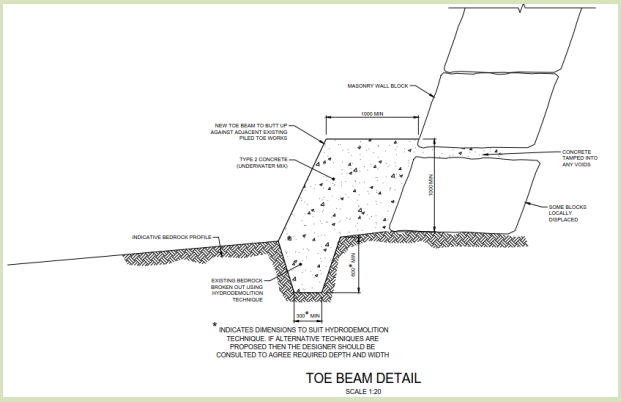
Background

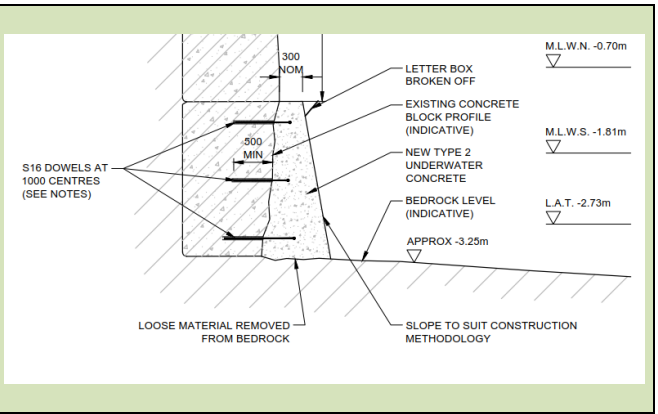
Balfour Beatty are contracted by Scarborough Borough Council to deliver a £6.7m package of repairs to the historic stone built Whitby Piers, as a coastal protection scheme and the innovation involves the removal of plastic matter from the underwater structural concrete. This is an innovation proposed with the backing of the whole site and professional team.

Scope

The main scope for the project comprises repairs to the existing masonry walls, using a combination of concrete, structural grouts and mortars, and replacement stone blocks from a local quarry. Scour and erosion to the toe of wall is recognized as a potential source of weakness in the future, so concrete protection is proposed in two areas, the toe beam, and the bullnose. Typical details are shown below.



Toe Beam Detail



Bullnose Repair Detail

Materials

Generally concrete is a poor material in shear, bending and tension, and therefore needs reinforcing. In a non-marine environment, steel is generally used as reinforcement to improve the performance of the material, but this is problematical in a marine environment, particularly underwater. Normal grades of steel corrode rapidly, as the concrete becomes saturated with high concentrations of salts/ chlorides from the seawater, whilst more specialist grades of steel, for example stainless steel, have a limited lifespan. In any case, installing reinforcing steels below water, using divers is time consuming and above all hazardous, so is usually avoided. Typically the solution to this problem is to use plastic (polypropylene) fibres as reinforcement, and these are mixed into the concrete during batching. Concrete is placed into the temporary shutters (formwork), which is designed for a marine environment using a tremmy pipe to deliver the concrete to the base of the pour so that the concrete displaces the water. Plastic fibre reinforced concrete has for many years or decades been seen to be the standard solution for marine concrete mixes, being comparatively cheap and easy to place – a proposal to use concrete of this type would normally go unchallenged.

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Environmental Considerations

During construction of the toe beams, a silt curtain will be deployed – this is intended to contain any silts created or released during construction works and concrete placement. In addition to this, the concrete contains an additive designed reduce scour and washout once the concrete has been placed. These measures were proposed at time of tender.

Balfour Beatty subsequently recognized the specified concrete mix – a plastic fibre reinforced concrete – was a concern environmentally as there was potential for fibres to be released into the marine environment during construction, and that ultimately all the fibres would be released over the life of the structure. With over 200 linear metres of concrete toe beam and bullnose concrete to construct, there was a requirement for approximately 1.5 tonnes of plastic fibres. Through several months of discussion with the designers, the client and the supply chain, two alternatives were proposed and accepted: a fibre-free concrete mix for the toe beam, and a mix containing mild steel fibres for the bullnose.

These designs were felt to offer an acceptable design life, while eliminating a large quantity of plastic from the marine environment.

Our designer (novated to the contractor and part of the site team) has confirmed that this change is unprecedented in modern marine construction.

Programme

This element of work is yet to be commenced. The contract completion is February 2020, but Balfour Beatty would hope to complete works on site before the start of the winter 2019.

Photographs

	
East Pier: section of wall requiring repair to face	***Whitby Harbour: construction works on West Pier***

West Pier – works in progress, safety boat in attendance

East Pier – erection of edge protection

West Pier: public / site segregation – robust water filled barriers

West Pier: inspections at low tide accessed from the beach