density and optimum moisture content shall be obtained in accordance with BS 1377: Part 4 using the 4.5kg rammer method or in accordance with ASTM D1577 using the vibrating hammer method. Field density shall be measured in accordance with BS1377: Part 9 or ASTM D1556 (sand replacement or nuclear densometer method).

Fill material shall consist of naturally occurring or processed material which at the time of deposition is capable of being compacted in accordance with the specification to form stable areas of fill.

Fill Material shall not contain any of the following:

i) material susceptible to volume change, including marine mud, swelling clays and collapsible soils;
ii) peat, vegetation, timber, organic, soluble or perishable material;
iii) dangerous or toxic material or material susceptible to combustion; and
iv) metal, rubber, plastic or synthetic material.

Fill material shall not be gap graded. Gap graded soils are defined as coarse soils composed of a mixture of fine and coarse particles with some intermediate sizes missing so that the finer particles can move within the soil matrix under hydraulic action.

The material shall be free from organic matter and shall have the following properties:

- Maximum particle size 100mm
- Maximum silt content dispersed in the granular material (material passing a 63 micron sieve) 10%
- Plasticity Index <6%

Any fill Material imported from other sources shall be well compacted, free from organic matter and shall also comply with the following:

- Aggregate Impact Value (BS EN 1097-2) (dry) <30%
- Aggregate Impact Value (BS EN 1097-2) (saturated) <40%
- Magnesium Sulphate Soundness (EN 1367-2) <30%
- Water Absorption (BE EN 13383 - 2) <6%
- Specific Gravity >2.3 Mg/m3
-

Fill material shall, in addition, be tested by means of shear tests to prove that it will achieve, in its final state of compaction, a minimum internal angle of friction equal to or greater than that adopted in the design.

3.8.12 BACKFILLING OVER SERVICES

The Contractor shall install warning tapes and tiles during backfilling over cables, buried pipes and ducts. Warning tape shall be colour-coded according to the service and suitably inscribed for identification at intervals not exceeding 700mm. The tape shall be installed with the inscriptions facing upwards. The tape shall be PVC or polyethylene mesh at least 150mm wide incorporating tracer wire with colour coding in accordance with NJUG Guidelines on the Positioning of Underground Apparatus for New Development Sites. (Note that red tape is to be installed above surface water pipes and fire mains and blue tape above freshwater mains).

3.9 PILING

3.9.1 WORK SCOPE

The Contractor shall provide all necessary design, procurement, installation, testing, including pile test load, and reporting for installation of all piling, embedded retaining walls and any other piles or piled foundations necessary for construction of the Works.

The Contractor shall be responsible for the selection of pile types and installation methods appropriate to the design loads to be carried and the function of the structure.

3.9.2 FUNCTION

Piling works may be required to:

- Create the quay and retaining wall structures in accordance with the Contractor's design;
- Provide a foundation to the crane support beams for rail-mounted electrically operated gantry cranes;
- Provide foundation to relieving platforms
- Provide foundations, anchorage or support for any other structure as required in the Contractor's design.

3.9.3 DESIGN METHOD AND EXECUTION STANDARDS

The design and execution of piled foundations, retaining walls, sheet piling and any geotechnical structures shall be designed in accordance with the codes of practice and standards approved by the Engineer.

3.9.4 GENERAL REQUIREMENTS FOR PILING WORKS

In the case of the use of vibration piling method, the Contractor shall take account of the impact of the vibrations on the existing structures and shall take all measures necessary to protect the existing structures from any damage.

The designs of all piles and embedded retaining/sheet piling walls shall be undertaken by the Contractor in accordance with ground settlement and deflection criteria set out in Employer's Requirements. These criteria define the serviceability limit state that shall be applied to the design.

The Contractor's design shall make appropriate allowance for durability of all pile elements. The required design life is set out in the Employer's Requirements.

The Contractor shall be responsible for any costs associated with the remedial works required due to pile performance failure in accordance with the Employer's Requirements for settlements and deflections.

The Contractor shall establish through his design Specified Working Loads (SpWL) for working piles.

While designing the SpWL the Contractor shall take into consideration:

- All permanent loads from superstructure required by his design;
- All operational loads set out in the Employer's Requirements;
- All additional imposed loads from environmental sources (wind, waves, etc.);
- All loads associated with short- or long-term settlements of natural ground and fill material, including any additional lateral loads acting on the piles;
- All construction loads consistent with the Contractor's proposed methods of working and future maintenance;
- All loads caused by deformation of piles in temporary or permanent conditions;
- All other loads consistent with the Contractor's design.

The sequence of working shall be determined by the Contractor with the approval of the Engineer in order to satisfy the programming requirements set out in the Contract Documents.

3.9.5 TESTING

3.9.5.1 GENERAL CRITERIA

Construction and testing of preliminary piles for design verification purposes is required. Preliminary piles are required for each pile type and each pile size supporting each specific structure.

Testing of working piles is required. Pile testing shall be carried out in accordance with valid regulations, standards and common practice.

The Contractor prior to the commencement of the testing shall submit for the Engineer's approval, a Method Statement for testing of piles and the location of all preliminary pile tests.
The Contractor shall calculate the Design Verification Load (DVL) taking into account negative skin friction loads and lateral loads where appropriate.

The DVL and SpWL for the piles under consideration shall be stated in the Contractor's Method Statement for Pile Testing.

In all cases, the preliminary pile test load for vertical (axial) loads shall not be less than DVL + SpWL.

The working pile test load for vertical (axial) loads shall not be less than DVL + 0.5 * SpWL.

The preliminary pile test load for horizontal (cross-sectional) loads shall not be less than DVL + SpWL.

3.9.5.2 PRELIMINARY PILE TESTING

Preliminary pile testing shall be carried out in accordance with the regulations, standards and engineering practice, and, in particular, with the following criteria:

- For piles designed to carry axial loads, not less than one preliminary pile test to failure under the vertical load, including the uplift tests where applicable, shall be carried out per every 100 working piles of the same dimensions and in similar ground conditions (i.e. in conditions where variations of

individual soil strata thickness is insignificant for the pile design the above shall be agreed with and approved by the Engineer) to be installed on the Site, with a minimum of one test being performed for each group of piles of the same dimensions and in similar ground conditions, and with not less than three preliminary pile tests carried out for the whole Site.

- Pile driving set monitoring and dynamic testing of piles shall be performed for all driven piles used for preliminary testing.

- For piles designed to carry horizontal (cross-sectional) loads, not less than one preliminary pile test under the horizontal (cross-sectional) load shall be carried out for each group of piles of the same dimensions and in similar ground conditions, with a minimum of one preliminary pile test carried out for the whole Site.

Interpretation of the data and results of preliminary pile tests shall be submitted to the Engineer for consent prior to application to the Contractor's design. On completion of all preliminary pile tests, the results and interpretations shall be collated into a single report in accordance with existing standards, regulations and engineering knowledge and practice.

The Contractor shall obtain the Engineer's approval for all preliminary pile test results and their interpretations for each pile group prior to execution of working piles.

3.9.5.3 WORKING PILE TESTING

Working pile testing shall be carried out in accordance with existing standards, regulations and engineering knowledge and practice and, in particular, with the following criteria:

- Pile driving set monitoring shall be carried out for all driven working piles. In addition, for piles designed to carry axial loads, dynamic testing of piles shall be performed on at least one driven working pile per 10 piles of the same dimensions and in similar ground conditions on the entire Site.

- For bored piles designed to carry axial loads, at least one working pile static load test shall be carried out per every 100 bored piles of the same dimensions and in similar ground conditions (i.e. in conditions where variations of individual soil strata thickness is insignificant for the pile design, as approved by the Engineer) to be installed on the Site, with not less than one static load test being performed for each group of piles of the same dimensions and in similar ground conditions.

- Non-destructive integrity testing is required for all bored, cast-in-place piles and all pre-cast concrete driven piles.

The Contractor shall obtain the Engineer's approval of all working pile test results and interpretations prior to commissioning of the piles.

On completion of all working pile tests, the results and interpretations shall be included in a report in a form agreed with the Engineer.

3.9.6 SPECIFICATION OF PILE DESIGN

The Contractor shall detail his pile design on drawings and in a form of written specification in accordance with Specification for Piling and Embedded Retaining Walls, 2nd edition, published by Thomas Telford (2007) or other relevant standards and regulations.

The Contractor's drawings and specification for the pile design shall be submitted to the Engineer for approval at least two weeks prior to the commencement of any piling works.

3.9.7 INSPECTION OF PILES IN THE FACTORY

The Contractor shall advise the Engineer a suitable time to inspect the piles for quality purposes at the factory prior to them being delivered to site. This shall be captured in the Quality Assurance Plans as specified in Section 1 of these Employer's Requirements.

3.10 ROCK

3.10.1 WORK SCOPE

The work described in this Section relates to the rock mattress, infill behind the quay walls/retaining structures and temporary slope protection provided within the Contractor's design to protect the reclamation works from wave erosion, scour protection and geotextiles.

It is to be noted that for the OWSB works, if a rock blanket, concrete mattresses, or stone bed is required to maintain controlled jacking conditions and to limit the leg penetration, it must be placed under the future berth pocket, i.e., -17.5mKr (-17.42 EV), in a way that ensure that the adopted layer is suitable for the future container terminal design and operations.

The Contractor shall be responsible for locating acceptable sources of rock. No quarrying shall commence until it has been demonstrated to the Engineer that the rock will comply with the requirements set out herein and that the quarries can supply the required quantity and specified stone sizes within the Contractor's programme.

The rock to be used in the works shall consist of dense, sound durable stone, free of cracks, joints and bedding planes which would result in breakdown of the rock in a marine environment. It shall be of sufficient strength to resist fracture and damage during handling, placing construction and service.

The Contractor shall include Drop Tests of the Rock as part of the Contractor's Test and Inspection to the satisfaction of the Engineer. Drop tests at the quarry shall be carried out at random at the direction of the Engineer and under his supervision.

All stones shall be angular or prizmoidal in shape with the greatest dimension not larger than twice the least dimension.

Material properties of rock shall comply with the following specifications:

- Water Absorption (BS EN 1097) — 3% by weight maximum
- Specific Gravity (saturated surface dry) (BS EN 1097) — 2.65t/m^3 minimum
- Point Load Strength Index (ISRM 1981) — 4N/mm^2 minimum
- Los Angeles Abrasion — 35% maximum loss

(BS EN1097-2)

-	Magnesium Sulphate Soundness	loss over: 5 cycles should be not more than 12% maximum for sodium sulphate or 18% for magnesium sulphate
-	10% Fines Value (BS EN 1097)	not less than 100 kN
-	Block Integrity	not more than 5%

Test methods shall be as outlined in 'The Rock Manual'. The use of rock in hydraulic engineering (second edition) (CIRIA C683).

3.10.2 SOURCES AND SUPPLY OF ROCK MATERIALS

The Contractor shall be responsible for locating and making arrangements for the supply of the required quantities of rock to the specified quantity and gradings. All costs incurred in locating and delivering such supply, shall be included in the Contract Price. The source of materials shall be subject to the approval by the Engineer.
For such approval, the Contractor shall provide the Engineer with adequate representative samples and the results of laboratory tests and if required laboratory test results for the respective samples, not less than twenty- one (21) days before any such material is required for use in the Works.

Supplementary samples and their tests results shall be submitted to the Engineer at agreed times during construction, to confirm that the materials continue to conform to the specifications. The Engineer may withdraw his approval for the source of material, at any time when the material no longer meets the specified quality.

3.10.3 GEOTEXTILE FILTER FABRIC

The filter fabric shall be approved fibre geotextile which shall comply with the following minimum requirements:

• Mass	200g/m^2
• Pore size – 90% finer than	250 microns
• Tensile strength of a 20cm strip	23kN/m
• Tear strength trapezoidal	500N
• Permeability L/M2/S under 100mm head	30

It shall not be susceptible to degradation caused by sunlight. The filter fabric shall be laid and joined in accordance with the manufacturer's recommendations. The minimum overlap at layered joints shall be 1m.

3.10.4 CONSTRUCTION METHODS

The method and sequence of construction of the quays, and their protection and placing of filling shall be to the approval of the Engineer.

The rock potentially to be used for filling of the quay shall be formed by end tipping or placed with rock trays and shaped to the specified tolerance of finish. Methods of placing and trimming the core shall minimize segregation.

Before the filter fabric is placed on the inner face of a bound core, a layer of blinding rock is to be placed to protect the fabric from damage from spanning holes or protruding rocks.

The filter fabric shall be laid directly on the slope and shall be secured against floating. The Manufacturer's instructions for laying are to be followed. Exposure of the filter fabric to the sun shall be minimised by ensuring that any particular area of fabric is covered by rock within 48 hours.

If any surface is approved above profile, the subsequent layer thicknesses are to be maintained. The cost of the additional rock required will be deemed to be included in the Contract Price.

3.10.5 ROCK PROFILES AND TOLERANCES

Rock structures shall be constructed to the formation levels and rock layer profiles as shown on the Contractor's design drawings and when the surface profile is measured using the techniques specified below, shall comply with the following vertical tolerances.

Vertical Placing Tolerances for Rock

Depth of placing below Chart Datum	All rock apart from Primary Armour	All primary armour layers	
		On individual measurements (m)	Design profile to actual
Dry, i.e. above Chart Datum	±0,2m	±0,3D_{n50}	+0,35D_{n50} -0,25D_{n50}
Less than 5m*	+0,5m -0,3m	±0,5D_{n50}	+0,6D_{n50} -0,4D_{n50}
5-15m*	+1,0m -0,4m	±0,5D_{n50}	+0,6D_{n50} -0,4D_{n50}
Horizontal Scour Protection	+150mm -150mm	+200mm -200mm	+200mm -200mm

Note:
All tolerances refer to the design profile to actual mean profile unless stated otherwise.
*Excluding Horizontal Scour Protection

Notwithstanding the tolerances above, the following shall apply to armour layers:

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

2. Notwithstanding any accumulation of positive tolerances on underlying layers, the thickness of the layer shall not be less than 80% of the nominal thickness when calculated using mean actual profiles. Where an accumulation of positive tolerances arises and is acceptable to the Engineer,

the position of the design profiles will need to be adjusted to suit.

3. The difference in level of the peaks of adjacent rocks in upper layers shall not exceed the given tolerance.

Measurements to survey the profile shall be carried out using a probe with a spherical end of diameter 0,5Dn50. For a land-based survey this will generally be connected to a staff or EDM target; for an underwater survey it will generally be a weighted ball on the end of a sounding chain.

Measurements shall be carried out at the following intervals across the measurement profile:

1. All rock surfaces except the Primary Armour Layers – 1m

2. Primary Armour Layers – 0,75 x Dn50

Measurement profiles shall generally be at intervals along the length of the structure, not exceeding 10m, but may need to me more frequent where the profile is changing rapidly or on tight-radius curves. The sections shall be taken as the work progresses and before the structure is back-filled or covered by a subsequent layer or by a beach. No layer shall be covered by a subsequent layer until the profile of the former layer has been approved.

Measurements to survey the profile shall be carried out using a probe with a spherical end of diameter 0,5Dn50. For a land-based survey this will generally be connected to a staff or EDM target;

The sections shall be taken as the work progresses and before the structure is back-filled or covered by a subsequent layer or by a beach. No layer shall be covered by a subsequent layer until the profile of the former layer has been approved.

3.10.6 SETTLEMENT OF THE STRUCTURES

The Contractor shall assess settlement of the structure during and after the construction of the structure and shall make due allowance for the same. It is the sole responsibility of the Contractor to estimate the anticipated settlement of the structure based on the available soil data and / or his own soil investigations and his sequence of construction and to suitably construct the structure to an elevation that, at the end of the Defects Period, corresponds to the profile as shown on the Contractor's design drawings.

3.10.7 ROCK TRIALS

Trial lengths of each type of rock structure shall be constructed before continuing with the remainder of that section of work. The trial section shall be within a length of the permanent works, shall be approximately 15 metres long and at a location agreed with the Engineer.

The trial shall be used to determine a satisfactory method of selection and placing of rock. If the opinion of the Engineer the initial trail is unsuccessful, the trial shall be repeated in whole or in part at the Contractor's own expense until a satisfactory result is obtained.

The approved trial panel shall then be marked as such to provide a reference for operatives on the site.

3.11 TERMINAL PAVING AND UNBOUND SURFACE LAYER

3.11.1 WORK SCOPE

The scope includes the provision of pavements/unbound surface layer covering the Terminal T5 area of approximately 21 hectares, and at the interfaces with the existing Terminal T3, as indicated on the Layout Drawings.

All pavement/unbound surface layer areas shall be designed and constructed as a continuation of, or a connection to, the pavement areas already existing on the terminal. The extended pavement areas after completion of the Works shall function as one system and ensure efficient terminal operations.

The scope of works includes but is not limited to the design, supply, installation, construction, monitoring, testing and quality assurance and commissioning of the Works as described herein.

Pavements/unbound surface layer shall be provided for the following areas as defined on the Layout Drawings:

- Preassembly area up to the edge of the Outbound berth capping beam interface.
- Inbound berth area up to the edge of the Inbound berth
- Storage area
- Crew transfer roadway

- Paving for the ro-ro area shall be steel fibre reinforced concrete.
- Paving for the access road shall be steel fibre reinforced concrete.
- Paving for the crew transfer walkway shall be as per Section 3.11.8

The pavement/unbound surface area shall comprise new construction and shall include kerbs, barriers, road markings, signage and street furniture, provision for drainage, services and the like.

In the area of crossroads of vehicle traffic self-propelled modular transportation vehicles (SPMT's) and mobile harbour crane operation heavy duty curbs should be used to protect structures and equipment where deemed necessary such as light masts and power cabinets etc.

The design solutions and materials shall as a minimum be similar to and fully compatible with the materials already used on the existing terminal and shall be fit for use by the Employer's equipment.

3.11.2 FUNCTION

The pavements/unbound surface layer shall be designed, detailed and constructed such that an adequate balance between capital expenditure and operational maintenance is achieved throughout the specified design life. It shall provide a durable surface.

The design of the pavement shall withstand the operational loads, settlements and gradients outlined in these Employer's Requirements. The Contractor's design shall demonstrate that the limiting settlement criteria will be achieved.

The design of the paving/unbound surface layer shall take full account of settlement and differential settlement (including surface rutting), regardless of the actual distribution of equipment and components. Special measures in the form of transition slabs may be employed by the Contractor to eliminate the adverse

effects of excessive differential settlement of the surfacing adjacent to piled structures and other areas where there are rigid structures.

Monitoring of settlement, by approved means, shall be undertaken by Contractor to demonstrate that compliance with settlement criteria is being achieved during warranty period.

Designed and constructed pavement/unbound surface layer areas shall drain water in such a way that puddles are not created.

3.11.3 MATERIALS AND STRUCTURAL FORM

The surfacing material for the OWSB terminal (unbound surface layer) shall be designed predominantly as compacted unbound granular paving. However, this paving material shall be ‘tanked’ and wrapped so that that any surface water percolating through the gravel shall not enter into the sub-base.

The paving for the Ro-Ro ramp run areas and the access roads shall be designed as steel fibre reinforced concrete paving or similar approved.

The paving/ unbound surface layer shall be designed to withstand the loads defined within the Employer’s Requirements.

3.11.4 UNBOUND SURFACE LAYER

The unbound terminal surfacing layer must be constructed by means of a gravel layer or similar to be designed and installed by the Contractor. The specification of the surface gravel layer is shown below:

Standard for test	Egenskap/ characteristic	Kategori/Category	Sikte verdi Sieve size value	Forventa expected	Variasjonsband/ Variation limit
EN 933-1	Kornstørrelse Grain size EN 13285 Cl4..4.1	Tables 4 and 6 GC OC_{80}	63mm	100	100
			45mm	100	9 - 100
			31,5	97	80 - 99
			16mm	71	61- 79
			8mm	58	41 - 64
			4mm	31	31 - 49
			2mm	23	22 - 36
			1mm	17	13 - 30
			0,5mm	14	10 - 20
EN 933-1	EN 13285 Cl 4.3.2	Finstoff innhold/ Max Fines content	UF	8.1	UF 9
EN 933-3	EN 13285 Cl 4.3.2	Flisighetsindeks/Min FinesContent	LF	~	LFN
EN 1744-1	EN 13285 Cl5.4	Innhold av syrelig sulfat / Water Soluble Sulfate	Declared value	0,007	~
	EN 13285 Cl 4.2	Percentage Crushed Particles	Declared value	100	~
EN 1097-6	EN 13285 Cl 4.2	Vannabsorpasjon/Water absorption	%	0.6	~
EN 13286-4	EN 13285 Cl 5.3	Vannabsorpasjon/ Density v Optimum moisture content	Declared value	4,0	%
EN 13286-4	EN 13285 Cl 5.3	Densitet/ Density	Declared value	2,21	Mg/m^3
EN 1097-6	EN 13285 Cl 4.2	Korndensitet/Grain density Saturated-surface dry	(Mg/m^3)	2,68	Mg/m^3
EN 1097-1	EN 13285 Cl 4.2	Motstand mot slitasje/ Resistance to wear (micro deval)	$M_{DE}10$	2	≤10
EN 1097-2	EN 13285 Cl 4.2	Motstand mot knusing/ Resistance to fragmentation (LA)	LA25	23	≤25

Table 3-2: Surface Gravel Protection Layer Specification

3.11.5 SUBBASE

3.11.5.1 GENERAL REQUIREMENTS OF UNBOUND SUBBASE

Unbound subbases shall be made and constructed using materials free from silt, clay, dust and organic impurities and shall be laid over the finished earth formation and compacted. The sub-base material shall have an in-situ CBR value of more than 30% when compacted.

Materials shall have a water-soluble sulphate content not exceeding 1500mg of sulphate (expressed as SO_4) per litre when tested in accordance with EN 1744-1 clause 10.

Total sulphur (TS) content determined in accordance with EN 1744-1 clause 11 expressed as (S) shall not exceed 1% for aggregates other than air cooled blast furnace slag or 2% for air cooled blast furnace slag.

The material shall lie within the grading envelope of the table below, and not be gap graded

Standard	BS EN 13285 Categories for unbound mixture properties
Mixture requirement category -designation -maximum fines -oversize	 0/80 UF_3 OC_{75}
Grading requirement category -overall grading	 G_E

The properties of aggregates used in unbound mixtures shall comply with the selected requirements of EN 13242 listed below.

Standard	BS EN 13285 Categories for unbound mixture properties
Crushed or broken and totally rounded particles	$C_{90/3}$
Resistance to fragmentation – Los Angeles test	LA_{50}
Magnesium Sulphate Soundness	MS_{35}
Water absorption	The supplier shall state the value for the aggregate used
Volume stability of blast furnace slags	Free from dicalcium silicate and iron disintegration
Volume stability of steel (BOF and EAF) slags	V_5

The material shall be transported, laid and compacted without drying out or segregation.

Unbound material up to 225mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Unbound material of compacted thickness greater than 225mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 110mm. Where the layers of unbound material are of unequal thickness the lowest layer shall be the thickest.

3.11.5.2 COMPACTION OF UNBOUND SUBBASE AND SURFACE LAYER

Compaction shall be completed as soon as possible after the material has spread and in accordance with the requirements for the individual materials.

Special care shall be taken to obtain full compaction in the vicinity of both longitudinal and transverse joints.

Compaction of unbound materials shall be carried out by a method specified in the table below unless the Contractor demonstrates at site trials that a state of compaction achieved by an alternative method is equivalent to or better than that using the specified method.

The surface of any layer of material shall on completion of compaction and immediately before overlaying, be well closed, free from movement under compaction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material laid and compacted.

For the purposes of the table below the following shall apply:

- The number of passes is the number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in the operating mode (or struck, in the case of power rammers).

- The compaction plant in the table below is categorised in the terms of the static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle, the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.

- For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230mm. Where the spacing exceeds 230mm the effective width shall be the sum of the widths of the individual wheel tracks only.

- Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls:

- The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5km/h for a towed machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.

- Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in the table below for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other, the number of passes shall be calculated as for the roll with the smaller value. Alternatively the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value.

- Vibratory rollers operating without vibration shall be classified as smooth-wheeled rollers.

- Vibratory rollers shall be operated with their vibratory mechanism operating at the frequency of vibration recommended by the manufacturer. All such rollers shall be equipped, or provided with devices indicating the frequency at which the mechanism is operating is the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

- Vibration plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts:

- The mass per square metre of base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material.

- Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer. They shall normally be operated at travelling speeds of less than 1km/h but if higher speeds are necessary, the number of passes shall be increased in proportion to the increase in speed of travel.

- Vibro-tampers are machines in which an engine driven reciprocating mechanism acts on a spring system, through which oscillations are set up in a base-plate.

- Power rammers are machines which are actuated by explosions in an internal combustion cylinder; each explosion being controlled manually by the operator. One pass of a power rammer shall be considered to have been made when the compacting shoe has made one strike on the area in question.

- Combinations of different types of plant or different categories of the same plant will be permitted; in which case the number of passes for each shall be such proportion of the appropriate number in the table below as will together produce the same total compactive effort as any one operated singly, in accordance with the following table.

Type of Compaction Plant	Category	Number of layers not exceeding the following compacted thicknesses		
		110mm	150mm	225mm
Smooth wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll over 2700kg up to 5400kg over 5400kg	16 8	Unsuitable 16	Unsuitable Unsuitable
Pneumatic tyred roller	Mass per wheel over 4000kg up to 6000kg over 6000kg up to 8000kg over 8000kg up to 12000kg over 12000kg	12 12 10 8	Unsuitable Unsuitable 16 12	Unsuitable Unsuitable Unsuitable Unsuitable
Vibratory roller	Mass per metre width of vibrating roll over 700kg up to 1300kg over 1300kg up to 1800kg over 1800kg up to 2300kg over 2300kg up to 2900kg over 2900kg up to 3600kg over 3600kg up to 4300kg over 4300kg up to 5000kg over 5000kg	16 6 4 3 3 2 2 2	Unsuitable 16 6 5 5 4 4 3	Unsuitable Unsuitable 10 9 8 7 6 5
Vibrating plate compactor	Mass per square metre of base plate over 1400kg/m² up to 1800kg/m²	8 5 3	Unsuitable 8 6	Unsuitable Unsuitable 10

	over 1800kg/m² up to 2100kg/m² over 2100kg/m²			
Vibro tamper	Mass over 50kg up to 65kg over 65kg up to 75kg over 75kg	 4 3 2	 8 6 4	 Unsuitable 10 8
Power rammer	Mass over 100kg up to 500kg over 500kg	 5 5	 8 8	 Unsuitable 12
Smooth wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll over 2700kg up to 5400kg over 5400kg	 16 8	 Unsuitable 16	 Unsuitable Unsuitable
Pneumatic tyred roller	Mass per wheel over 4000kg up to 6000kg over 6000kg up to 8000kg over 8000kg up to 12000kg over 12000kg	 12 12 10 8	 Unsuitable Unsuitable 16 12	 Unsuitable Unsuitable Unsuitable Unsuitable
Vibratory roller	Mass per metre width of vibrating roll over 700kg up to 1300kg over 1300kg up to 1800kg over 1800kg up to 2300kg over 2300kg up to 2900kg over 2900kg up to 3600kg over 3600kg up to 4300kg over 4300kg up to 5000kg over 5000kg	 16 6 4 3 3 2 2 2	 Unsuitable 16 6 5 5 4 4 3	 Unsuitable Unsuitable 10 9 8 7 6 5
Vibrating plate compactor	Mass per square metre of base plate over 1400kg/m² up to 1800kg/m² over 1800kg/m² up to 2100kg/m² over 2100kg/m²	 8 5 3	 Unsuitable 8 6	 Unsuitable Unsuitable 10
Vibro tamper	Mass over 50kg up to 65kg over 65kg up to 75kg over 75kg	 4 3 2	 8 6 4	 Unsuitable 10 8

Power rammer	Mass over 100kg up to 500kg over 500kg	 5 5	 8 8	 Unsuitable 12
Smooth wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll over 2700kg up to 5400kg over 5400kg	 16 8	 Unsuitable 16	 Unsuitable Unsuitable
Pneumatic tyred roller	Mass per wheel over 4000kg up to 6000kg over 6000kg up to 8000kg over 8000kg up to 12000kg over 12000kg	 12 12 10 8	 Unsuitable Unsuitable 16 12	 Unsuitable Unsuitable Unsuitable Unsuitable

3.11.5.3 GENERAL REQUIREMENTS OF CEMENT BOUND GRANULAR MATERIAL (CBGM) SUBBASE

Material to be stabilised with cement shall consist of an approved granular aggregate complying with EN 13242. Furthermore, this shall be a material such as crushed gravel, sand, hard clinker, crushed coral, rock pit run laterite or recycled material. The following requirements apply:

- Resistance to fragmentation of coarse aggregate LA50
- Acid soluble sulphate content AS0.2
- Total sulphur content S1

Aggregate grading shall comply with grading envelope G1 from of EN 14227-1 Annex B.

The size fraction of the aggregate passing the 0.425 mm size test sieve shall be non-plastic as defined by EN 1377-2 and tested in compliance therewith.

The material shall not have a soluble sulphate content exceeding 2.5g per litre.

3.11.5.4 CBGM SUBBASE MIX PROPORTIONS

The ratio of cement to aggregate by weight (including any absorbed moisture but excluding free water in the aggregate) shall be sufficient to produce average crushing strengths to design requirements. The binder content shall not be less than the minimum binder content of 3% (per mass).
Where mixing in plant using volume batching, the amount of binder will be increased by 1%.

During processing only sufficient water shall be available in the material to hydrate the cement and enable satisfactory mixing and compaction to be achieved. Any added water shall be through an integral spray-bar on the stabilising machine, to the satisfaction of the Engineer.

3.11.5.5 LAYING CBGM SUBBASE – MIX IN PLANT

Mixing plant, transport and laying equipment must be of consistent capacity and suitable for the rate of working required.

Materials shall be mixed in a paddle or pan type mixer, which may be of batch or continuous type. If batch mixers are used the mixing time shall be not less than one minute. If continuous mixing is used the paddles, baffles and rate of feed of materials shall be adjusted to give a uniformly mixed material. If a spray is distributing water into the mixer, it shall be adjusted to give uniformity in moisture content throughout the mix.

Materials when mixed shall be removed at once from the mixer and transported directly to the point where it is to be laid. It shall be protected from the weather both during transit and whilst awaiting tipping, unless otherwise agreed by the Engineer. Segregation shall be prevented during loading, transport and discharge.

Unless otherwise agreed by the Engineer, materials shall be laid in thicknesses that enable the specified density and surface tolerance to be achieved with the equipment being used, whilst avoiding segregation and drying out.

Minimum lift thickness shall be not less than 150mm and not more than 300mm thick.

Construction of layers including multiple lift layers and any reworking shall be completed within the lesser of 8 hours, the Construction Period specified below or the mixture setting time. The time shall be measured for the addition of cement to completion of compaction.

The Construction Period, in degree hours shall be the product of the average air temperature above 3˚C and the time measured in hours. The maximum construction period shall be 35 ˚C hours.

Should compliance with the Construction Period not be met, the contractor may propose measures which, when implemented, ensure that the multiple layers behave as a single, homogeneous layer. Such measures could include scarifying the upper surface of a layer prior to placing the subsequent lift and/or the application of a bonding agent between lifts. Full details of such measures should be presented to the Engineer for his approval.

Alternative methods to those described above may be employed provided that the Contractor can show, by site trials, that the method will give a material with the properties required in all respects.

Cement bound materials shall be laid in individual widths not less than 2m and not exceeding 5m.

3.11.5.6 SAMPLING AND STRENGTH TESTING OF CBGM SUBBASE

Five random samples shall be taken for each 1,000m2 or part thereof, laid each day including trial areas. The making, curing and testing of cubes shall be in accordance with EN 13286-51 and EN 12390-3. Cubes for testing shall be 150mm unless otherwise agreed by the Engineer for testing at 28 days and shall give a minimum characteristic compressive strength of 10 N/mm2.
If the test cubes do not attain the minimum compressive strength the Contractor may, without expense to the Employer, elect to cut cores from locations selected by the Engineer to determine the equivalent 28 days cube strength and density of the concrete in the works. Concrete represented by these cores, which fail to meet the minimum requirements of the Specification, shall be broken out and replaced with compliant material.

Core holes remaining in the works shall be reinstated in mass concrete at the Contractor's expense. Refer to the concrete part of the specification for details of this material.

The mix shall be altered if the average of five consecutive results falls less than 85% of the characteristic strength.

3.11.5.7 JOINTS IN CBGM SUBBASE

The Contractor shall organise the work so that longitudinal joints against hardened material are avoided. Before work proceeds against a longitudinal joint of such material the edge compacted earlier, if it has been exposed for more than one hour, shall be cut back vertically to produce a face of the specified thickness of layer and of properly compacted material.

Positions of joints shall be agreed with the Engineer before construction commences. Joints shall be planned to be as far away as practically possible from high load areas.

Compacting equipment shall not bear directly on hardened or partially hardened cement treated material previously laid, other than that necessary for achieving the specified compaction at the joint.

Special care shall be taken to obtain full compaction in the vicinity of all joints and in the case of cement treated material the Contractor shall use special small compactors in addition if necessary. Any poorly compacted cement treated material in the vicinity of construction joints shall be removed and replaced with compliant material.

Any loose or defective material shall be treated as specified but if this cannot be done within 24 hours of mixing, the making good shall comprise of the material being broken out to the full thickness of layer, removed and replaced with freshly mixed material compacted to Specification.

Unless the material is compacted against forms or haunches, the edge of all material, which has been laid for more than one hour, shall be cut back to a square, vertical face over the full layer depth before additional material is laid alongside.

Where the material is laid in more than one layer, the vertical construction joints in successive layers shall not align.

For CBGM with a compressive strength in excess of C8/10, the fresh material shall have transverse cracks induced during construction at a maximum longitudinal spacing of 3 m +/- 10% by grooving the material to a depth which leaves a vertical groove not more than 20mm wide. The depth of the induced crack shall be between one half and two thirds the layer thickness after compaction, over the full width of the pavement. An approved crack inducing material shall be inserted into the grove prior to final compaction, extending from the bottom of the groove to not less than half the height of the groove. During final compaction of the material, the groove shall be closed at the surface of the crack inducing material shall be fully encased and remain continuous within the closed groove.

Joints in the material below rigid concrete pavement shall be staggered by at least 300mm from pavement joints generally, and 1000mm from transverse joints.

3.11.5.8 COMPACTION OF CBGM SUBBASE

Compaction of the mixture shall be carried out by means of a vibratory roller, which applies a mass of more than 1800 kg per metre width of vibrating roll or by a vibratory compactor with a mass per unit area under the base plate of more than 2100 kg/m2. Where required by the Engineer, the vibrating roller shall be operated both longitudinally and transversely and the surface finished by rolling without vibration. Compaction shall be continued until visible movement of the surface of the layer beneath the roller ceases, and the density of the compacted base meets the requirements for the density in the Employer's

Requirements. The maximum period of time between mixing of the material and completion of compaction of any given material shall be 2 hours.

Making-up of level, after initial compaction, shall not be permitted for one lift working or the uppermost lift of multiple lift working. For multiple lift working scarifying of compacted material surfaces is required between lifts.

Surface trimmed mixture and risings from ramps can be used in the layer provided it is within the construction period of the binder and is uncontaminated and has not dried excessively.

On completion of compaction the surface shall be well-closed, free from ridges, cracks, loose material, pot-holes, ruts, shear planes and other defects. All defective areas shall be rectified within the construction period for the binder as stated in Section 3.11.5.5. If rectification is not completed within the construction period, the defective area shall be removed to the full thickness of the layer, and new mixture laid and compacted.

3.11.5.9 DENSITY TESTING OF CBGM SUBBASE

The average density of a saturated core obtained from sets of 5 tests for each 1,000m2 or part thereof laid each day, carried out in accordance with EN 12390-7 shall not be less than 95% of the overall average density. Failure of more than one of five consecutive results will result in the Contractor having to remove and replace the affected area.

The cores will be 100mm diameter and cut from the full depth of pavement. Measurements shall be made between 4 hours and 24 hours following the completion of compaction.

Core holes remaining in the Works shall be reinstated in MC1 concrete at the Contractor's own expense.

3.11.5.10 SURFACE FINISHES AND TOLERANCES OF CBGM SUBBASE

The finished surface of the CBGM sub-base shall lie within the tolerances of +/-15mm. High spots shall be removed to achieve an even surface. Surface levels shall be checked on a 5m square grid.

The method of correction will depend on the period that has elapsed between detection of the error and the time of mixing. If this is less than 2 hours, the surface shall be scarified to a depth of not less than 50 mm and supplemented with freshly mixed material as necessary and re-compacted, to Specification. If the period is 2 hours or more the full depth of the layer shall be removed from the pavement and replaced to Specification. In either case the area treated shall not be less than 5 m long by 2 m wide. For areas corrected within 7 days of laying, no construction traffic or compaction plant shall use the surrounding satisfactory areas.

3.11.5.11 CURING OF CBGM SUBBASE

Each layer of compacted CBGM not covered within a 2 hour construction period either by another layer of the same material, or by another pavement course, shall be cured for a period not less than 7 days or until the next pavement layer is laid, with impermeable plastic sheeting. The sheeting shall be adequately secured with joints overlapped at least 300mm. The final layer of CBGM shall be cured for a minimum period of 7 days before placing the next paving layer.

3.11.6 SUBGRADE

3.11.6.1 PREPARATION

All earthworks to form formation/subgrade are to be carried out in accordance with EN 6031.

Existing surfaces shall be excavated to a depth at which the material is accepted by the Engineer as suitable to form the subgrade, subject to the requirements of the Employer's Requirements, and to provide sufficient depth to allow the construction of the pavement to the levels and details identified in the relevant drawings.

Where necessary to raise the level of the subgrade for construction of the pavement to the required levels, filling shall be carried out in accordance with EN 6031. Filling material and method for filling as proposed by the contractor is to be agreed with the Engineer prior to commencement of filling activities.

All demolition works of existing buildings and structures, including foundations, previous pavement construction, tree roots and other vegetation, obsolete services and all other obstructions that are not to be retained, shall be complete and all demolition waste removed prior to testing and acceptance of the subgrade.

3.11.6.2 TOLERANCES

The sub-grade shall be graded to within tolerances of +20mm/-30mm. Tolerances shall be checked on a 5m grid.

Subgrade shall be trimmed to the correct level and proof rolled and tested ready to receive the first pavement layer.

3.11.6.3 CBR REQUIREMENT

It is envisaged that a subgrade CBR of 15% or greater may be achieved however, this shall be confirmed by the Contractor. Nevertheless, the contractor is responsible for ensuring that the pavement design is consistent with the soil conditions encountered on site. This shall take account of the heavy loads resulting from the container stacking and repetitive heavy equipment moves which are more demanding than a typical highway project, for example.

3.11.6.4 TESTS

The following tests are required to be undertaken to confirm the acceptance of the finished surface.

In situ CBR tests shall be carried out on the subgrade at locations based on a minimum 25m grid. Unless otherwise agreed by the Engineer. Additional CBR tests shall also be carried out at any other locations required by the Designer.

In situ CBR values will be determined by Dynamic Cone Penetrometer (DCP) tests. The test results shall be supplied to the Engineer promptly at the end of each test.

Prior to large scale commencement of in situ CBR tests, the results shall be correlated by comparison with laboratory CBR tests to be carried out on samples of adjacent subgrade material in accordance with Clause 7 of EN 1377-4 and with in-situ measurements of the subgrade using the cone penetrometer. All test results and proof of the correlation between in situ and laboratory tests shall be provided to the Engineer. The Employer shall also be supplied with all information he deems necessary to satisfy himself of the accuracy of the in-situ tests. Once correlation of CBR values and cone penetrometer measurements has been established and accepted by the Engineer, large scale in situ DCP testing may commence.

In the event of a change in the equipment and/or methods used for the in situ testing, further proof of the accuracy of the new methods and correlation of the results shall be provided to the Engineer.

3.11.6.5 TEMPORARY PAVEMENT AREAS

In areas where granular or CBGM sub-bases have previously been laid to form temporary working platforms, and for which CBR results for the underlying subgrade are not available or at the request of the Engineer, the sub-base shall be locally excavated down to the subgrade to enable CBR tests to be carried out.

3.11.6.6 UNACCEPTABLE SUBGRADE

Subgrade is considered to be unacceptable if:

- It comprises organic, degradable or other unacceptable material, or
- It fails to achieve the CBR stipulated in the design

Unacceptable subgrade shall be rectified, including excavation, removal from site and replacement with fresh suitable material of the same classification laid and compacted to Specification, or as otherwise directed by the Engineer. The depth of replacement shall be agreed with the Engineer. The subgrade shall then be subject to satisfactory retesting.

3.11.6.7 CAPPING LAYER

If a capping layer is required, the contractor may elect to incorporate geogrid into this element or to use soil stabilisation, subject to adequate substantiation by the Contractor.

3.11.7 PROOF ROLLING

Proof rolling shall be performed in the following situations:

- On completion of cut excavation at the final subgrade level.
- On completion of the excavation/ trimming of material for the areas designated to receive fill or insitu HBM binder mixing.
- On completion of excavation to structure/pit platform level.

Proof rolling shall consist of a minimum of five (5) passes of an approved vibrating or non-vibrating roller of not less than 16 tonne dead weight to achieve a final relative dry density of not less than 98% standard compaction.

Special attention shall be paid to the compaction of subgrade below and adjacent to permanent structures including pits, kerbs and channels, drains and footings to achieve the required 98% compaction, this may require the use of an alternative compactor or roller.

A final “dead roll” (no vibration) of the entire area shall be carried out by the Contractor in the presence of the Employer to identify any “soft spots” or areas of the subgrade which fail to meet the CBR requirements.

Proof rolling shall be carried out over the full extent of the areas nominated in the situations above.

The frequency of all in-situ testing at subgrade level or at a level ready to receive the first layer of fill shall be as defined in these Employer’s Requirements.

3.11.8 CREW TRANSFER WALKWAY

A light asphalt pavement on a typical CBGM base over a HBM subbase is required for the crew transfer walkways although the Contractor may produce an alternative smooth paving design for the walkways which meets the Employer's Requirements. For guidance, this light asphalt pavement is equivalent to a typical sealed cycle path, however, all paving must satisfy the requirements of the Environmental Decision and drainage design adopted.

3.11.9 TOLERANCES

3.11.9.1 HORIZONTAL ALIGNMENTS

The edge of the pavement/unbound surface layer as constructed and all other parallel alignments shall be correct within a tolerance of 25mm, except for kerbs, channel blocks and edge lines which shall be laid with a smooth alignment within a tolerance of ±13mm.

3.11.9.2 SURFACE LEVELS OF PAVEMENT/UNBOUND SURFACE LAYER COURSES

The level of any point on the constructed surface of the pavement courses shall be design level subject to the appropriate tolerances stated in the table below.

Surface	Tolerance
Pavement/unbound surface layer Base Layer	±6mm
Pavement/unbound surface layer adjacent to drains / gullies or other structures	+6mm -0mm
Pavement/unbound surface layer not adjacent to drains / gullies or other structures	+6mm -0mm
Sub-base	±15mm
Sub-bases other than above	+10mm -30mm

Notwithstanding the tolerance permitted in surface levels of pavement/unbound surface layer courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement/unbound surface layer, excluding the sub-base, by more than 10mm from the specified thickness. The levels of any two adjacent concrete blocks shall not differ by more than 2mm.

For checking compliance with this Clause, measurements of the surface levels of all courses will be taken on a 10m grid of points. In any length of pavement/unbound surface layer, compliance shall be deemed to be met for all surfaces, other than the final pavement surface/unbound surface, when not more than one of ten consecutive measurements taken longitudinally or one in any transverse line, exceeds the tolerances permitted in the table above, provided that this one measurement shall not exceed by more than 5mm the tolerance for the course concerned. For the final pavement/unbound layer surface the tolerance given in the table above shall apply to any point on that surface.

The Contractor shall perform level surveys of the port area to be paved/surfaced to demonstrate that the design levels have been achieved and are within tolerance. Surveys shall be undertaken at the following stages before the ensuing section of works are to be undertaken:

- Prior to placing the sub-base

- Prior to placing the concrete/unbound surface layer
- After placing the concrete/unbound surface layer.

If the level survey demonstrates that the levels are not within the specified tolerances, the Contractor shall submit proposals for remedial action for the approval of the Engineer. Such proposals will only be accepted if the specified constituent pavement thicknesses are achieved as a minimum.

3.11.10 WATERTIGHT MEMBRANE

All pavement subbases and surface course gravel must be lined and contained within an impermeable membrane of at least 2000 gauge.

3.12 CONCRETE

3.12.1 MATERIAL PROPERTIES

Concrete works shall be designed and executed in full accordance with the PSA's Concrete Durability Guidelines provided in the Disclosed Data, including the key requirements provided below.

The minimum concrete grade to apply shall be C32/40, i.e. cylinder strength 32 MPa or cube strength 40 MPa, tested at 28 maturity days, in accordance with BS EN 12390-3.

Design parameters for the concrete classes shall be based on the table below in accordance with EN 1992-1.1:2004. A brief summary of the key parameters is listed below.

Class	Section of Works	f_{ck} (MPa) cylinder strength	f_{ck} (MPa) cube strength	E_{cm} (GPa)
C40/50	All structural reinforced concrete unless noted otherwise	40	50	35
C32/40	Mass concrete	32	40	33

In addition, the concrete materials and concrete design philosophy used shall conform to PSA's Environmentally Sustainable Concrete Guidelines provided in the Disclosed Data.

All reinforcement steel shall have a characteristic yield strength of 500N/mm^2.

3.12.2 DURABILITY

3.12.2.1 INTRODUCTION

The durability of concrete shall be designed in accordance with PSA's Concrete Durability and Technology Specification Framework for Maritime Terminals and Environmentally Sustainable Concrete included in the Disclosed Data.

3.12.2.2 GLOBAL TEMPERATURE CLASS

In accordance with PSA's Concrete Durability and Technology Specification Framework for Maritime Terminals, the global temperature class for Gdansk, Poland is XT1 with an annual mean temperature range of between 5.0-15.0 degrees Celsius.

3.12.2.3 REINFORCED CONCRETE DURABILITY

Different areas of the works will need different classes of concrete to be specified based on their exposure class. These will depend on the position of the structural element and can be categorised as either buried, submerged, splash, spray, tidal and atmospheric. The exposure classes to be used for the maritime structural elements are as follows:

- Reinforced concrete cope and other structures: XS2/3 and XS3
- Permanently submerged concrete structures: XS2
- Onshore concrete structures (e.g. rear crane beam): XS1

The compressive strength class of each element shall be chosen in accordance with BS 6349-1-4-2004 Table 1. This table relates the minimum cover required to the exposure class, concrete strength class, cement type, and water / cement ratio for the given design life.

SULPHATE CLASS

The sulphate content in soil and groundwater shall be assessed and classified using limits set out in PSA's Concrete Durability and Technology Specification Framework for Maritime Terminals provided in the Disclosed Data, which are based on the XA classes in BS EN 206-1. Should the sulphate content in the soil or ground water warrant the use of a concrete sulphate class, the following table give the indication of the class shall be used.

Sulphate Class	Sulphate Content	
	Groundwater, tested per BS EN 196-2 [12] [mg/l]	Soil, tested per BS EN 196-2 [12] [mg/kg]
XA 1	≥200 and ≤600	≥2,000 and ≤3,000 a)
XA 2	>600 and ≤3,000	≥3,000 a) and ≤12,000
XA 3	>3,000 and ≤6,000	>12,000 and ≤24,000
a) 3,000 mg/kg shall be reduced to 2,000 mg/kg in the buried zone where there is a risk of accumulation of sulphate ions in the concrete due to wetting/drying cycles (due to e.g. time-dependent changes in groundwater or seawater level).		

As a minimum exposure class XA1 shall be used for design but must be verified by the Contractor by examining the chemical testing data provided as part of the disclosed data.

CHLORIDE-INDUCED CORROSION

Exposure class XS3 shall be considered for concrete design based on chloride induced corrosion from seawater.

CARBONATION-INDUCED CORROSION

Exposure class XC4 shall be considered for concrete design based on carbonation induced corrosion.

ABRASION

The physical process of abrasion shall be considered for all reinforced concrete elements. PSA's Concrete Durability and Technology Specification Framework for Maritime Terminals classifies two types of abrasion, common to maritime structures, and provides additional requirements that shall be implemented to the concrete mix design and/or aggregate in the cases described. In addition to requirements, the final finish of concrete for quay decks and slabs will influence abrasion resistance.

Appropriate finishing and curing operations shall be implemented to maximize abrasion resistance of the quay decks and slabs with due consideration of traffic/wheel type and loading, any need for air entrained concrete, requirements to skid resistance, etc.

FREEZE THAW

All concrete mix shall be designed to resist freeze thaw attack in accordance with BS EN 206-1 and BS EN 197-1. The appropriate freeze thaw attack XF classes for the concrete element being designed should be used subject to the approval of the Engineer. Aggregates in accordance with EN 12620 with sufficient freeze/thaw resistance shall also be used in the concrete design. As a minimum, all concrete shall be designed to meet exposure class XF4.

TESTS FOR CONCRETE DURABILITY AGANST FREEZE THAW ATTACK

Concrete shall be tested for durability against freeze thaw attack in accordance with RILEM TC 117-FDC/CDF and CEN/TS 12390-9 CF-/CDFT. Tests for both scaling and cracking shall be performed under the recommendations of the guidance quoted. The minimum number of specimens, specimen size and freeze thaw cycles etc shall conform to RILEM TC 117-FDC/CDF and CEN/TS 12390-9 CF-/CDFT requirements for the CF-/CDFT tests to be performed.

ALLOWABLE CRACK WIDTH

All reinforced concrete elements shall be checked for serviceability requirements.

The maximum crack width shall be 0.30mm at nominal cover for quasi-permanent load combinations.

CONCRETE COVER TO REINFORCEMENT

The minimum concrete cover shall be in accordance with PSA's Concrete Durability Guidelines and are as follows:

Exposure zone	Nominal cover [mm]	Minimum cover [mm]
Atmospheric	50	40
Submerged/buried	75	65
Splash/spray/tidal	75	65

Based on the above, the minimal cover to be used for the design of reinforced concrete structures shall be 75mm.

3.12.2.4 Reinforcement

Steel reinforcement for the project using Eurocodes shall comply with EN 10080 Steel for the reinforcement of concrete. *Weldable reinforcing steel*. All reinforcement shall be accurately placed and adequately supported before concrete is placed. Spacers shall be provided to all bottom reinforcement and between reinforcement and all formed surfaces. Concrete spacers shall be fabricated from the same quality of concrete as that to be used in the member/section/pour. No ferrous tie wire shall be placed in the concrete cover zone.

3.12.2.5 General

The Contractor shall carry out all concrete work in accordance with the Contractor's specification. The design and specification for concrete construction shall be in accordance with the existing regulations, standards, opinions, decisions and modern engineering practice and knowledge. The Contractor's specification shall be approved by the Engineer. In addition, the following general principles shall be adhered to for concrete structures.

CONCRETE FINISHES

All exposed concrete shall have a fine smooth finish except the quay deck which shall have an approved brush finish. All exposed arises and ultimately exposed pre-cast unit arises, shall have 50mm chamfers except the edge of the quay which shall have a 100mm chamfer against paving shall have 10mm bull-nosed radius.

CAST-IN ITEMS

Galvanized or stainless steel items cast into concrete shall not be permitted to come into contact with steel reinforcement or other steel cast-in items. Holding down bolts shall be cast in to the correct level ± 3mm and vertical and shall be adequately supported by templates and accurately positioned before concrete is placed; ducts shall be adequately restrained to resist movement.

CLEANLINESS

Before concreting the reinforcement and other embedded items shall be thoroughly cleaned of all deleterious matter including concrete splash from previous concreting operations. Every precaution shall be taken to ensure that contamination due to wind-borne dust or other organic or chemical products from adjacent operations does not occur.

CONSTRUCTION JOINTS

Where fresh concrete is to be placed against a previous pour, preparations shall be taken to provide adequate and clean construction joints. Such preparation shall include scabbling of previous surfaces to remove laitance and to expose locked in aggregates without damage, and cleaning of surfaces by water/air jetting to remove deleterious materials or debris. (An acceptable alternative to scabbling would be 'green cutting' by water/air jetting of fresh but initially set concrete surfaces to provide an acceptable construction joint finish).

CURING AND PROTECTION OF CONCRETE

All exposed fresh concrete shall be protected during hardening from the harmful effects of sunshine, moisture and drying winds. Exposed top surfaces of concrete shall, immediately after finishing, be covered with polythene sheeting until the concrete has hardened sufficiently, when clean wet hessian shall be inserted under the polythene and the whole pour substantially sealed to prevent air circulation and the drying

of the hessian. Polythene sheeting shall be retained for not less than 3 days from placing the concrete. The hessian shall be retained for the whole of the wet-curing period. Vertical and soffit surfaces of the concrete may be protected against initial evaporation by retaining formwork in place for prescribed periods. On removal of the formwork, wet-curing procedures shall be followed. Care shall be taken to ensure that concrete surfaces are not allowed to dry out at any time. Surface defects shall be made good within 24 hours of removing formwork. Alternative curing methods shall be subject to the consent of the Engineer.

3.13 STEELWORK

3.13.1 GENERAL

Any structural steel frame shall be designed in accordance with the relevant regulations, Standards and Codes of Practice for Structural Steelwork Design approved by the Engineer. The supply and quality of all structural steelwork, fabrication, transportation, handling and erection shall be in accordance with the relevant Codes of Practice.

The Contractor shall perform tests and provide test certificates, or obtain the manufacturers' test certificates for the Material to be used. The tests shall be carried out by an approved testing authority and shall include Chemical Analysis, Tensile, Impact, and Bend and Flattening tests. If any sample fails a test, the consignment it represents may be rejected in part or in total as decided by the Engineer.

The Contractor shall be responsible for producing detailed fabrication drawings for approval by the Engineer which shall include:

- Plans, sections and details indicating profiles, sizes and the specific location of structural members.
- The locations and details of movement joints in the structure.
- Connection details – welded connections to be identified using standard Polish or British recognised welding symbols, with net weld lengths indicated.

The Contractor shall submit the following to the Engineer for information prior to commencement of fabrication:

- The manufacturer's Mill Certificates certifying that steel members meet the specified requirements;
- Mill Test Reports indicating structural strength, destructive and non-destructive test analysis;
- Welders' Test Certificates which shall verify that welders employed on the Works qualified within the previous 12 months for the weld procedures they shall be required to undertake in the fabrication process. The Contractor shall submit to the Engineer copies of all test records for each welder commencing work on the Site (but welders may be subject to approval by on-site practical testing).

Metal-arc welding of steel shall be in accordance with the relevant PN/EN Standard Codes of Practice. The Contractor shall be required to submit his proposals in this respect to the Engineer but consent to the welding procedure shall not relieve the Contractor of his responsibilities under the Contract.

Diagonal braced frames in the external elevations shall be positioned having regard to:

- the avoidance of doors and windows;
- compatibility with the positions of movement joints;
- the ability of the foundations to transmit to the ground the associated vertical and horizontal forces.

3.13.2 MATERIAL PROPERTIES

Primary structural steel elements shall have a minimum yield strength of 355N/mm^2.

Secondary structural steel elements shall have a minimum yield strength of 275N/mm^2.

Dowel bars shall be stainless steel of minimum grade 1.4436, with a minimum ultimate tensile strength of 500 N/mm^2 and minimum yield strength of 240 N/mm^2.

3.13.3 DURABILITY

3.13.3.1 General

All structural steel members, other than cold-formed sections, shall have a shop and site-applied protective coating system. Surface preparation and application of paint coatings shall be strictly in accordance with the manufacturer's instructions by air-less spray, and only thinners recommended by the paint manufacturer shall be employed. Final colour shall be subject to the approval of the Engineer. All external hot-rolled or cold-formed steel sections shall be hot dip galvanised to DIN ENISO 1461 except where agreed by the Engineer. Minimum thickness of zinc layer shall not be less than 150µm. Steel elements shall also be protected with epoxy paint kit-No. S9. 13 polyurethane according to PN- EN ISO12944-5:2001 suitable for corrosion category C5-MPN- EN ISO12944-2:2001. The degree of surface quality to be Sa 2-1/2 according to ISO8501-1.

3.13.3.2 Corrosion allowances

Steelwork corrosion allowances shall be in line with EN 1993-5:2007, PN-ISO-8501 or the PSA Minimum Coating Requirements for Quay Furniture and Marine Fixtures Guideline provided in the Disclosed Data (whichever is more stringent).

No corrosion allowance is required to be considered for the inner side of tubular piles if there is no exposure to air (i.e. the upper part of the piles are plugged with reinforced concrete).

The actual corrosion allowances over the specified design life shall take account of the anticipated life of any coatings.

3.13.3.3 Pile coating

Unless sufficient sacrificial steel is provided, the upper sections of steel piles shall receive a protective coating which shall extend from the point at which the pile intersects with the reinforced concrete cope and extending as deep as necessary to be complimentary with other corrosion protection measures.

Pile coatings shall be compliant with PN-ISO-8501.

3.13.3.4 Cathodic protection

The contractor shall investigate the possibility of ALWC (MIC) and if it has been identified within 100km of the Site then the piles shall be protected with a cathodic protection system. If ALWC (MIC) has not been identified, then the piles shall be fitted with brackets to allow for future installation of a cathodic protection system.

A cathodic protection system in the form of galvanic anodes shall be used as the secondary protection system along with the pile coating. Provision shall be made for the installation of sacrificial anodes at the construction stage.

The Contractor's specification shall be approved by the Engineer. In addition, the following general principles shall be adhered to for steel structures:

- All steel components other than piles shall be protected against corrosion with a protective treatment system appropriate to the marine environment.
- The protection of steel piling against corrosion shall be based on the principle of minimizing whole life cost, consistent with a minimum design life of 75 years. In estimating rates of corrosion, the recommendations within PN-EN ISO 12944 and any other existing recommendations shall be used.
- Any steelwork requiring painting shall comply with PN-ISO-8501 and any other existing recommendations.
- Above the immersion zone any corrosion protection shall have a maintenance-free design life of 15 years.