

Chester Brick Sewer Rehabilitation

replacement of approximately 100m of 1,240mm diameter Victorian brick sewer in the historical city of Chester, working in live flows

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The city of Chester has many thousands of metres of Victorian brick sewers which convey combined flows. A number of collapses over recent years have given Dŵr Cymru Welsh Water cause for concern over these aging assets. In order to keep ahead of the issue Dŵr Cymru Welsh Water arranged sonar and CCTV surveys of the principal sewers and identified a number of areas as partially damaged and at severe risk of collapse. Amongst the affected sections was approximately 100m of 1,240mm diameter sewer on Sealand Road, Chester. Sealand Road is the access to the Greyhound Park shopping area and a main artery for the city centre. The road has 2 lanes for general traffic and a bus lane, with the damaged sewer running beneath the kerb line of the bus lane and an unsegregated shared use path. The scheme was designed collaboratively with Waterco Consultants Ltd and O'Connor Utilities Ltd to ensure a constructible cost effective solution.



Brick sewer exposed, outer skin in better condition than anticipated - Courtesy of O'Connor Utilities Ltd.

Design Considerations

The site proved to have a number of issues that would impact on the design and needed to be addressed in order to deliver an appropriate solution. These included:

Sewer serving a large population with high dry weather flow: Due to the large amount of flow present, it was determined that over pumping would not be a feasible solution due to the large number of pumps required at considerable cost. Existing chambers were small and the downstream chamber is on the opposite side of the busy road resulting in the need to install a temporary trough

to carry as many as 8 (No.) 200mm hoses if flows were to be over-pumped. Dry weather flows witnessed did not rise above the sewer springing level meaning the sewer could be temporarily left as an open channel during dry weather.

Shallow depth of cover: The typical depth of cover along the 100m length was approximately 700mm, which had likely exacerbated the structural issues the sewer was experiencing. This would limit the selection of pipe material and would necessitate additional protection from other services to mitigate the potential for accidental damage by others.

Multiple Utility Crossings: A ground penetrating/utility trace survey was carried out which established that a number of services were in close proximity to and also crossed the sewer; it was also believed that some of these were in direct contact with the brick sewer.

Lateral connections from nearby industrial units: There were two lateral connections for the neighbouring industrial units that would need to be incorporated into the solution.

Time constraints on site due to embargos relating to Christmas shopping & events at Chester Race Course: Cheshire West & Chester Council enforces a number of road embargos during Chester's busier periods. A clear window for continuous working was required between the last Chester race meeting in mid-September and the start of the Christmas shopping period at the end of November. This gave an 11-week window to complete all works.

12 hour access, 5 days a week for heavy goods vehicular over sewer and into neighbouring industrial units: Access across the works would be required by HGVs during the week meaning access crossings would ideally need to be done on weekends thus making operations during the week critical leading up to works during the weekend period.

Limits on lane closure: Consideration was needed in closing the bus lane only and reducing the width of the unsegregated shared use path thus restricting it to a cyclists dismount zone.

Final solution

It was decided that a replacement solution where flows would remain live at all times would be required to keep disruption to a minimum. The ground beneath the sewer was considered to be well consolidated, therefore the brick sewer was deemed suitable to cradle the replacement sewer. This involved removing the top half of the sewer to springing level, cleaning detritus from the invert and installing a thin walled pipe and a pipe jointing system that did not involve any direct contact with sewage.

Experience from other brick sewer replacements has shown that removing keystones from the arch of the sewer can lead to a continuing collapse, or 'zip-like' failure. To reduce the likelihood of this, steel arch straps were installed at the upstream and downstream junctions with the manhole chambers to strengthen the transition from new replacement pipe to brickwork.

Steel was selected as the replacement pipework material and designed for a shallow depth of cover. Lifting lugs on the lengths of steel pipe were also specified to enable lifting and the lowering of the steel pipe into the brick channel.

Close inspection of CCTV footage enabled the positioning of the two lateral connections which were welded on during the manufacturing process.

The steel pipe featured a Scotchkote Uretane 165 HB internal coating and a Versathane external coating which facilitated sliding of the steel pipe along the brick channel. On completion of the steel pipe installation the gap between the brickwork and new steel pipe at both ends was sealed. Due to the tightness between the new steel pipe and the brickwork the annulus void was filled using a high cement content grout which also displaced any remaining sewage.

The highway was subsequently reinstated and opened on time, before the start of the Christmas embargo.

The Editor & Publishers would like to thank David Jones, Senior Technician, and Andrew Russell, Assistant Engineer, both with Waterco Consultants, for providing the above article for publication.



A view along Sealand Road - Courtesy of Waterco Consultants



Steel pipe installed within open brick channel
Courtesy of O'Connor Utilities Ltd.