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INNOVATION IN PROVIDING A SOLUTION TO RIVER SCOUR

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Summary

River scour is a recognised threat to many bridge structures in the form of the undermining of structural foundations. The size and scale of the problem varies much like the hydrology and topography of each structure's location.

Tried, tested and traditional methods of preventing scour are feasible at locations with available area and ease of access. However many sites are remote with restricted access possibilities, so there was a need to research and develop a process/ technique to combat and protect structures from scour at remote sites.

Keywords: scour solution; durability; academic research; recycled plastic sheet piling; Guadua Bamboo; low maintenance; longevity; renewable/sustainable; low carbon footprint

1. Introduction

Orchard Footbridge carries a public right of way across the Roman River at Stanway, Colchester. The main problem in February 2016 was significant under-scouring by the river of the western abutment.

The area was not easily accessible for heavy equipment, as it is 145 metres from a public highway across arable farmland and on rough, wet ground. Due to the proximity of a gas main adjacent to the abutment this also further limited the size and weight of plant and materials that could be used.

The footbridge is sited in a Woodland Local Wildlife site, so the Environment Agency (EA) required ecological survey checks before work could commence. Minimal disturbance of the riverbed, bank and downstream water quality was also an important consideration because the Roman River *"is one of the best East Anglian Rivers for native Brown Trout and European Eels."* (Extract from EA Consent).

Traditional use of steel sheet piling using heavy machinery for all operations would have been difficult in this location where it was necessary to minimise disturbance to the wildlife site. It would also have required careful maneuvering of plant to both deliver materials and place them close to the gas main.

Fig. 1. Extent of scour at abutment

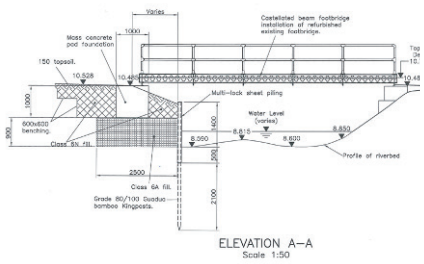

Fig. 2.Cross section of design

Fig. 3. The completed scheme

2. Alternative viable scour components

2.1 Recycled plastic sheet piling

Research led to qualities and potential applications of recycled Polyvinyl Chloride (PVC) sheeting. For example the durability and carbon footprint of the PVC materials are analysed in work by the Manufacturing Department, School of Applied Sciences at Cranfield University (2011). This study estimates the durability of recycled PVC at up to 75 years without further treatment, whereas steel, even with further treatment is known to last around 50 years. In addition, a complex and provisional calculation, including all raw material, manufacturing, transport and installation stages carried out by the University gives a 10-15 per cent smaller carbon footprint for the PVC solution over steel sheeting. Also the carbon dioxide emmisions during the manufacture of the plastic sheet piling equates to less than one third of that for the comparable steel piling equivalent.

Multilock recycled plastic sheet piles are formed through an extrusion process, they are 500mm wide and formed with two 120mm hexagonal tubes giving enhanced rigidity, in turn enabling more efficient installation. The hexagonal tubes allow posts to be driven through them to form the ‘kingpost’ style retaining wall. One or two posts could be driven in each 500mm section depending on the loading on the retaining wall. The traditional kingpost materials used were steel tubes (more expensive and heavy) or timber posts (restricted lifespan).

2.2 Guadua Bamboo kingposts

Research has continued over several years to find a renewable/sustainable, comparable strength alternative to traditional kingpost options. The potential use of bamboo in construction has been developed on diverse projects, including direct personal involvement as member of a design team managing the construction of the Bangkok Underground. Academic research projects confirmed the potential to use Guadua Bamboo as a structural material.

Guadua Bamboo has been pioneered for various uses in construction. It is an organic material, which rapidly absorbs carbon as it grows (by up to 30m per year, to material maturity at 3-5 years). It is grown extensively in Colombia, a developing country in the north-west of South America, where legitimate agricultural employment is valuable. Because the material is durable and strong it is useable in preference to steel or other high-carbon-footprint polluting metals in a variety of roles in construction as for example developed and studied by the universities of Bath, Cambridge and Coventry.

The bamboo is highly durable, its strength is found in the longitudinal direction via culm pole botanical construction in the form of stiff vascular bundles/ lignin matrix enabling the option of piling. Guadua Bamboo poles of 100mm diameter (allowing for irregularities) was determined as the ideal size kingpost.

Fig. 4. Guadua Bamboo

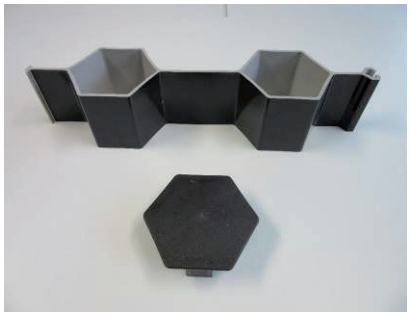

Fig. 5. Plastic Sheet Piling

3. Conclusion

The combination of materials and ease of on-site construction negated the need for heavy piling plant for installation (resulting in a reduction in cost of approximately 42%). The longevity and low maintenance requirements of the piling combination contributed to an overall reduction in construction and ongoing maintenance costs. Also, the materials used were cheaper than traditional materials. The products used are renewable/sustainable and have a low carbon footprint.