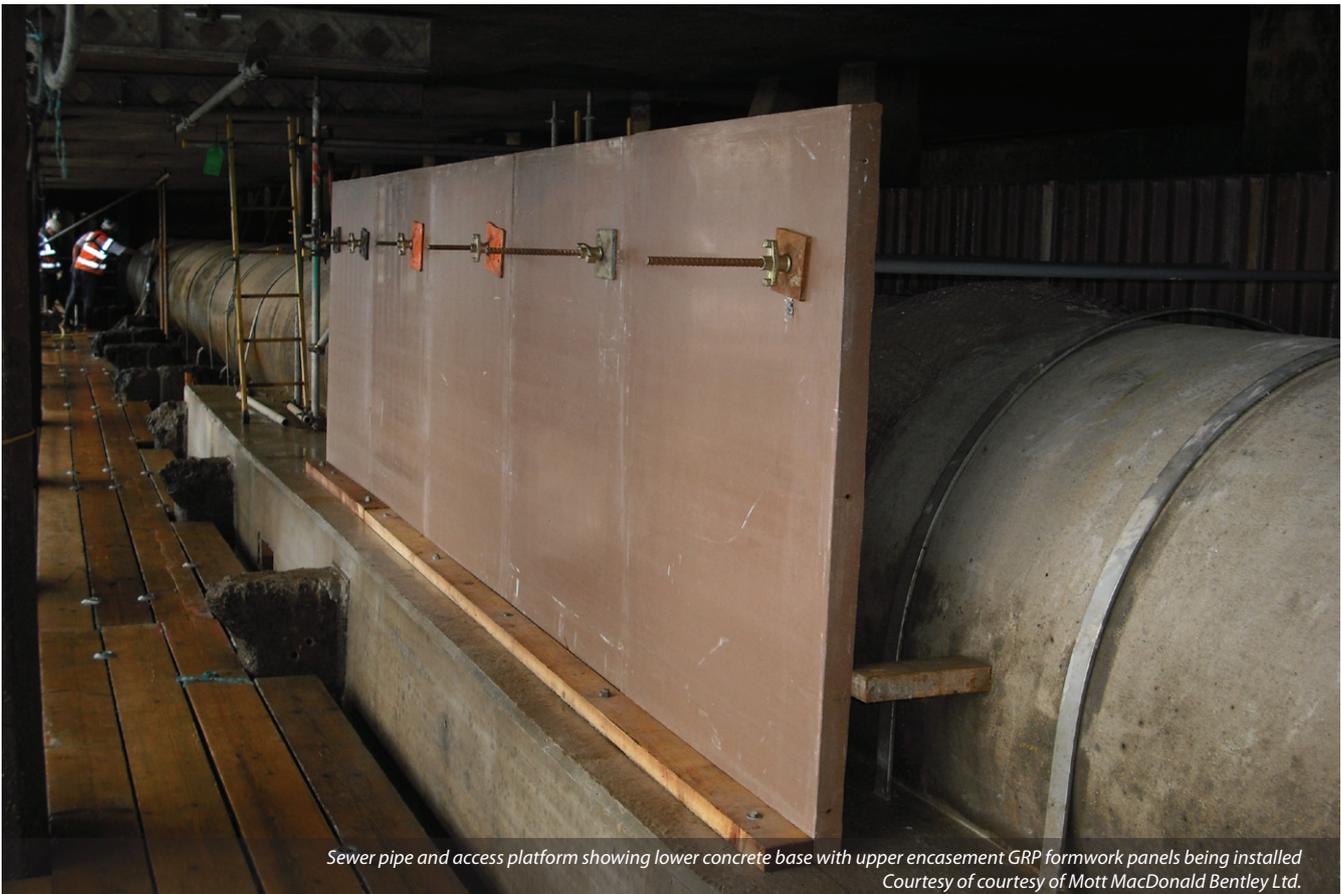


Endeavour Wharf, Whitby, Sewer Repair

close community and supplier liaison to deliver a main sewer repair
by Mark Wood

The seaside town of Whitby in North Yorkshire is one of North East England's most popular tourist destinations. At the start of 2010, Yorkshire Water identified that the integrity of a main sewer, flowing underneath New Quay Road to the Endeavour Wharf Sewage Pumping Station (SPS) in Whitby Harbour, had been compromised and was susceptible to leakage. Due to the imminent start of the bathing season, Yorkshire Water commissioned Mott MacDonald Bentley (MMB), as one of its AMP5 Sewerage Networks framework partners, to undertake feasibility, design and construction works to resolve the deficiency. Whilst temporary repairs to the sewer had been undertaken previously, the project initiated by Yorkshire Water at this time, was to provide a permanent resolution.



*Sewer pipe and access platform showing lower concrete base with upper encasement GRP formwork panels being installed
Courtesy of Mott MacDonald Bentley Ltd.*

Project scope

The scope of works entailed the prompt design and delivery of a feasible long-term solution, to secure the deteriorating 1,200mm concrete wastewater main, fundamental to the operation of the local sewerage network. The pipework, which runs under Whitby Harbour, had been progressively weakened by tidal forces over the previous decade.

Feasibility

The first task was to understand the nature and extent of the deficiency with the Endeavour Wharf Sewer, as well as the root cause of the problems. The project team undertook site surveys to gain an appreciation of the site characteristics, including internal CCTV examination of the sewer carried out by Onsite Central Ltd, and desk studies to obtain an operational and maintenance history.

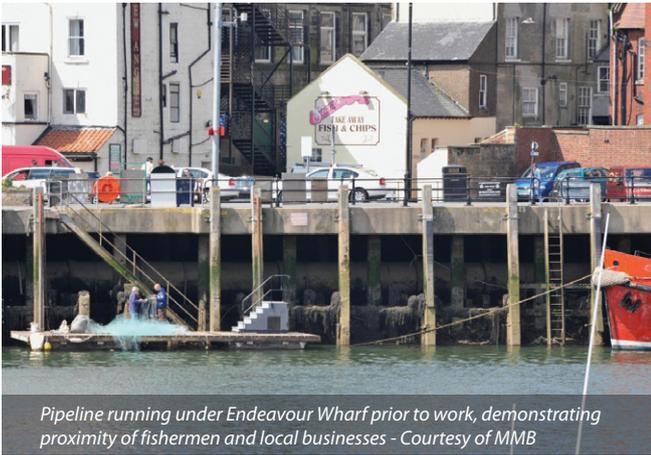
The surveys revealed that the sewer was laid on a concrete plinth under the wharf within the normal tidal range, and that damage

had occurred to joints along a length of approximately 65m. At this time, the central location of the site in the town, and the need for extensive community liaison and careful construction planning, also became evident, particularly since the site was located on the main pedestrian route between the car parks and town centre.

The pipe was supported on cantilevered brackets underneath the pavement, held in place by stainless steel banding. The failure of some of these brackets was a key contributor to the issues with the sewer. Further analysis indicated that the sewer's location within the tidal range and its buoyancy were causing regular flexing of the joints. Additionally, the saline environment was aggravating deterioration to the pipe.

Design

During the design phase of the scheme, the project team commenced discussions with local residents and businesses, establishing forums to share details of the works, and identify any



Pipeline running under Endeavour Wharf prior to work, demonstrating proximity of fishermen and local businesses - Courtesy of MMB

constraints. Photo montages, supplied by Hobbs Reprographics, were used to visually demonstrate the planned works. The early involvement of other agencies, such as Scarborough Council, North Yorkshire County Council, the Highways Agency, Harbour Masters and the Environment Agency, was also critical to the project's success.

The timing of the scheme meant that construction work would coincide with peak tourist season, and consequently full consideration needed to be given to the number of people that would be in town. Discussions identified that not only is New Quay Road, adjacent to Endeavour Wharf, a popular part of Whitby with its views over the marina, but that tourists queue on the pavement here to board pleasure boats. Concern was also raised regarding potential disruption during the very busy periods of the Whitby Regatta and Folk Festival. To avoid disruption the project team agreed not to work during these events.

Working closely with Yorkshire Water and key suppliers, Mott MacDonald Bentley (MMB) developed a solution, which included repairs to the sewer joints, additional strapping of the sewer to the concrete plinth, and encasement of the pipe in concrete to eliminate buoyancy and provide additional protection.

Of these works, the concrete encasement element had the potential to be the most disruptive and, due to tidal inundation twice daily, ran the risk of causing pollution to the harbour from cement wash out. The Environment Agency highlighted this pollution risk as a major concern, not only in relation to the placing of the concrete, but also the management of cleaning any equipment adjacent to the harbour. Consequently MMB commenced detailed discussions at this stage with concrete supplier Cemex to select an appropriate solution.

With Cemex, the project team developed an environmentally friendly and efficient method for placing concrete in the tidal range. This bespoke marine concrete mix had to be sufficiently fluid to allow for the time taken to transport it to site and to enable it to be placed in the narrow space around the pipe, where it would be required to flow through the small gaps and bends surrounding the sewer. The mix also had to set sufficiently quickly so as not to cause pollution on the return of the tide.

Cemex's solution was to combine a concrete mix with a superplasticiser and an admixture called Sika UCS. The end result was a product with a compressive strength class of C32/40 and a minimum cementitious content of 400kg/m³. It would be fluid enough to pour easily, and stay workable for a longer amount of time, but with minimal risk of wash out.

Cemex also provided remote storage, handling and cleaning facilities for the concrete pump at their local batching plant, to



Static concrete pump receiving concrete, showing proximity of live pedestrian traffic

Courtesy of Mott MacDonald Bentley Ltd

remove any risk of pollution from the harbour side. Taking this approach also ensured access to the harbour-side footpath was maintained for the large number of pedestrians, without requiring lane closures in the adjacent road.

Construction

Undertaking construction works in a marine environment always provides additional challenges with regard to the tidal regime and the constraints that this places on the working day. Combining these constraints with the implications of working in a busy seaside town, placed significant restrictions on how and when the project team could undertake construction works.

The location of the sewer and timing of the tides meant that only six hours work could be carried out on the structure each day. Interference with the normal working of the town had to be minimised; it was not permitted for any roads or footpaths to be closed, and noise had to be kept to a minimum, with no noise outside of the 06:30 to 20:00 period.

To reduce noise during construction, a temporary power supply was installed by Intellect (UK) Ltd rather than using generators. Also, to avoid visual impact and traffic disruption, it was agreed that use of heavy plant would be restricted, with no equipment on site on a day-to-day basis. Premier Concrete Pumping Ltd was asked to provide a static concrete pump small enough not to obstruct the footpath or highway. Concrete was only placed on specific days of the week, in prior agreement with the Highways Agency.

To avoid taking up space on the pavement, and to obscure the construction works from view, a floating pontoon supplied by Humber Workboats Ltd was moored alongside the sewer, and work was undertaken from this staging point. From the pontoon a scaffold access platform was erected, by Harsco Infrastructure Services Ltd, along the entire length of the exposed sewer. Maintaining access to the harbour for boat traffic at all times was essential, and this required close liaison and agreement with the Harbour Masters.

The majority of construction work was undertaken with the sewer remaining operational, to minimise the need for over-pumping. Firstly new straps were installed to secure the sewer to its in-situ concrete plinth. Once this work had been completed the installation of the concrete casing commenced.

The first stage was to cast a base plinth, which secured the new straps and provided a sound foundation upon which to build the full encasement. To reduce the time spent on site, and improve the appearance of the concrete works, pre-formed modular formwork was used. Due to the constrained nature of the site, glass reinforced plastic (GRP) formwork panels supplied by EMJ Plastics were used, since these are lightweight and can be installed without the need for heavy lifting equipment.

A requirement of the design was to install an internal structural liner to further improve the integrity of the pipe. Traditional methods for lining a pipe of this diameter would have required significant excavation around existing manholes in order to facilitate access. This was not an option, as through-access for tourism was one of the major constraints raised at the community liaison forums. The project team reviewed various options to line the pipe, and highlighted Amex10 joint seals as a potential solution to the address the public interface concerns. Amex10, an internal mechanical joint seal, could be installed through the normal manhole covers. Each and every one of the 32 (No.) pipe joints was sealed using Amex10 by Planned Maintenance (Pennine) Ltd.

Post-construction

To celebrate completion of the works, Yorkshire Water and MMB invited a selection of people from the local community, including business owners and local MP, Robert Goodwill, to take a trip into



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the harbour to see the work that had been undertaken first hand. The feedback received was overwhelmingly positive regarding the high-quality workmanship as well as the professionalism and sensitivity with which the scheme was delivered.

Conclusion

The scheme was successfully completed on time and to budget in October 2010, preventing leakage from the sewer and providing a robust, long-term solution for the asset. The approach to engaging the local community and incorporating their concerns into the design approach and construction planning, enabled the project to proceed efficiently, without causing significant disruption to residents or visitors, and resulting in positive feedback from all involved.

Outcomes and learnings

The project team worked hard to ensure the project was completed as quickly as possible and to minimise disruption. Many lessons were learned in the development and delivery of the scheme. Chief amongst these was the development of a bespoke concrete mix for use in this environment, that could be transported to the site and placed without difficulty, whilst at the same time setting before inundation by the tide. The importance of engaging the local community to take account of any concerns was also reinforced.

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