PORTS ENERGY AND CARBON SAVING

PECS

REPORT BY PARTNER NUMBER 8 – PORTSMOUTH CITY COUNCIL

Report D.3.8.1 The Building of No 4 Link span for Portsmouth

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A1 Description of works and environment

A1.1 Outline Description of the Works

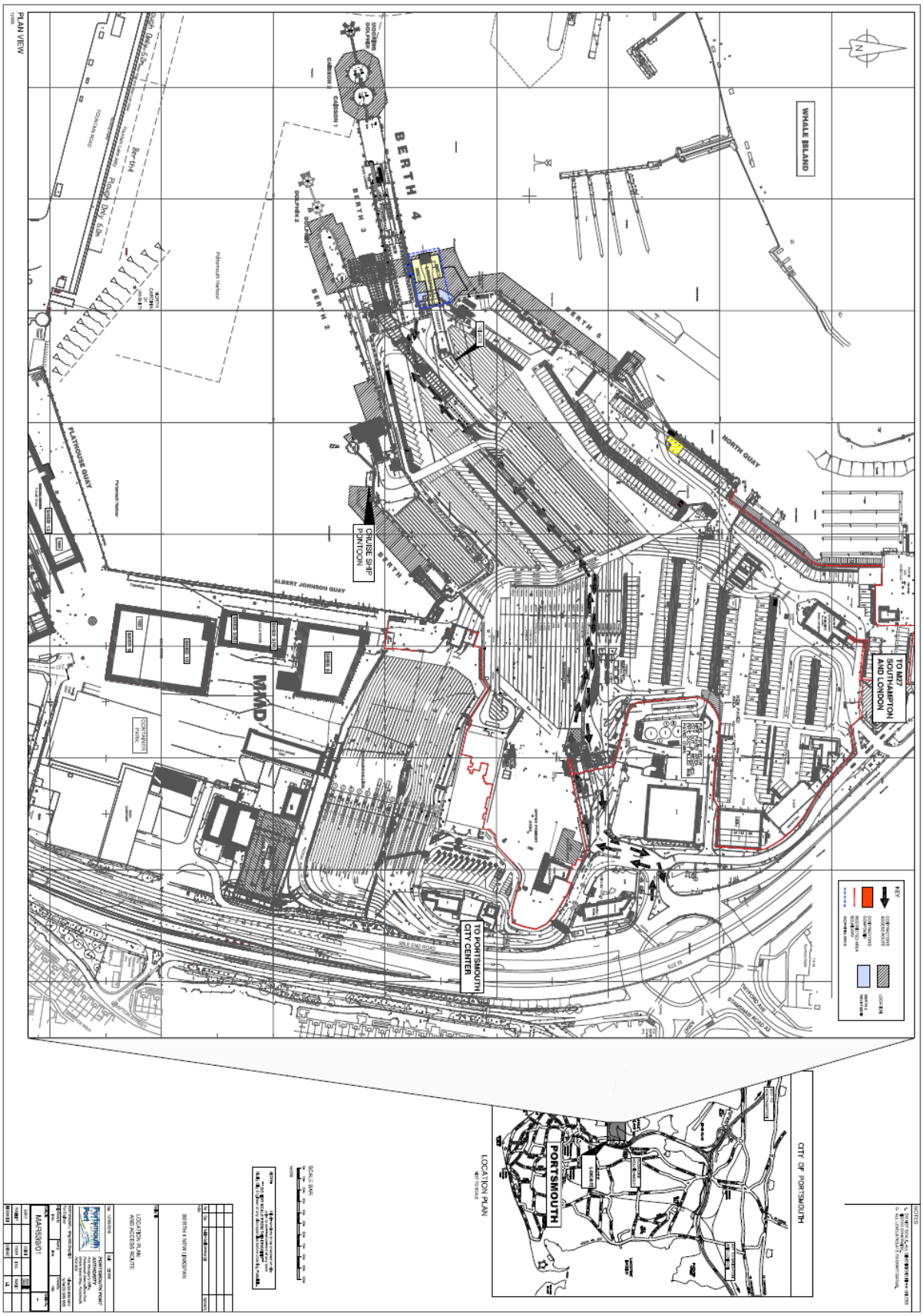
a. The Works comprise the design and fabrication of a double deck linkspan, its transportation to Portsmouth Harbour, installation on to civil engineering supports, commissioning and initial superintendence of operation and all designer and Contractor duties under CDM 2015.

b. The linkspan is to be designed and constructed in accordance with, and classified as, a Lloyd's Register classification ✠AT Passenger and Vehicle Linkspan.

A1.2 Installation Site

The b. Loading of the quay/jetty adjacent to Berth 4 is to be established by the contractor.

a. The linkspan is to be installed at Berth 4, Portsmouth International Port, Portsmouth Harbour.


PLAN VIEW
BERTH 4
BERTH 3
BERTH 2
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WHALE ISLAND
NORTH QUAY
FLATHOUSE QUAY
ALBERT JOHNSON QUAY
CRUISE SHIP PONTOON
TO M27 SOUTHAMPTON AND LONDON
TO PORTSMOUTH CITY CENTER
MMD
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KEY
LOCATION PLAN
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CITY OF PORTSMOUTH
SCALE BAR
BERTH 4 NEW LINKSPAN
LOCATION PLAN AND ACCESS ROUTE
MAR5380/01

A1.3 Tides

a. A link span is very simply the floating link between the ship and the port itself. It is unusual for any two ships to have exactly the same freeboard (height above sea level) and therefor the linkspan must be fully adjustable for height. Whilst the link span and ship will both be prone to the same tides, the linkspan itself must be built such as to be afloat at all times but also have sufficient buoyancy to support the discharging cargo of freight and passenger vehicles. The heights of High and Low water are therefore critical. The following tidal data has been extracted from the 2016 Admiralty Tide Tables in respect of Portsmouth

Description	**Level w.r.t. Chart Datum**
Highest Astronomical Tide (HAT)	+5.10 metres
Mean High Water Springs (MHWS)	+4.70 metres
Mean High Water Neaps (MHWN)	+3.80 metres
Mean Low Water Neaps (MLWN)	+1.90 metres
Mean Low Water Springs (MLWS)	+0.80 metres
Lowest Astronomical Tide (LAT)	+0.10 metres

b. The design shall allow for 0.5 metre tidal surge in addition to HAT and also 0.3 metre tidal depression to be subtracted from LAT, which gives an operational tidal range of:

Maximum tide height - CD + 5.60 metres;

Minimum tide height - CD - 0.20 metres.

A1.4 Current

a. Normal current conditions at the berth are:

Flood Tide - Northwards at 0.15 to 0.25 m/s;

Ebb Tide - Southwards at 0.30 to 0.40 m/s.

A1.5 Temperature

a. The design shall take into account the following temperature ranges:

Ambient air temperature range - -10°C to +35°C

Ambient sea temperature range - 0°C to +20°C

A1.6 Depth of Water and Bank-seat Profile

a. The bank-seat is essentially a large hinge on top of which the landward end of the linkspan pivots and whilst immensely strong amounts to little more than a very large well-built length of large pipe on top of which sits a pair of half circles securely attached to the underside of the linkspan allowing it to move relatively freely. The general arrangement and details of the latest soundings taken at Berth 4 are shown on the drawings.

A1.7 Adjacent Quay Loading and Height

a. The nominal coping level for the berth is CD + 5.615 metres.

A1.8 Effects of Waves and Wakes

a. The sheltered nature of Portsmouth Harbour and the position of the Continental Ferry Port within the harbour minimises the effects of wave action. However, the design shall take into account the following:

Wave heights -	1.0 metre;
Wave period -	2.5 seconds.

b. The effects of wakes and draw off from passing vessels is negligible.

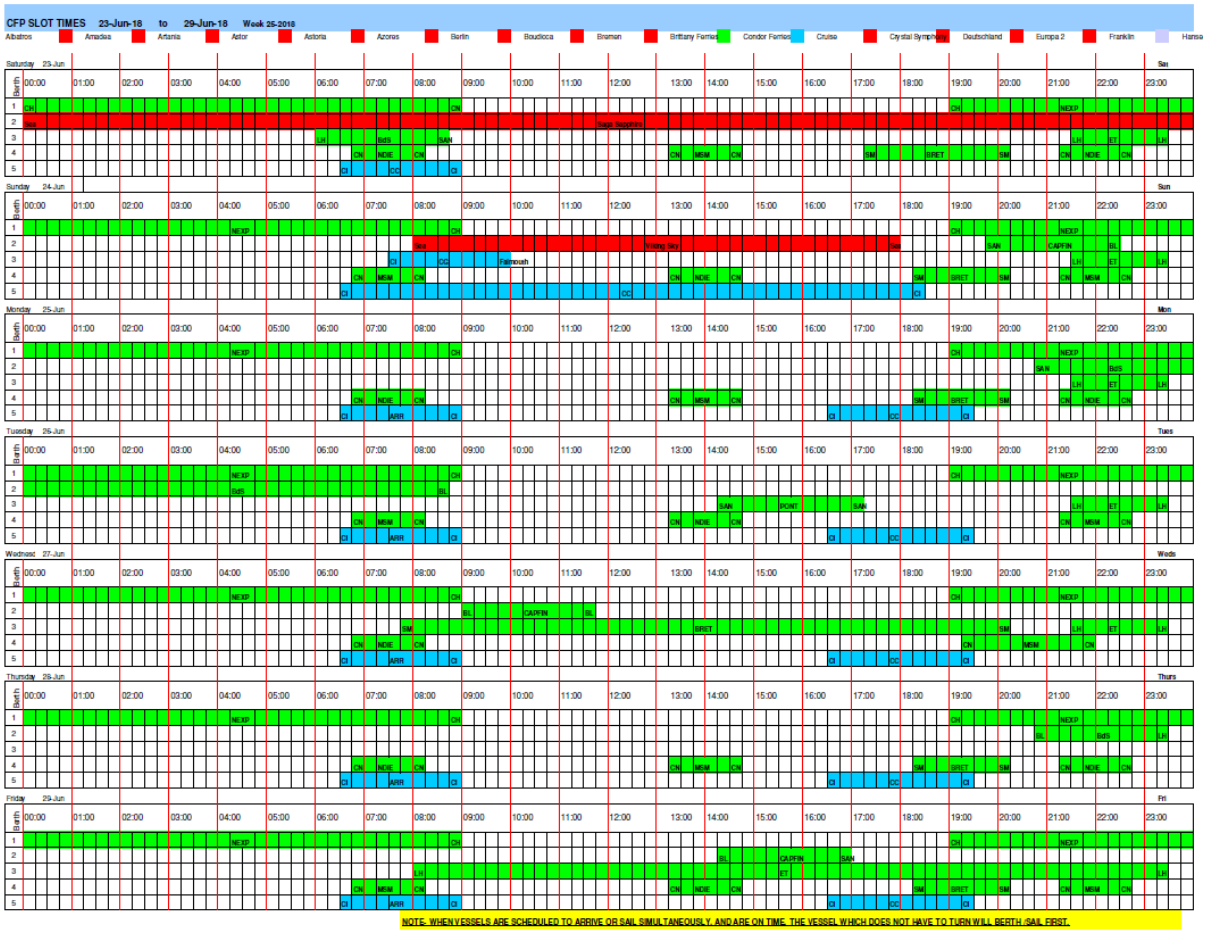
A2.0 Energy Saving

a. Purchase of berthing ‘slots’.

Portsmouth International Port provides a service as a landlord port to commercial customers who wish to berth their vessels and then unload/load. The manner in which this is done is very much along the lines of an airport where a four hour ‘slot’ is provided with the vessel being ‘turned round’ inside that time period. Where more than four hours is taken at the berth then a further four hour ‘slot’ is charged against the company.

b. Berth Utilisation.

One of the few effective methods of measuring the performance of a port (insofar as its use of its infrastructure is concerned) is berth utilisation. Portsmouth International Port has a high berth utilisation as can be seen in the ‘CFP Slot Times’ sheet reproduced below.



c. Commercial Specification of the New Linkspan

The requirements of the customer were of the greatest consideration in replacing the old linkspan at berth 4. That requirement was heard very clearly as requiring a linkspan of greater capacity and higher performance. In this regard higher performance means a linkspan that can more quickly be raised and lowered into the positions required to accept each ship. In the old linkspan the span itself (with a large ‘tank’ beneath) it was lowered by pumping water into the tank and then raised by blowing air into the tank and expelling the water, (thus altering the height of the linkspan to accept ships of differing ramp heights.

d. Energy Saving features possible given higher specification of Linkspan

The customer required a larger linkspan of greater capacity. This did not mean that the new linkspan could not be made more energy efficient but it did mean that the absolute measurements of energy used may be higher than the original link-span's albeit for greater load and greater performance. The features that were considered (and either implemented or not were as follows):

i. Solar Panels. These were considered for use on the linkspan but were dismissed as being impossible for two reasons, the first that the linkspan has no roof onto which attach such solar panels and no side that could be similarly used, being an 'open' structure and because the linkspan moves up and down and would not be able to be kept at the optimal angle for solar reception.

ii. 'Soft Start' Electric motors. These were considered and implemented in the design and build of the new linkspan as providing not just an energy saving in the operation of the link-span but also extending the life of the motors and auxiliaries in use. Across the line starting of induction motors is accompanied by inrush currents up to 7-10 times higher than running current, and starting torque up to 3 times higher than running torque. The increased torque results in sudden mechanical stress on the machine which leads to a reduced service life. Moreover, the high inrush current stresses the power supply, which may lead to voltage dips. As a result, lifespan of sensitive equipment may be reduced. A soft starter eliminates the undesired side effects.

iii. Low Loss Electrical Transformer and Switchboard unit. The new Linkspan being of greater size and performance than the original needed a new larger transformer and switchboard that could take advantage of the new technology available since the time of the original linkspan at berth 4. By the nature of the operation of a transformer there is a heat loss created, due to current-low in conductors and a magnetic flux circulating around the magnetic core. Whilst transformers are inherently efficient (around 99% plus), transformer losses are thought to represent around 25% of all the UK distribution network losses. The new low-loss Transformer and distribution boxes have been fitted as part of the new linkspan in order to take advantage of these energy savings.

iv. LED Lighting. The new Linkspan incorporates latest generation LED lighting throughout.

v. Sustainability Measures. The new linkspan incorporates higher quality steel that should give this structure an operating life of 30 years rather than the 25 years of its predecessor.

B2 Contractor's Work

B2.1 Drawings and Specification

The contractor was obliged to submit with his tender a set of drawings and a specification detailing:-

Drawings

General arrangement plans and elevations showing the layout and geometry of the linkspan and complete range of movements as well as all principal dimensions e.g. length, headroom, clear width of decks etc.

Specification

Specification details to be submitted with the tender shall include, but not be limited to:-

Structural specification
Paint & deck surfacing specification
Pump details
Hydraulics details
Electrical system details
Control system details

Power requirements
Details of any carbon-reduction technology incorporated in the design

Maintenance schedule detailing the periodic maintenance requirements for the linkspan

Proposals for reducing the Carbon Footprint of the linkspan and its eventual re-use/re-cycling/disposal.

B2.2 Programme

a. The Contractor was obliged to submit with their tender any berth closure period required by the Contractor for decommissioning and removal of the existing linkspan and the installation and commissioning of the new one. This programme was in the form of a Gantt chart showing dependency and clearly indicating the critical path and the milestones indicated above.

b. The Contractor supplied a detailed programme for the whole Works which defined fully the expected duration for each part of the Works including the linkspan, and showing in sufficient detail the time allocated to the various parts of the Works in order that they shall be completed within the Contract time period. Due account was taken of the following in programming the installation element of the Works:

i) Shipping movements will continue to Albert Johnson Quay, Flathouse Quay, North Quay, RNSC Moorings, Fountain Lake Angling Club and Berths 1, 2, 3 and 5 of the Continental Ferry Port. Vessels shall be allowed uninterrupted access to and from these locations and any movements of such vessels shall take precedence over the linkspan installation operation.

ii) At least four weeks notice was to be given to the Employer's Representative, in writing, before the date of the removal of the existing linkspan from service.

iii) **Time was of the essence** in this Contract and the Contractor and any subcontractors had to adhere to the overall programme which required the linkspan to be completed, installed, commissioned, fully tested and ready for use by 26 January 2018. The existing linkspan was required to remain in operation until 25 December 2017.

B2.3 Method Statement

a. The Contractor was required to submit with his tender an outline method statement. The statement should identified the Contractor's preferred methods of fabrication, transportation and installation. It also detailed the Contractor's proposal for future use/recycling/scrapping of the existing linkspan or parts thereof.

b. The Contractor was required (within 14 days of the award of the Contract), to submit to the Employer's Representative detailed method statements for all sections of the Works for approval. These included such drawings and calculations necessary to permit the Employer's Representative to satisfy himself as to the adequacy of the Contractor's proposals in respect of fabrication, outfitting, painting, surfacing, plant, resources, transportation and the installation procedure.

B2.4 Fabrication and Installation Details

a. The Contractor was required to allow reasonable time for the approval of drawings and calculations by the Employer's Representative and third parties as nominated by the Employer.

b. Two copies of any design calculations and drawings were forwarded to the Employer's Representative. The Contractor allowed the Employer's Representative 10 working days from the date of receipt to the date of dispatch to comment upon the details.

B2.5 CDM and the Machinery Directive

a. The Contractor was required to provide to the Principal Designer, in a timely manner and suitable format, all information necessary for him to fulfil his obligations under the CDM Regulations.

b. The Contractor ensured that Works resulting from the Conditions of Contract, Specification and Drawings shall, where applicable, comply with all aspects of relevant legislation, in particular the Construction (Design and Management) (CDM) Regulations 2015 and the EC 'Machinery' Directive as implemented by the Supply of Machinery (Safety) Regulations 2008 as amended 2011. The Contractor shall also take account of the relevant aspects of the following legislation:

i) Health and Safety at Work Act 1974;

ii) Supply of Machinery (Safety) Regulations 2008;

iii) The Provision and Use of Work Equipment Regulations 1998;

iv) Lifting Operations and Lifting Equipment Regulations 1998;

v) HSE L148 Safety in Docks ACOP 2014;

vi) Electrical Equipment (Safety) Regulations 1994.

b. Where appropriate the Contractor ensured that all relevant equipment supplied under the Conditions of Contract, Specification and Drawings are issued with either a "declaration of conformity" and/or "declaration of incorporation" and as such carry a 'CE' mark.

c The Contractor was responsible for compiling a technical file to demonstrate compliance with essential health and safety requirements and to retain a copy of this file for 10 years, after handover to the Client of the linkspan, in such a manner that it can be retrieved for inspection by any appropriate authority. The technical file was additional to the "Health and Safety File" required under the Construction (Design and Management) (CDM) Regulations 2015.

B2.6 Safety Assessment and Risk Analysis

a. The design, fabrication, installation and commissioning was undertaken in accordance with BS EN ISO 12100: 2010 and BS EN 349: 1993+A1: 2008 to ensure compliance with all relevant Health and Safety legislation and regulations. In particular the Contractor complied with the requirements of the Construction (Design and Management) (CDM) Regulations 2015.

b. The Contractor investigated the possible failure modes as part of his safety assessment and the investigation included a risk analysis complete with severities, probabilities and appropriate measures/controls.

B2.7 Quality Assurance

a. The Contractor was required to operate and document a Quality Assurance System complying with the applicable clauses of BS ISO 9001:2015. This Quality Assurance System included an approved Quality Plan specifically for use on this Contract. The Contractor provided a draft Quality Plan with the tender and confirmed his ability to comply with a certified Quality Assurance System.

b. The Quality Plan was submitted to the Employer's Representative for prior approval and referenced all inspection and test procedures for which the Employer's Representative's approval was required. Activities controlled by the Quality Plan did not commence until the Employer's Representative's approval had been given.

B2.8 Sub-Contract Work Containing Design Elements

a. The Contractor ensured that the following clauses were incorporated into any sub-contract documentation for those sections of the Works containing design elements for which the Contractor was responsible:

i) "The Subcontractor is to provide to the Contractor timely and correct information of details of associated works which he requires of others."

ii) "The Contractor is to be responsible for the performance of the Subcontractor in all respects."

c. The sub-contract clauses quoted above were considered to provide for the protection of the Contractor against any failure of the Subcontractor's design.

B2.9 Linkspan Weight and Centre of Gravity

a. The Contractor and any subcontractors employed by him monitored, recorded and audited the weight and centre of gravity for all fabrications, plant items, mechanical sub-assemblies and ancillary equipment both during the design and the construction phases. The Quality Plan reflected this requirement and drawings were appropriately annotated.

B2.10 Passage of Craft

a. Craft continued to sail to and from Albert Johnson Quay, Flathouse Quay, North Quay, RNSC Moorings, Fountain Lake Angling Club and Berths 1 to 5 of the Continental Ferry Port and the Contractor made provision for the passage of craft from time to time. Vessels were allowed uninterrupted access to and from these locations and any movements of such vessels took take precedence over the linkspan installation operation.

B2.11 Temporary Marks and Lights

a. All underwater obstructions resulting from the Works, which were likely to be a hazard to navigation were suitably marked and lit to the satisfaction of the Employer's Representative and the Queen's Harbour Master for Portsmouth, who were consulted beforehand.

B2.12 Interference with Navigation

a. When working conditions at any time involved possible interference with navigation, reasonable notice was given by the Contractor to the Employer's Representative in order that shipping was kept fully informed of the position of any vessel or other obstruction to navigation. At all times shipping operations took precedence over construction operations.

b. During installation operations the Contractor was particularly careful to keep interference with navigation to a minimum and exhibited proper and necessary lights and signals. They at all times obeyed all instructions on these matters, issued at any time by the Employer's Representative or Queen's Harbour Master.

c. All vessels shall, whilst under way, were manned by suitably qualified personnel responsible for navigation.

d. All floating craft were equipped with channel 16 for emergency communications and channel 11 radio for two-way communications with the Queen's Harbour Master and Portsmouth Harbour Radio at the Continental Ferry Port.

B2.13 Commissioning, Tests and Trials Before Handover

a. The Contractor ensured that the linkspan and all associated structures, mechanisms, plant, machinery, systems and controls including all proprietary items were fully commissioned, tested and trialled to the satisfaction of the Employer's Representative prior to hand over to the Client.

b. The Contractor allowed an adequate time scale and sufficient resources in his clause 14 programme to the Conditions of Contract for commissioning, tests and trials.

c. The Contractor gave the Employer's Representative adequate notice before undertaking any commissioning, test or trial and made the necessary arrangements for the Employer's Representative to witness the commissioning, test or trial.

d. The Contractor made provision for all consumables, equipment and services required for the satisfactory completion of the commissioning, tests and trials.

e. The Contractor was responsible for ensuring that all structures, sub-assemblies, equipment and systems are inspected, correctly fitted and positioned and safe for use before undertaking any commissioning, test or trial.

f. In addition to the specific proof tests required for the electrical and piping systems as required by this specification, the fully assembled linkspan was proof load tested by the application of a test load to 1.1 times the worst case design load. This load was applied throughout the duration of one complete tide cycle. The magnitude, position and application of this test load and the methodology of the test measurements was subject to the Employer's Representative's approval of the test method statement.

B2.14 Documentation included within the Contract

a. The Contractor provided (within three months of receiving the substantial completion certificate), to the Employer's Representative both the final Health & Safety File and the final Technical File plus one electronic and one hard copy (unless specified otherwise) of the following:

i) General arrangements of
- the complete installation;
- separate plant rooms;
- major mechanical assemblies;
- critical sub-assemblies;

ii) Schematic Diagrams for
- electrical systems and circuits;
- all pipe line systems;
- mechanical linkages;
- control systems;

iii) Location drawings detailing the position, part number and QA reference of all major plant items, valves, control equipment, test points, electrical junction boxes and system isolators;

iv) Installation drawings, particularly for electrical wiring and control circuits together with their reference numbering and wiring schedule;

v) Schedule of all hydraulic flexible hoses, if applicable, detailing QA reference number, ISO number, size and cure dates;

vi) Schedule of all pipeline expansion joints;

vii) Schedule of all proprietary items together with data sheets, handbooks etc.

viii) List of recommended spare parts and schedule of usage as part of a Planned Maintenance System for Contractor manufactured equipment;

ix) List of recommended spare parts for all proprietary items;

x) Three copies of the operating manual for the linkspan detailing the performance requirements, normal, abnormal and emergency operation. The manual to include details of all relevant operating pressures, temperatures and flow rates as applicable.

xi) A maintenance schedule for the complete installation and all separate sub-units of the linkspan detailing daily, weekly, monthly and annual routines and inspections. The maintenance schedule to detail specific consumables and lubricants required, include a greasing map and highlight any exceptional health and safety requirements;

xii) Listing and copies of all appropriate QA certificates, fabrication/installation concessions, test certificates and paint data sheets;

xiii) PLC logic ladder or control programme network in English if and as appropriate provided on electronic media.

xix) List of recommended spare parts.

B2.21 Staff Training & Superintendence

a. The Contract included a two day training period for Port Operational and Maintenance Staff. The training was given on the CFP site by competent personnel totally familiar with the aspects of operation and maintenance of the linkspan.

b. The Contractor ensured that an Engineer totally familiar with the operation and maintenance of the linkspan was available at short notice for a period of two weeks from the commencement of commercial operation of the berth to advise upon the operation of the linkspan and/or to attend site to maintain as necessary.

B3 PERFORMANCE REQUIREMENTS

B3.1 Lifespan

The linkspan was designed for a life of 30 years.

The lifespans first major maintenance will be 10 years.

B3.2 Design Standards

The linkspan was designed and constructed in accordance with, and classified as, a Lloyd's Register classification ✠AT Passenger and Vehicle Linkspan and also, where applicable, to the latest British Standards, in particular BS5400 and BS6349.

B3.3 Existing Facility

The shore end of the linkspan was supported on the existing bank-seat. The contractor had to determine that the existing structure was capable of taking the loads to be applied to it.

The existing guide pile was retained for the new linkspan. The Contractor had to determine its adequacy for the loads to be applied to it.

The upper deck connects to the existing viaduct structure. The contractor determined that the existing structure was capable of taking the loads to be applied to it.

B3.4 Berthing and mooring loads

Horizontal structural capacity was determined from berthing impact, mooring and vehicle braking loads.

B3.5 Sinkage

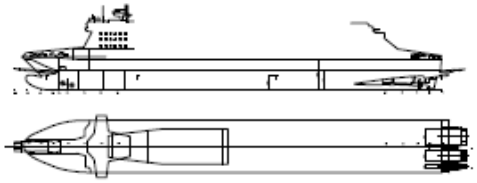
The sinkage of the linkspan under live loading was not to exceed 350mm.

B3.6 Vessels to be considered

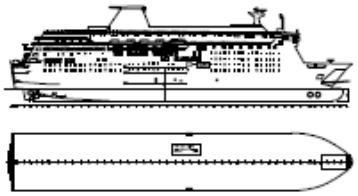
All vessels in the existing Brittany Ferries fleet were considered**.** These vessels are indicated on drawing MAR539/08. The requirement for freeboard of the linkspan measured at 1.5m from the face was 1.0m to 4.5m achievable at all states of the tide.

The upper deck was to be retractable to provide clearance for overhanging bow structures/visors.

1 CAP FINISTERE

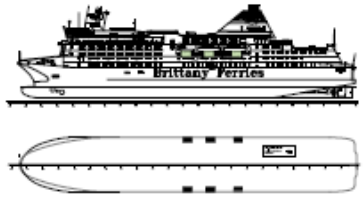


5 VAL DE LOIRE

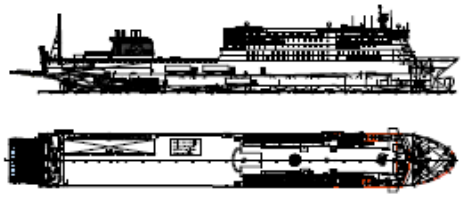


9 BRETAGNE

2 NORMANDIE



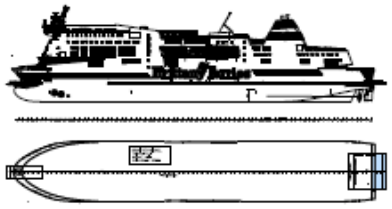
6 BAIE DE SEINE



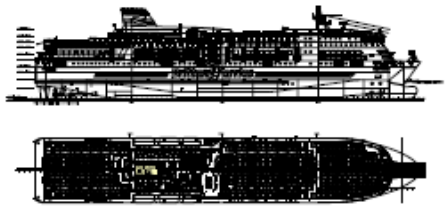
	VESSEL NAME	LENGTH (m)	BREADTH (m)	GT	DRAUGHT (m)
1.	CAP FINISTERE	203.6	29.0	32,736	6.9m LOADED 5.2m LIGHT
2.	NORMANDIE	151.4	29.0	27,541	6.2m LOADED 5.0m LIGHT
3.	MONT ST MICHEL	170.25	25.0	34,800	6.2m LOADED 5.2m LIGHT
4.	ETRETAT	186.2	29.0	39,804	6.6m LOADED 5.6m LIGHT
5.	VAL DE LOIRE	151.2	27.0	31,766	6.2m LOADED 5.2m LIGHT
6.	BAIE DE SEINE	186.4	29.0	32,382	6.65m LOADED 6.1m LIGHT
7.	PONT AVEN	186.2	29.0	41,745	6.6m LOADED 5.6m LIGHT
8.	ARMORIQUE	186.2	29.0	32,800	6.2m LOADED 5.2m LIGHT
9.	BRETAGNE	186.2	29.0	33,834	6.2m LOADED 5.2m LIGHT

VESSEL DETAILS

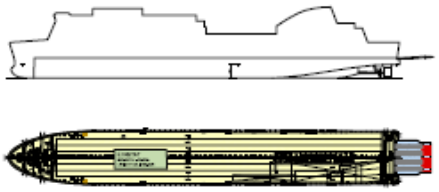
3 MONT ST MICHEL



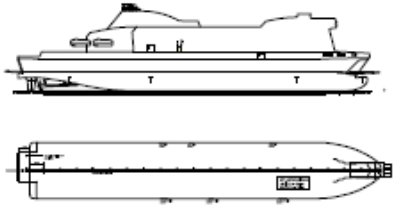
7 PONT AVEN



4 ETRETAT



8 ARMORIQUE



PLAN AND ELEVATIONS - VESSELS

NOTES

1. ALL DIMENSIONS IN mm. DO NOT SCALE.

SCALE BAR

BERTH 4 NEW LINKSPAN

NEW BERTH 4 LINKSPAN
VESSELS

SEPTEMBER 2010

PORTSMOUTH PORT AUTHORITY

MAR/539/08

B3.7 Vehicles/Loading to be considered

For normal operations, the seaward end of the linkspan is supported on a buoyancy tank capable of supporting the dead load of the bridge, upper deck and tank structure and the additional live load of any one of the following vehicular loadings.

(i) 2 lanes of HGV Vehicles on the top and bottom decks simultaneously.

(ii) 1 lane of loaded, 85t MAAFI units/Cassettes plus one lane of tugs returning empty on the lower deck only.

(iii) 1 vehicle of 45 units HB loading (180t) on the lower deck only.

B3.8 Geometry

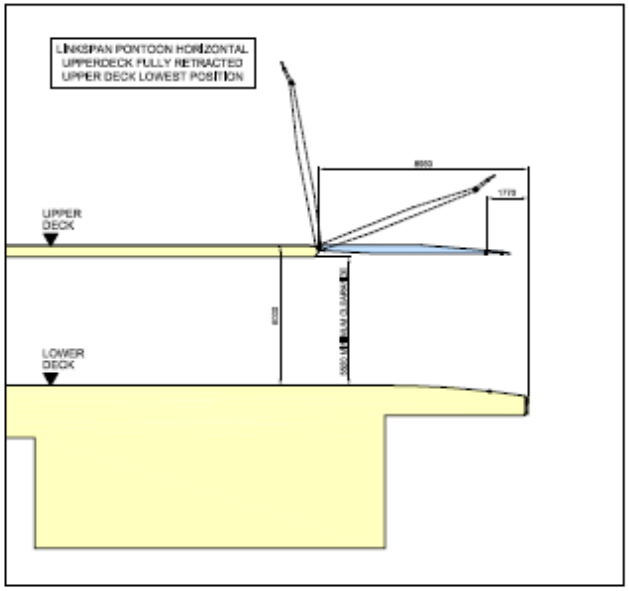
The outer end of the lower deck of the linkspan was to be the same as existing to maintain the position of vessels in relation to mooring and passenger access systems.

The operational requirements for the range of adjustment required for the linkspan decks and fingers are shown on drawing MAR539/05.

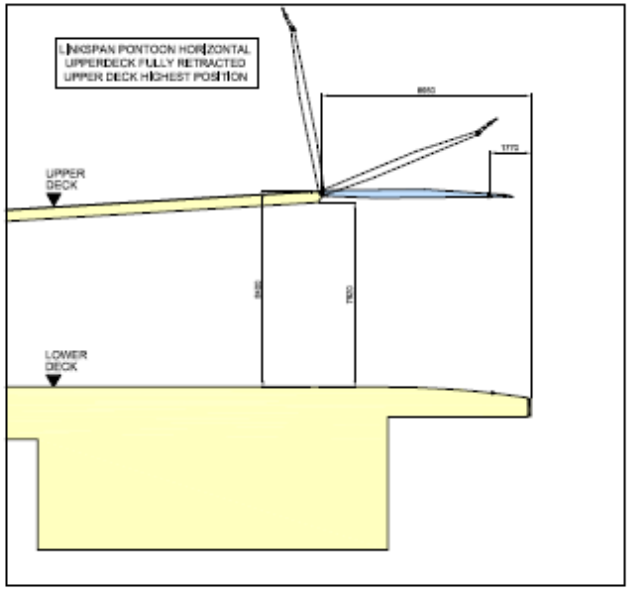
Minimum headroom for the lower deck was 5500mm under normal operating conditions. Maintenance stops were provided at the seaward end of the upper deck such that this headroom may be maintained if the upper deck adjustable supports are removed.

The lower deck ship's ramp landing area were to have a vertical curved profile similar to that of the existing berth 3 linkspan ref. drg. MAR539/07. Wear strips shall be 100mm wide at 500mm spacing provided over the seaward 12m of this area.

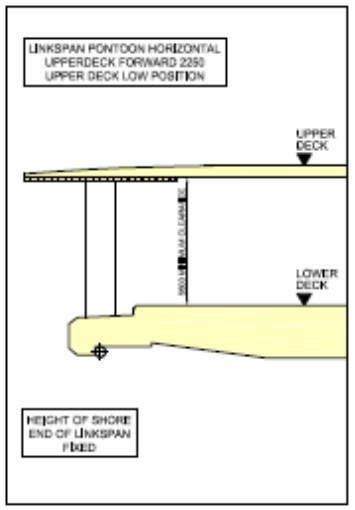
There is an adjustable flap approx. 20m wide at the seaward end of the lower deck capable of being raised by 1.0m. Drg.MAR539/07 refers Hydraulic systems actuating this flap are accessible for maintenance/replacement without the requirement for the flap to be removed or for floating plant.



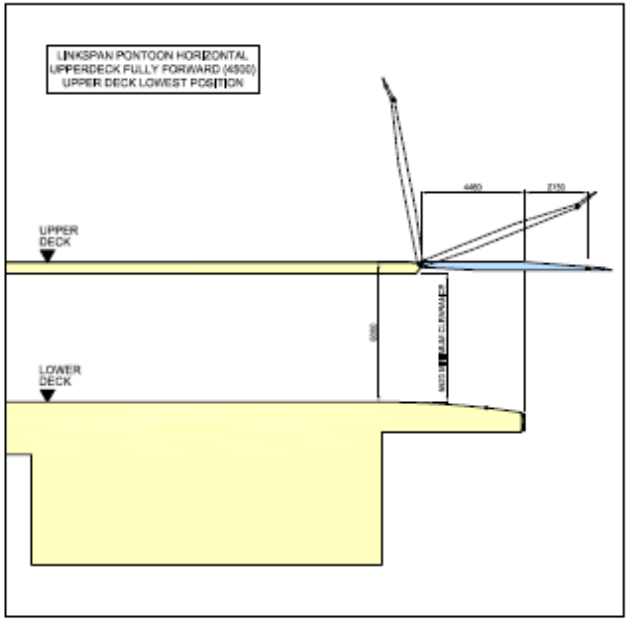
ELEVATION - UPPER DECK FULLY RETRACTED MINIMUM HEIGHT



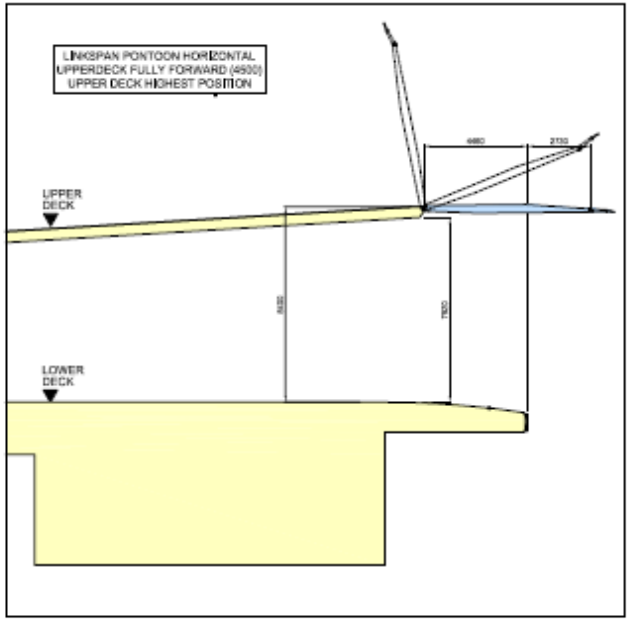
ELEVATION - UPPER DECK FULLY RETRACTED MAXIMUM HEIGHT



ELEVATION - SHORE END SHOWING MINIMUM HEAD CLEARANCE



ELEVATION - UPPER DECK FULLY EXTENDED MINIMUM HEIGHT



ELEVATION - UPPER DECK FULLY EXTENDED MAXIMUM HEIGHT

NOTES

1. ALL DIMENSIONS IN mm. DO NOT SCALE.

SCALE BAR

BERTH 4 NEW LINKSPAN

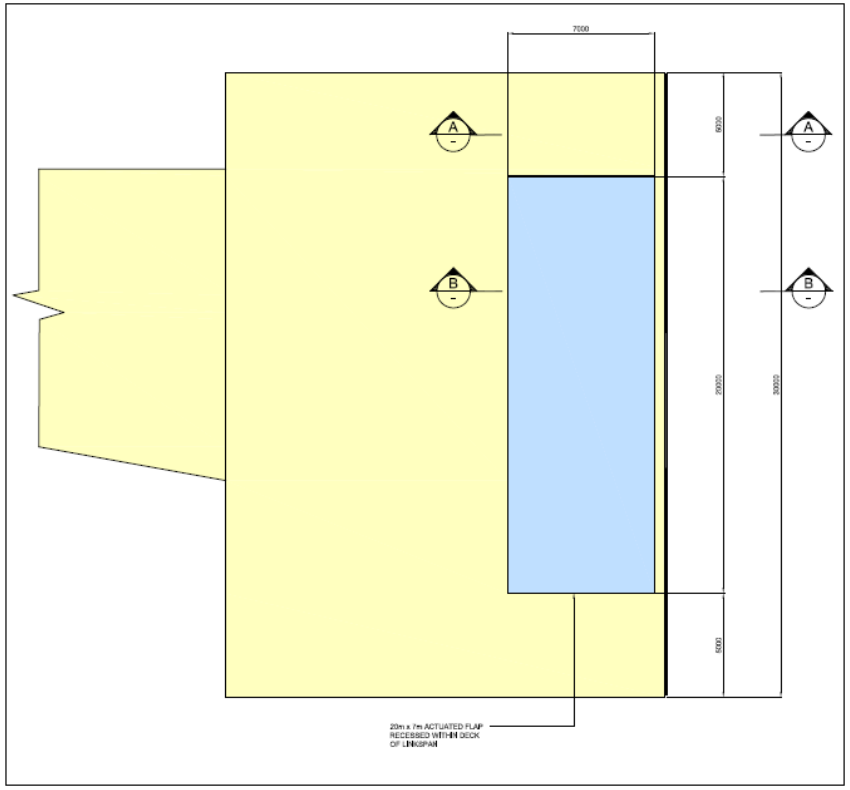
NEW BERTH 4 LINKSPAN
PROPOSED OPERATIONAL
PARAMETERS

SEPTEMBER 2010

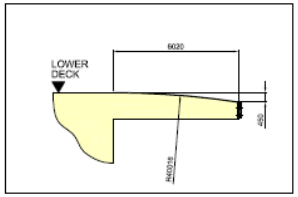
1:100

PORTSMOUTH PORT AUTHORITY

MAR/539/05



PLAN VIEW - LINKSPAN LOWER DECK
1:100



SECTION A - A
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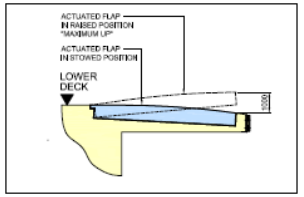

SECTION B - B
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NOTES

1. ALL DIMENSIONS IN mm. DO NOT SCALE.

NOTES: All dimensions to be checked on site prior to commencement of any work — do not scale. Figured dimensions only taken. Harry Clay Engineer of any discrepancies before ordering materials.

SCALE BAR

1:100

Rev	Date	Revision Details	Amended by	Approved by

Project

BERTH 4 NEW LINKSPAN

Drawing Title

NEW BERTH 4 LINKSPAN
PROPOSED ACTUATED FLAP
DETAILS

Date SEPTEMBER 2016 Scale 1:100 & 1:200

Portsmouth International Port

PORTSMOUTH PORT AUTHORITY
Port Manager's Office,
Portsmouth International Port,
Whale Island Way, Portsmouth,
PO2 8ER

RORY BRAMWELL BEng (Hons) CEng MICE
Port Engineer
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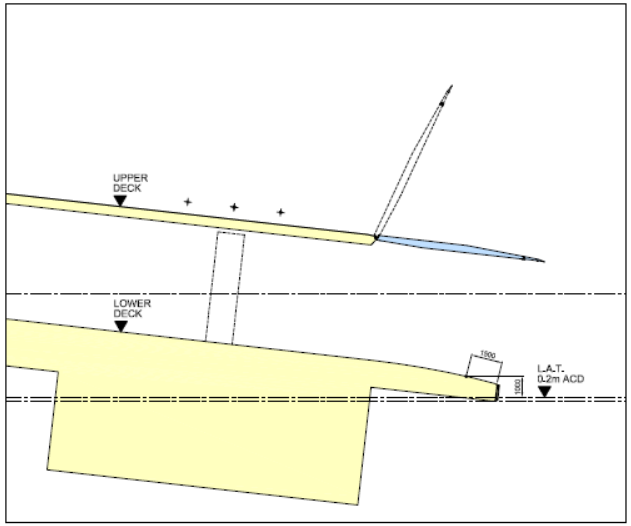
Fax 023 9285 5836

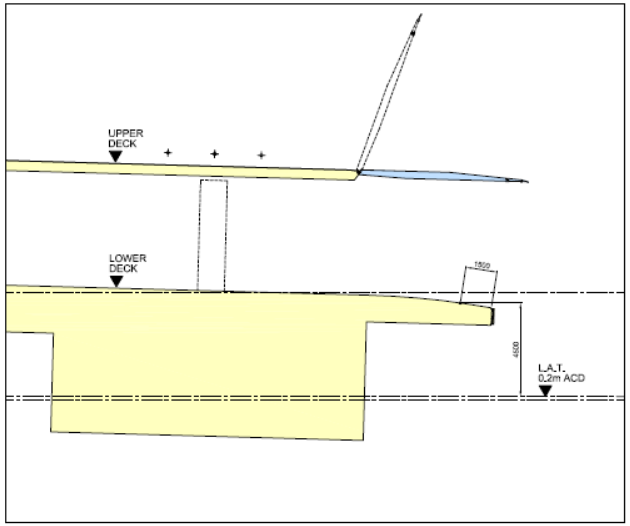
Design/Survey by	Drawn by	Checked by
PSA	PSA	RB

Drawing No. MAR/539/07 Revision -

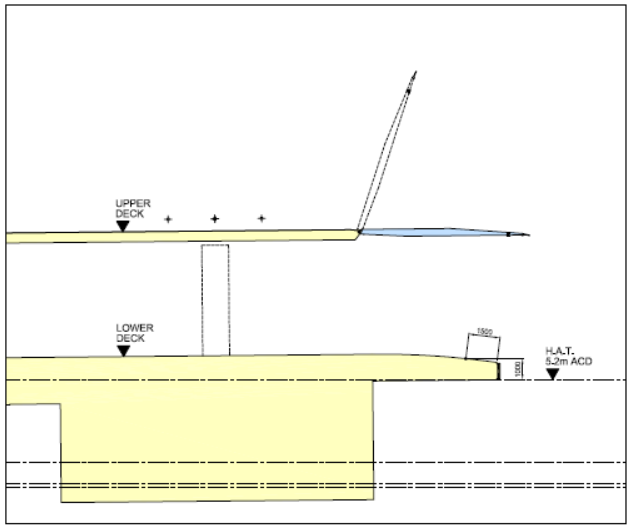
SURVEY		DESIGN		AS BUILT	
PLANNING		TENDER		AS-BUILT	
INFORMATION		CONTRACT		ALL	



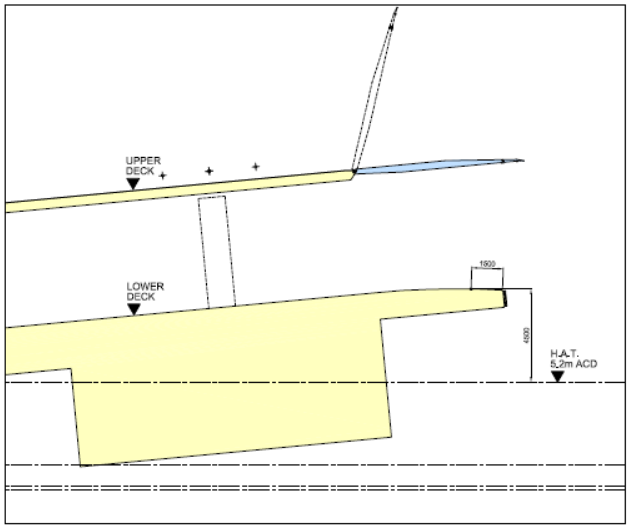
ELEVATION - BERTH 4 LINKSPAN
(MINIMUM FREEBOARD @ LAT)
1:100



ELEVATION - BERTH 4 LINKSPAN
(MAXIMUM FREEBOARD @ LAT)
1:100



ELEVATION - BERTH 4 LINKSPAN
(MINIMUM FREEBOARD @ HAT)
1:100



ELEVATION - BERTH 4 LINKSPAN
(MAXIMUM FREEBOARD @ HAT)
1:100

NOTES

1. ALL DIMENSIONS IN mm. DO NOT SCALE.

SCALE BAR

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

1:100

NOTE: All dimensions to be checked on site prior to commencement of any work. DO NOT SCALE FROM THIS DRAWING. Notify City Engineer of any discrepancies before ordering materials.

Rev	Date	Revision Details (Amendments)	Approved by

Project

BERTH 4 NEW LINKSPAN

Drawing Title

NEW BERTH 4 LINKSPAN
PROPOSED FREEBOARD
PARAMETERS

Date SEPTEMBER 2016 Scale 1:100 & 1:200

Portsmouth International Port

PORTSMOUTH PORT AUTHORITY
Port Manager's Office,
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Design/Surveyed by	Drawn by	Checked by
JRA	JRA	RB

Drawing No. MAR/539/06 Revision No. -

SURVEY		DESIGN		WORKING DRAWING	
FEASIBILITY		TENDER		AS-BUILT	
INFORMATION		CONTRACT		ALL	

B3.9 Tank Size and Arrangement

The width of the tank is 30m at the outer face. The outer face of the buoyancy tank over a distance of at least 5 to 25 metres from the projected line of the berthing face is set back by 3m from the nose of the linkspan to provide room for bulbous bows.

The depth of the tank is limited by the draft available.

Additional bulkheads are provided within any permanent buoyancy tanks to reduce sinkage in the event of damage.
The tank and its internal bulkheads are designed to resist water pressures equivalent to it being sunk at high tide level.

There is be safe access to all permanent and adjustable buoyancy tank compartments, in accordance with confined spaces regulations, for operatives carrying out maintenance works.

B3.10 Pumping System

The nose level of the linkspan is adjusted by changing the ballast water in the buoyancy tank using a system of pumps and valves.

A pumping system shall is arranged to ballast and de-ballast the tank. The pump set must be arranged such that pump(s) may be isolated and removed for maintenance whilst maintaining the capability of the linkspan to operate at no less than 75% of its design speed.

Pumps are capable of raising or lowering the linkspan at not less than 200mm per minute and are contained in a fully accessible plantroom. Electric pump motors are of the ‘soft-start’ type to reduce energy consumption.

Valves are to be electric motor actuated. Electric motors to be of ‘soft-start’ type.

B3.11 Pump Plantroom

The plantroom is accessed from the deck of the linkspan via a staircase. It contains adequate lighting and a ventilation system. Lifting beams are provided over heavy items of equipment and adequate hatchways to enable such equipment to be easily lifted in and out.

Flooring is non-slip finish and walls and the ceilings are painted white.

B3.12 Hydraulic Power System

The Hydraulic Power Unit is located within the pump plantroom. It contains three pump/motor units. It normally operates with two pumps running and one standby.

B3.13 Hydraulic Fluid

Hydraulic fluid is biodegradable, fully compatible with Fuchs Plantohyd 40N (datasheet at Appendix A). All components and seals are compatible with the use of this fluid.

B3.14 Operator's Cabins

a. The control stations are housed in enclosures which afford the necessary environmental conditions for the control equipment they contain. They also provide all weather protection for the linkspan operator and are fitted with internal lights, a suitable heater and provision for data connections including ducting to the bankseat.

b. The position and layout of all controls and the arrangement of all control panel switches, lamps, visual and audible displays etc. have been subject to the approval of the Employer's Representative.

c. Each cabin contains 4 no.13A power sockets

B3.15 Lower deck operator's cabin

The cabin is situated on the lower deck with a good view of the ship's ramp landing area.

The lower deck operator's cabin contains controls for the following:-

Main on/off switch/Swipe card reader

Ballast/deballast
Adjustable flap
External Lighting
Berth availability lights
Lower deck traffic barriers & lights
It shall also contain two CCTV monitor screens both fully capable of being switched between any of the CCTV cameras.

Audible/visual Alarm with its Accept button, and fault annunciator lamp panel, or MMI with capability to display all fault conditions of the pump system, HPU and mechanical and control equipment.

Freeboard (set and actual) is displayed together with indicators for all other functions.

It also contains 2 no. CCTV monitor screens both fully capable of being switched between all and any of the CCTV cameras.

B3.16 Upper Deck

The upper deck is supported from the lower deck and has the range of adjustment detailed on drawing MAR539/05.

Speed of operation of the upper deck is:-

Extend/retract 50mm/sec
Up/down 50mm/sec

There is a self-levelling tread access stair to the upper deck from the lower.

B3.17 Upper deck fingers

Fingers are individually selectable to cater for different vessel access widths and beams. The total width of flaps is 10m (5m each side of the linkspan centreline). Fingers are 500mm wide.

B3.18 Upper deck operator's cabin

The upper deck operator's cabin is sited with a good view of the fingers and the landing area on the vessel. It contains controls for:-

Vertical adjustment of upper deck
Horizontal adjustment of upper deck
Upper deck fingers
Viaduct automatic barriers & lights

Vertical and horizontal positions of the upper deck are displayed, together with indicators for all other functions.

It also contains 2 no. CCTV monitor screens both fully capable of being switched between all and any of the CCTV cameras.

B3.19 Berth Availability Signal

The linkspan includes LED berth availability lights in a position clearly visible from the bridge of vessels. These lights are controlled by the linkspan operative from the lower deck control station. The controls are:

i) Red - berth not available, stand off;

ii) Green - berth available, commence approach;

iii) Off - no signal visible.

B3.20 External lighting

Lighting to both decks are LED and provide an average of 50 Lux minimum, evenly spread.

B3.21 Internal Lighting

a. Internal lighting is installed in all the linkspan internal compartments for which access is required for operational purposes and regular maintenance at monthly or more frequent intervals.

b. Internal lighting required for operational purposes is designed in accordance with the current CIBSE Lighting Guide to give a minimum illumination of 150 lux. Isolation is by means of a manual switch in the switch panel

c. Lighting levels for maintenance purposes are sufficient to permit the maintenance function without further portable lighting.

B3.22 Emergency Lighting

a. Emergency lighting is installed in all linkspan internal spaces for which access is required for operational purposes and also in any enclosed control station.

b. Emergency lighting is in accordance with BS 5266:1988 Part 1. All fittings are of twin tube self-contained and maintained type, with a 3 hour duration.

B3.23 Cyclamen

a. The Cyclamen units mounted at the shore end of the linkspan were removed.

b. Mounting brackets and ducts for Cyclamen units were provided in a similar position on the new linkspan so that the units could be re-fitted.

B3.24 Water Supplies

A water supply for vessels was provided at the jetty side of the ship end of the linkspan with local operating valve and provision for connection of a water meter by others. The shore end connection is a 3” BSP female hose connection to connect with the existing supply and the ship end is a 3” 8-bolt flange to BS 4504/8 PN16 to accept a meter by others.

B3.25 Automatic barriers

The linkspan control system links in to the existing automatic traffic barriers and lights situated on the bank-seat for the lower deck and at the bottom of the viaduct for the upper deck.

B3.26 Audible & visual warning systems

All movement of the upper deck and upper deck fingers sound an audible warning and a visual warning to all potential areas of danger.

B3.27 CCTV System

4 No. CCTV cameras compatible with Dedicated Micros operating system are provided to monitor the upper and lower decks of the linkspan.

The cameras are linked to screens in both operator's cabins. These are capable of displaying the current view from all or any of the cameras.

The cameras are also connected to a sprite compatible with Dedicated Micros and capable of real-time recording, which will retain 30 days of records. This is connected to the Port CCTV network.

B3.28 Vessel Approach Speed Monitoring

A speed monitoring device is fitted to the linkspan to monitor the approach speed of vessels. This is displayed digitally on the appropriate CCTV monitor screen and linked into the CCTV data retention system.

B3.29 CCTV Monitors

CCTV monitors are 19" TFT screens

B3.30 Control System

The linkspan is activated by a key operated switch. Provision is made for alternative activation by proximity card. Space is available in the control cabinet for the necessary equipment to enable this.

The Ballast system is programmable to automatically achieve and then maintain an adjustable pre-set freeboard height. There is also a facility for manual up/down operation. The freeboard pre-set and actual levels are monitored and displayed in the lower deck operator's cabin.

The adjustable flap controls are up/down buttons.

All valves and pumps are capable of being locally manually operated in case of control system failure.

The upper deck controls are up/down and extend/retract buttons, both manually operated. The position of the upper deck is monitored and displayed in the upper deck operator's cabin.

The upper deck fingers are individually selectable with an up/down button to operate all selected fingers.

B 3.31 Carbon Reduction

The Contractor included carbon reduction technology into the design: Higher Quality (longer lasting) steel to S355.

Softy starters on the ballast pumps to reduce electrical consumption. LED lighting.

Environmentally friendly hydraulic Oil.

Paint system to have approximately 20-25 year life-span. Warranted for at least 10 years.

B3.32 Disposal of Existing Linkspan

The existing linkspan was re-used (in part), recycled (in part) and disposed of (the remainder) in accordance with environmental best practice.

B3.33 Bird Deterrence

a) Where practical, measures were to be taken to prevent birds roosting in the structure and on services.

b) External hydraulic valves and hydraulic/electric control equipment were contained in enclosures to protect them from bird fouling, with access for maintenance.

B3.34 Maintenance Access

All regular maintenance shall be possible without the requirement for additional access equipment.

B4 COMMODITIES AND WORKMANSHIP

B4.1 Steelwork

B4.1.1 Fabrication Drawings

a. The Contractor was responsible for the preparation of all detailed fabrication drawings for the structure and all mechanical sub-assemblies.

b. Fabrication drawings were fully annotated and detail elements shown with all dimensions, specifications, material preparation, weld details, weld procedure references and sequences necessary for the fabrication and traceability of the elements concerned. Drawings were prepared in accordance with BS 308 and other appropriate British Standards and were in English. All dimensions are in millimetres.

c. All steelwork dimensions as shown on the fabrication drawings are those achieved after weld contraction has taken place.

B4.1.2 As Built Drawings

a. Within three months of commissioning of the linkspan, three full sets of fully detailed as built drawings of the structure and all mechanical sub-assemblies were delivered to the Employer's Representative.

B4.1.3 Materials

a. All materials comply with the latest editions of the appropriate Lloyds Regulations or British Standard.

B4.1.4 Material Traceability

a. The Contractor operates a full traceability system for all materials. The Quality Plan shall detail this system.

b. In particular for steel plate and sections, the system enables these elements to be traced from the mills, to the stock yard, through the fabrication process to the final completed structure. Hard stamping is not permitted for this purpose.

B4.1.5 Workmanship

a. Workmanship complies with the latest editions of the appropriate Lloyds Regulations or British Standard.

B4.1.6 Qualification and Testing of Welders

a. Only welders qualified and holding current certification to BS 4871:1985 Part 3, BS 4872:1995 Part 1 and BS EN 287:1992 Part 1 were employed in the fabrication of the structure.

b. The Contractor identified which welders were employed on each type of weld.

c. The Contractor ensured that all welder qualifications were current for the duration of the Contract.

B4.1.7 Weld Procedures

a. The Contractor was responsible for all weld procedures, testing and certification thereof by an independent testing organisation acceptable to and approved by the Employer's Representative.

B4.1.8 Supervision of Welding

a. Welding was carried out only under the direction of supervisors who were experienced and competent in the fabrication of similar structures to that required under the Contract.

B4.1.9 Welding Processes

a. The use of either electro-slag or fusearc welding was prohibited.

c. Strict control shall was exercised over the issue of electrodes to ensure that they are used in accordance with the manufacturers' instructions. Baking ovens and heated quivers were used as appropriate to maintain compliance with the manufacturers requirements.

B4.1.10 Welding Plant

a. Welding plant used was capable of maintaining, at the weld, the voltage and current specified by the electrode manufacturer.

B4.1.11 Fabrication

a. The Contractor was responsible for establishing the size of all plates, sections and items required and made due allowance for weld contraction, distortion, cambering, machining and edge preparation.

B4.1.12 Imperfections

a. The extent of recording of imperfections was decided by the Employer's Representative in light of the standard of workmanship by the Contractor and his Subcontractors.

B4.1.13 Trial Assembly

a. Trial assembly was carried out at the place of fabrication to ensure that all parts will fit during the installation.

b. The trial assembly included all mechanical and electrical attachments and was as complete as possible.

B4.1.14 Lift Out

a. The Contractor provided details of the lifting arrangements for the structure. In the design of lifting points, intermediate steelwork and slings, the effect of a 60/40 snatch load distribution was taken into account.

B4.2 General Requirements for Protective Coating

B4.2.1 Blast Cleaning

a. All steelwork, other than steelwork with intact shop primer was blast cleaned to achieve a finish in accordance with SA2½.

b. The blast surface profile was within the limits set by the Surface Profile Comparator for the Assessment of Abrasive Blast Cleaned Surfaces, conforming to BS EN ISO 8503:1995 Part 1. Blast cleaned surfaces were free of sharp spikes of parent metal defined as rough peaks. These were removed or given additional protection subject to the approval of the Employer's Representative.

c. Steel with intact shop primer was sweep blasted to remove all contaminants or traces of rust.

d. Methods of cleaning and blast cleaning were such that after surface preparation the surfaces were free from detrimental contamination.

e. All blast cleaning was carried out after final fabrication of the steelwork.

B4.2.2 Application of the Paint System

a. All steelwork, other than that detailed at 4.2.2 (b) and (c) received a protective paint system as detailed below, or equivalent as approved by the Employer's Representative.

Treatment Incl. Productname	Colour	DFT	WFT	Solids Cont. %	Thinner	Overcoating time Min 20°C Max	
Apply Sigmacover Primer, 7413	Green	50 µm	90 µm	57 %	91-92	8 hr.	6 months
Apply Sigma TCN 300, 7472	Brown	225 µm	320 µm	71 %	91-79	6 hr.	18 days
Apply Sigma TCN 300, 7472	Black	225 µm	320 µm	71 %	91-79	6 hr.	18 days

b. The paint system for the pump-room and all the linkspan internal compartments for which access is required for operational purposes and regular maintenance at monthly or more frequent interval is the same specification with a white finish colour.

c. The finish colour for all handrails and crash barriers is Zinc Yellow RAL 1018.

d. The paint system was applied using methods and plant appropriate to the paint manufacturer's requirements

e. Painting was carried out under the direction of a suitably experienced supervisor and under conditions complying with the requirements of all applicable health and safety legislation.

B4.2.3 Storage of Paint

a. Storage complied with the manufacturer's instructions.

B4.2.4 Samples

a. Were not required.

B4.2.5 Handling, Storage and Transportation

a. Particular care was taken when handling, storing and transporting painted steelwork. Precautions included the following:

i) No painted steelwork was placed directly on the ground or other surface which may damage the finished coating;

ii) No metallic slings, chains or hooks came into contact with the finished painted surface;

iii) Paint was fully cured before steelwork was handled.

B4.2.6 Rectification of Damage

a. The Contractor submitted a method statement for the Employer's Representative's approval, giving his proposed methods of repair of damage to the paint system.

B4.2.7 Galvanised Coatings

a. Galvanised coatings complied with BS 729:1994 and with the following:

i) Inhibited hydrochloric acid with a strength not exceeding 14% and within a temperature range of 15°C to 25°C, or inhibited sulphuric acid with a strength not exceeding 14% and within a temperature range of 60°C to 80°C shall be used for pickling;

ii) Components shall not be immersed in the pickling acid longer than is necessary for cleaning the surfaces prior to galvanising;

iii) The surfaces of components to be galvanised shall be dried before immersion in the molten zinc;

iv) When an aqueous flux is to be used, all traces of acid shall be washed off immediately after pickling;

v) Galvanised coatings shall be virtually free from imperfections, including porosity, to the satisfaction of the Employer's Representative;

vi) Detrimental surface contamination of galvanised coatings which are to be painted shall be removed by wet cleaning. Methods shall be approved by the Employer's Representative. The surfaces shall not receive chromate passivation treatment;

vii) Vent holes drilled in hollow sections prior to galvanising shall be plugged to the satisfaction of the Employer's Representative;

viii) The thickness of galvanised coating shall not be less than 130 microns.

b. Methods of galvanising were approved by the Employer's Representative. The Contractor provided all necessary documentation to demonstrate that methods employed would not be detrimental to parent steel properties, particularly with respect to hydrogen embrittlement and hydrogen release effects on the integrity of the paint system.

c. Bolts, nuts and washers were spun galvanised to achieve a coating thickness of 40 microns.

B4.3 Deck Surfacing

B4.3.1 Materials

a. The surfacing system for to be used was Gouda Chemiebouw (or equivalent approved by the Employer's Representative). With epoxy thickness and aggregate size similar to that on the existing Linkspan.

All applied in accordance with the manufacturer's recommendations.

Treatment Incl. Productname	Instruction number
Blasting damaged areas	
Apply EP slurry compound	Gouda Chemiebouw Datasheet
Apply EP slurry compound	Gouda Chemiebouw Datasheet
Apply Calc. Bauxiet	Gouda Chemiebouw Datasheet

B4.3.2 Application

a. The system was applied to steelwork grit blasted according C4.2.1(a).

b. The prepared surface shall had a surface temperature of at least 5^{o}C and was free from contaminants.

c. The deck surface was vacuumed to remove all dust immediately before application of the surfacing.

d. Surfacing was applied by a Contractor approved by the Employer's Representative and familiar and experienced in the application of the deck surfacing. It was laid in accordance with the manufacturer's instructions.

B4.3.4 Protection from Adverse Weather Conditions

a. Where it was the Contractor's intention to lay the deck surfacing without controlled enclosed facilities, he made due provision for such a temporary weather envelope, as was necessary to give the manufacturer's required application conditions, over at least one half of the structure's surface at any one time.

B4.4 Cathodic Protection

a. Where dissimilar metal connections are unavoidable all practical measures were taken to reduce galvanic corrosion with consideration to the life of the linkspan.

b. The external underwater structure of the linkspan has been provided with a suitable passive cathodic protection system. Impressed current systems were not used. The proposed arrangement is compatible with the external steelwork coating system.

c. Where internal compartments, tanks and chambers of the pontoon are designed for sea water flooding, either frequently or infrequently, they have been provided with a suitable cathodic protection system which is compatible with the internal steelwork coating system.

B4.5 ELECTRICAL SYSTEM

B4.5.1 Electrical Work General

a. All electrical work complied in all respects with Lloyds Regulations the current edition of the IEE Regulations for Electrical Equipment in Buildings, other applicable British Standards, the Electricity Supply Regulations and good and acceptable practice for the installation of equipment for the environmental conditions in which it is to be used.

b. A certificate of completion and inspection of the electrical system, by a body approved by the Employer's Representative, was provided before the substantial completion certificate was signed.

c. All electrical cabinets are lockable.

B4.5.2 Power Supply

a. The current established local supply is 2 x 160A at 415V 3-phase.

b. The Contractor allowed for all cabling over the linkspan and for connecting to an isolator mounted in the existing switch-room.

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B4.5.3 Electrical Equipment

a. All electrical equipment complies to the current edition of the latest relevant British Standards specification.

b. All electrical equipment required by the design has been installed to the manufacturer's recommendations in well lit, ventilated, dry positions offering reasonable access for inspection and maintenance.

c. Where electrical equipment is exposed to a risk of either flammable gases, mechanical damage, water or oil it has been either appropriately constructed and certified or protected by an appropriate enclosure to the relevant IP rating of BS EN 60529:1992.

B4.5.4 Cables

a. All cables used in the execution of this construction comply to the latest British Standards specification and shall only be used for the duty for which they are designed.

b. Wherever possible cables were not run adjacent to hydraulic machinery. However, where cables have to be used in the vicinity of hydraulic machinery, damp conditions or are run through ballast tanks they were made impervious to the effects of hydraulic oil, fresh and salt water.

c. The sheathing of the cores of the control cables and panel interconnections are white with black numbering.

d. All cables are either braid or steel wire armoured. All the electrical conducting cables have copper conductors and are appropriately coloured for identification.

e. Where cables are connected to moving items of structure or machinery they remain flexible throughout the operational envelope and working environment. Flexible trays have been used where necessary to prevent cables being trapped.

f. Cables with differing voltages have not been laid together, however, where this was unavoidable care was taken to ensure that the correct voltage gradient of insulation was used.

g. Cables were installed to the manufacturer's recommendations, without joints and connectors, adequately supported and neatly arranged. They have not been pulled over or rest on any sharp edges.

h. Care has been taken to prevent electrical inductance interference between cables run in the same vicinity.

j. All cables have been terminated by a suitable gland of the appropriate size and type and all exposed glands have been protected by PVC shrouds.

B4.5.5 Equipotential Bonding

a. The Contractor has carried out equipotential bonding throughout the linkspan in accordance with BS 7671:1992, terminating cables at the main earth terminal for the linkspan. The earth terminal is of sufficient size to terminate a separate protective earth conductor of appropriate size to suit the incoming supply cable.

B4.5.6 Earthing

a. In addition to the armour of the incoming supply cable the Contractor has supplied and installed a separate protective earth conductor between the linkspan main earth terminal and the shore supply point in accordance with the current edition of BS 7671:1992.

B4.5.7 Labels

a. All the electrical distribution equipment, terminal blocks, switches, fuses, control devices, cables etc. are suitably labelled in English. Labels are indelible i.e. engraved plastic not dynotape.

B4.5.8 Fuses

a. All main fuses shall conform to BS 88 and shall be of the HRC pattern or MCB type. Electrical equipment shall be fused to the recommendations of the equipment manufacturers. Re-wireable fuses are not used.

B4.5.9 Testing

a. The electrical installation has been tested in the presence of the Employer's Representative and was certified before the linkspan was handed over to the Employer. Tests s included:

i) Insulation Resistance;

ii) Earth Loop Impedance;

iii) Polarity.

B4.6 Piping Systems

B4.6.1 Piping General

a. All spaces subject to water ingress under normal operational conditions have adequate arrangements for venting, sounding and drainage.

b. Pipework to satisfy the above arrangement has been manufactured from materials and constructed in a fashion which suits the maximum pressures and temperatures arising from the intended service.

c. All pipework has been installed in appropriate lengths connected by approved mechanical joints, such that sections of pipework can be removed for maintenance or replacement without interference with the linkspan structure.

d. All pipework has been correctly supported with due consideration for expansion and contraction. The pipework support adjacent to expansion joints provides adequate lateral support such that the expansion joints do not receive undue transverse or lateral loading due to the pipe movements.

e. Where pipelines pass through watertight bulkheads and longitudinal partitions, the watertight integrity of the space has been maintained by appropriate means.

f. Air pipes have been fitted to all tanks and internal compartments which do not have any other means of ventilation. The air pipes terminate above the pontoon deck and are supplied with an appropriate fitting.

g. All tanks and compartments which are not readily accessible and are not opened for routine maintenance have been fitted with a sounding pipe which terminates above the pontoon deck with an appropriate screwed closure.

h. Valves and other pipe fittings have been constructed from materials commensurate with their function and the system maximum pressures and temperatures.

i. Remotely controlled valves have provision for local manual operation and if they are system critical they have manual operation from a position readily accessible to the linkspan operational staff.

j. Fittings attached to the linkspan pontoon external plating adjacent to and below the maximum design draft, have either been attached directly to the plating or fabricated water boxes, or have short distance pieces of size and thickness approved by the Employer's Representative.

k. Pipes and fittings have been pressure tested to either 1.5 times the system working pressure, or 3.5 bar, whichever is the greater.

l. Non-return valves or other means have been used, as appropriate, to prevent accidental siphoning or cross compartment flooding.

B4.6.2 Permanent Water Ballast System

a Permanent water ballast was required to position the linkspan correctly following delivery and installation, suitable means were provided for filling, emptying and measuring the tank levels.

b. Permanent water ballast is separate from any salt water ballast required and is be fresh water. The City Council made fresh water available from a hydrant adjacent to Berth 4, all connections and hoses were provided by the Contractor.

B4.6.3 Temporary Water Ballast System

a. The sea water ballast system has the appropriate pipework, pumps, valves and other fittings commensurate with the linkspan function. The control of the system is in accordance with a Control Philosophy to the approval of the Employer's Representative.

b. The pump and main sea water valve installations are that units can be easily isolated for maintenance and removal.

B4.7 SERVICING AND MAINTENANCE

B4.7.1 Detail Design

a. The design addresses installation routes, inspection access, visibility and positioning of all plant and systems on the linkspan, including propriety items. In particular lighting and ventilation are provided to ensure enclosed spaces on or within the linkspan subject to regular access for maintenance and inspection shall not be classified as "confined spaces" as defined by the Health and Safety Executive (HSE) Confined Spaces Regulations 1997.

b. Where any hydraulic, electric, pneumatic or other pipe system runs through a confined space, it has no joint or connection within the confined space.

c. The design ensures that sufficient permanently tallied system isolators are incorporated to meet Codes of Practice and legislative requirements for the isolation of plant, machinery systems, fluid systems and electrical services.

B4.7.2 Special Tools

a. Where any special tools are identified for any aspect of servicing and maintenance they were provided within the contract and clearly labelled for their function. Space for secure and safe stowage of special tools was provided such that they are reasonably accessible from the locations for which they are required. Details were provided such that replacement special tools may be procured or manufactured without undue delay.

B4.8 Control System

All necessary programming software and devices were supplied along with back-up copies of as-built installed software to enable the user to maintain and modify the software without reference to the original supplier.

C1.0 Completion of Construction & Delivery

The Linkspan as detailed above was completed by Ravestein and delivered to Portsmouth in March 2018. Whilst there was a short delay due to bad weather the linkspan was delivered by tug to the port on 7th March.