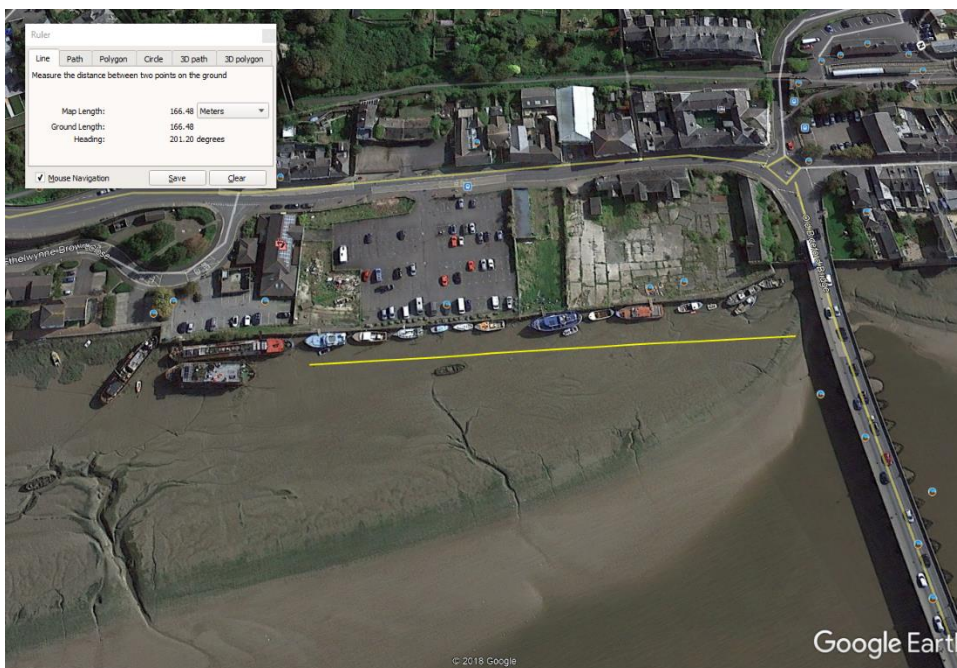


Reference: Bideford Brunswick Wharf

Date: 3.6.19

Harbour Wall. Aide Memoire:

Location:



Design:

Remediation design and specification proposals were put forward by John Grimes Partnership (JGP) acting for both the Developer and the Authority.

The initial proposals were as described by annotated JGP's drawings:

- 14466 201 P1
- 14466 202 P2
- 14466 203 P2
- 14466 204 P2
- 14466 205 P2

Drawings under separate cover.

These propose several degrees of associated and related forms of remediation as noted below to the existing harbour wall of varying height of the order of 5m above the sediment layer for a length of the order of 170m with a 4m (approx.) return , namely:

- Repair type 1. Catering for masonry face strengthening and replacement and fixing back to harbour wall substrata
- Repair type 2. Catering for repointing and fixing back to harbour wall substrata
- Harbour wall upgrade including retention via 'dead man' block. This is located at the optimal position whilst remaining outside the development demise. T and fixing back to harbour wall substrata that is within 7m of harbour wall. New RC Coping.

The total specification above caters for the highest of specifications without a 'life expectancy' benchmark being pre-set ,however JGP anticipate this to be of the order of 60 years with minimal maintenance.

The specification caters for :

- Stainless steel tie backs, Grade 316 ties at 3m centres horizontally and approximately 2m vertically between 'dead block' and wall face with D70 H/W retaining fenders.
- Stainless steel grade 316 ties with resin bond at horizontal and vertical 450mm centres.
- Stainless steel joint reinforcement
- Stone replacement
- Marine grade grout and mortar to fill and joints
- Weep pipes

- Mass concrete ‘dead man’ block for entire length of wall section 2m x 3m deep with SS tie fixings

Construction cost.

The cost to undertake the above works was ‘market tested’ with specialist contractors for each of work sections, namely civils works, stone repair and tie drilling and wall construction. The works to be undertaken under a single contract based on an agreed standard industry prime cost form due to the uncertain nature and type of works being undertaken.

Budget Costs, Harbour Wall Repair.

Stone wall repair:	£	£
• Masonry repair	15,550.00	
• Re-pointing	4,650.00	
• Helical bar fixing	65,100.00	
• Drill holes for grout	18,300.00	
• Grouting holes	13,250.00	
• Grout	45,750.00	
• Weep holes	<u>2,300.00</u>	164,900.00

Specialist tie bars:

27mm stainless at 3m spacing per JGP specification

	£	
• Mobilisation	7,000.00	
• Horizontal ties	179,200.00	
• Horizontal drainage	<u>53,200.00</u>	239,400.00

Civils constructions :

	£
• Preliminaries	25,600.00
• Excavations	50,800.00

- Concrete and backfills 174,300.00
- Temporary works 80,000.00
- Sundries 10,000.00 340,700.00

Fenders:

D70 52,700.00 52,700.00

Total } £ 797,700.00

Scope:

The scope is based on a total of 112Nº 27mm diameter stainless steel ties each 6.5m in length installed as pairs at 3m centres over the 170m wharf length together with 112Nº 4m long horizontal drains in pairs **at 3m centres** all as detailed on The John Grimes Partnership drawing Nº205 rev P2.

Ties

The ties would consist of 27mm diameter stainless steel thread bars as specified installed with 114mm diameter permanent steel casings installed from commencement level through the existing wall and hearting material terminating in the Deadman block excavation using the 'odex' drilled installation system.

The horizontal drains would be drilled using the same method using slotted steel casing, with a suitable slotted plastic well liner installed as specified on completion.

No allowance is made at this stage for rotary core drilling through the face of the wall.

Installation

The ties and drainage boreholes would be installed using a drilling unit mounted within a load tested working platform suspended from a suitable telescopic handler standing on the wharf. Compressed air for the drilling

process would be provided by a three-tonne portable air compressor that would be located adjacent to the working area.

Programme

The installation of the 112No ties and horizontal drains would take approximately 10 weeks to complete assuming uninterrupted access.

Cost

The proposed design and associated specification are considered to be a very conservative solution in response to an unspecified cycle maintenance regime and intended improvement of the quay wall's intended extended life. Consequently, the resultant capital cost is considered overly expensive.

Essentially the JGP design proposes to build a large Deadman block, with the use of fenders (every 3m) bolted back through the masonry face back under the car park and then through the Deadman block to create a retaining structure.

Whilst the proposed work is proving to be extremely expensive. The problem is that the ground under the car park is an old mass concrete block which has now started to deteriorate and return to rubble and so the philosophy of the design would appear to be the only solution, however the design can be made more economic by re-considering the specification and materials being put forward.

Consideration has therefore been given to a) increasing the spacing of the tie rods to 4.5m centres. This however has a consequence of the need to increase the rod diameter from 27mm to 33mm. Consideration has also been given to replacing the rod in each case (i.e. either 3m or 4.5m) to galvanised steel ties.

The revised ties and spacing has been considered by John Grimes Partnership Engineers and translated to a further drawing, reference 14466-205 P3. This is attached.

A further simplification to design would be considering building a stainless-steel anchor into the Deadman block and bolting the steel bars to them. However, with consideration of reducing the cost of Stainless steel and using

zinc plated mild steel bars a further consideration is needed. The problem is when you connect the zinc plated to the stainless anchors there is risk of bimetallic corrosion of dissimilar metals . It is therefore suggested to use a zinc sacrificial anode at this joint to reduce or eliminate the corrosion risk.

Because the Client and Council would want some sort of product warranty or life expectancy times, we contacted Vector Corrosion Technologies Ltd to verify the technical attributes of this solution. The flowing positive response underwrites the proposal to use Zinc plated in lieu of stainless steel.

“ I think your idea is sensible and Galva shield XP4 would offer the highest level of protection and eliminate the risk of a corrosion cell starting. We have data showing Galva shield lasting for up to 20 years, with still a considerable amount of zinc still left. Should it get continually saturated with sea water then its life would decrease, but if it is in a benign environment (like new concrete) its life expectancy will increase”.

It is recognised that with respect to the anodes, design and specification to cover a means of access for replacement will be required

This thus catered for further considerations of cost alternatives as follows.

It can be easily deduced that there are considerable savings in considering either the enlarged spacing and /or using zinc plated rods.

It is contended that these options should be discussed and considered.

<u>Item</u>	<u>Rate per tie</u>
27mm stainless steel tie	£1,600.00
33mm stainless steel tie	£1,750.00
32mm galvanised tie	£950.00
40mm galvanised tie	£1,050.00

27mm Stainless at 3m spacing JGP

Mobilisation

7,000.00

Horizontal Ties S/S 27mm x 112No	£ 1600.00 each	179,200.00
Horizontal drainage x 112No	£ 475.00 each	53,200.00
		£ 239,400.00
33mm Stainless at 4.5m spacing		
Mobilisation		7,000.00
Horizontal Ties S/S 33mm x 75No	£ 1750.00 each	131,250.00
Horizontal drainage x 112No	£ 475.00 each	53,200.00
		£ 191,450.00
32mm Galvanised		
Mobilisation		7,000.00
Horizontal galvanised 32mm x 112No	£ 950.00 each	106,400.00
Horizontal drainage x 112No	£ 475.00 each	53,200.00
		£ 166,600.00
40mm Galvanised		
Mobilisation		7,000.00
Horizontal galvanised 40mm x 75No	£ 1,050.00 each	78,750.00
Horizontal drainage x 112No	£ 475.00 each	53,200.00
		£ 138,950.00

Option 1 27mm Stainless	£
Wall repairs	164,763.91
Ties and drilling	239,400.00
RF Construction	340,673.00
Fenders	52,615.00
Total	797,451.91

Option 2 33mm Stainless	£
Wall repairs	164,763.91
Ties and drilling	191,450.00
RF Construction	340,673.00
Fenders	52,615.00

Total **749,501.91**

Option 3 32mm Galvanised	£
Wall repairs	164,763.91
Ties and drilling	166,600.00
RF Construction	340,673.00
Fenders	52,615.00
Total	724,651.91

Option 4 40mm Galvanised	£
WALL REPAIRS	164,763.91
Ties and drilling	138,950.00
Construction	340,673.00
Fenders	52,615.00
Total	697,001.91

Other cost saving considerations suggested by the specialist stone repair contractor include:

Areas opened for masonry repairs can be filled as repair works underway by adding chippings to grout to bulk out grout, minimise cost and cancel the need to drill and grout fill in these areas.

JGP estimate 90% of wall and 300mm deep, the contractor believes this may be erring on the side of caution if this much material had washed away behind the wall it would probably have already collapsed. We therefore suspect that what they have allowed for are some areas where not only the concrete has

washed away but some of the backfill behind. This would be covered during repair as above.

The drawings show 600mm vertical and 450mm horizontal for helical fixings. We have allowed for whole wall but think that only areas that have been repaired or where significant re-pointing or loss of concrete backing need to be secured.

Example JGP extra grout 45.9 m³ if the actual amount was 15m³ would be 1200 bags and £ 14,940 a saving of over £ 30,000.

If only helical bars fitted over defective repair areas allowing 27 number each being 2m² we would only need 3 Or 4 fixings per area allowing 4 would equate to 216 fixings or £ 12,398.40 a saving of over £ 52,000.

We believe these should also be considered when specifying the final works.

Gareth Steventon BSc MRICS

The logo for QSPM Consultants, featuring the letters 'QSPM' in a blue square followed by the word 'Consultants' in a blue sans-serif font.

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