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Shotley Stour footpath renovation. Conceptual design report.



Zone 3 beach 23/9/09

Introduction.

An 840m length of Shotley foreshore has been severely eroded in recent years. This erosion has resulted in the total loss of a 340m length of the coastal footpath.

Hawes Associates have been given the design brief to evaluate possible cost effective options of restoring the coastal path and reinforcing the total length of 840m against the continued coastal retreat and degrading of the existing defence structures.

Existing conditions.

The area under consideration has been divided into three zones :

Zone 1. 160m.

This is the eastward end of the route and the length of healthiest beach, the existing footpath is approximately 1m above existing beach level and is retained at this level by a sloping bank with a skin of cemented in rocks and bricks. In places the armoured skin of this retaining bank has been breached with the resulting internal erosion threatening the structural integrity of the retaining structure.

Zone 2. 340m.

This section of path has retained it's original profile thanks to the interlocking sheet piles running along the southern boundary. Corrosion has led to holes appearing in places, these have led to loss of ground from behind the retaining piles. In places this has necessitated repairs.

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Zone 3. 340m.

Erosion along this length has washed away all traces of the coastal path that ran here. A near vertical 2m high exposure of London Clay covered by the Pliocene Crags can be seen on the shore here. Continued undermining and over toppling of soils from higher up the cliff leaves this section very vulnerable to high winds from the south west generating significant wave amplitudes.

Design requirements.

Cost.

We have set what we believe is a realistic cost target for the works of £300,000. It is not felt anything less than this could possibly achieve the 50 year design life hoped for.

Construction materials.

All material must be non corrosive, abrasion resistant and frost resistant. Materials should be the same for each of the three zones in order to keep construction costs down and to avoid the inevitable weaknesses at the junction of differing construction methods.

Construction.

The design must overcome the problems of access to the fore shore. Cost effective construction will not be possible without the ability of all materials to be delivered to the beach with ease. The materials must not be vulnerable to damage prior to being incorporated within the structure.

Life time of the structure.

A fifty year design life should be achievable. During the life of the structure damage from ships or very severe storm events from the south west must be easily repairable.

Thought has been given to the possibility of beach material accretion, all aspects of the design must avoid reflective flat faces and encourage energy dissipation. In this way scour can be minimised .

Design options considered.

All the design options would require similar quantities of high specification geotextile, with high strength and UV resistance. Geotextiles are a separating membrane preventing loss of fines during hydraulic surging. The geotextile specified would be suitable for placing under rock armour in a marine environment.

Deposition of dredged material blown onto the beach by Westminster Dredging.

Whilst this option was discussed with Westminster dredging they declined to cost it as it was too small for them and could only take place on the back of a much larger project. The dredged material would also need to be encapsulated within a high strength geotextile which if punctured would rapidly empty itself.

It was decided not to pursue this design.

Maccaferri, Terramesh reinforced earth, Reno Mattresses and box gabions.

The Maccaferri PVC coated galvanised wire would be suitable in this environment, having a BBA Certification of 120 years however situated within the intertidal zone it is possible that this would be significantly reduced. It's modular construction allows an economic use of materials and certainly in Zone 3 would facilitate the new path construction on top of it.

Meetings with Maccaferri provided a useful insight into the potential for having the baskets pre-filled with gabion stone and brought to site ready filled. Two specifications of stone were looked at

Bring materials to site, all gabions pre filled at quarry :	£ 278,000 (course gravel)
	£ 312,000 (gabion stone)
Geotextile cost, similar for all options :	£ 12,000
Forecast handling and construction costs on site.	£ 65,000

Conventional rock armour.

Granite or limestone rock armour (75kg – 330kg) is available in the U.K. and by boat from France. This has the advantage of being simple to handle with a 360° excavator it can simply be lifted into place, there is not skilled assembly or difficult placement.

When placed on a suitable geotextile membrane it will out perform the other options considered due to there being no long term corrosion issues and the fact that any damaged areas can be simply repair by topping up with any suitably sized armour stone.

Bring materials to site :	£ 211,000
Geotextile cost, similar for all options :	£ 12,000
Forecast handling and construction costs on site.	£ 65,000

Conclusions of the defence options.

As can be seen from the above the one option that is easy to repair and can achieve the design life whilst being cost effective is the conventional rock armour which can be seen protecting King Edward VII Drive round the coast to the east.

Footpath construction options.

To design and construct a 1.5m wide path along Zone 3 has resulted in several options being considered.

Hardwood board walk on piles.

A hardwood boardwalk must be supported by piles of some form which would interrupt the chosen sea defence, this would increase costs of the defence option. The materials are very costly and contain a significant labour element, design life may be a problem as may wheel chair access.

Excavation of a terrace along the toe of the cliff to be stabilised with soil nails.

Excavation of a terrace along the cliff would encounter trees along the way along, excavation would kill many of the trees and damage the cliff as well as removing the reinforcing effect of the roots. The cost of supporting the steep sided terrace with soil nails would be very high and labour intensive.

Compacting hoggin into a cellular confinement system.

Compacting hoggin into a cellular confinement system protected along its base and sides by a high grade geotextile would be labour intensive and could be washed away in a storm event. The finish could be tarmac but this would add even more cost.

Pumping concrete down from Stour side.

The option of a concrete pump above Zone 3 in Stour View Road has several advantages. The concrete could be pumped directly onto a geotextile platform resting on the rock armour, reinforcement would be included in each panel. This option has a low materials cost and low labour cost. Any damaged effected by a major storm event could easily be repaired.

Expected cost £15,000

Conclusions.

Whilst the cost analysis is only an indication of likely costs it is a fair comparison of relative costs of the various options.

It has become clear through a process of elimination the only option that is close to the £300,000 budget involves the placing of rock armour over a high specification geotextile along the entire length of the restoration project.

To construct the path in Zone 3 the only cost effective option seems to be the casting of a reinforced concrete path along the top of the armour.

Yours sincerely

Andrew Hawes

Enclosures :

Zone 1 Proposed cross section

Zone 2 Proposed cross section

Zone 3 Proposed cross section

Extracts of Maccaferri Gabion brochure

Photograph of rock armour being placed

Photograph of rock armour as placed