

CASE STUDY FOR CURED IN PLACE LINING WORKS AT TEN FATHOMS DARTMOUTH

Location: Ten Fathoms, Dartmouth, UK
Client: Black & Veatch/ South West Water.
Date: May 2008
Contractor: Exjet Services.

Overview.

As part of the implementation of the “Clean sweep” programme undertaken by South West Water throughout Devon and Cornwall the existing sewer outfalls for the properties adjoining the water front of the River Dart, (which have historically discharged directly to the River) were connected to the mains sewerage system via a new PE pipe laid along the base of the Dart.

As part of this programme there was a requirement for detailed CCTV surveys to be carried out to the existing sewerage network to ensure that all relevant connections were identified. This also provided an overview of the current structural condition of the network ensuring that any necessary repairs were carried out within the programme of works.

The survey revealed a number of defective pipelines, with the most prevalent below “Ten Fathoms”. This had shown that the existing 225mm Foul Water Vitrified Clay Pipe was in advanced state of degradation with significant levels of vertical deformation, loss of pipe wall material and subsequently loss of surrounding sub-strata.

To compound matters further the position of the defect was found to be located directly below the living room of the property making traditional open cut excavation and replacement unfeasible without significant disruption to the householder and subsequently increased costs to South West Water.

This left one of two options available:

1. A sewer diversion around the property.
2. A “no dig” solution.

A comparison of the two techniques was then sought in order to assess the most suitable method of repair.

Points that were taken into consideration included:

- Minimal Disruption
- Cost Effectiveness
- Duration of works

- Life expectancy of repair
- The position of the property, i.e. approx 60M below road level and access by foot via steps or boat only.

Exjet Services were then tasked with finding a suitable “no dig” solution that could offer a 50 year life design life whilst also maintaining cost efficiency.



Ten Fathoms, Dartmouth.

Subsequently a decision was made that if a method of repair by means of a “no dig solution could be devised and approved this would take precedence over any excavation works as this was more cost effective, less labour intensive considering the access problems associated with the property, and ultimately less intrusive for the householder.

Design Criteria.

In order for the design to be successful a number of factors had to be taken into consideration. This included:

- Offering a “no dig” solution for reinstating the missing side support around the void area of the defect
- providing structural support to the damaged pipe during the installation of the liner

- Finding an effective method of cleansing the pipe without causing further damage
- Ensuring any installation complied with Water Industry Standard 4-34-04
- Ensuring any design incorporated the requirements as set out in The Sewerage Rehabilitation Manual (4th Edition) for fully deteriorated pipes.
- That full ground loading had been taken into consideration within the design to prevent failure through fatigue or strain corrosion.



Extent of damage to pipe prior to remedial works.

Method.

Drawing on previous experience of repairing sewers with this extent of damage a method of works was collated and put forward for approval.

Firstly a method of cleansing the pipe had to be devised. This included removing the loose sections of pipe that were projecting into the main run. Exjet proposed that this should be carried out by progressively towing cleansing swabs through the line until such point that the pipe was deemed to be in a condition that would allow the installation of a liner.

This method offered a distinct advantage over traditional High Pressure Water Jetting as the pipe was not subjected to additional pressurisation and the subsequent risk of further damage.

Once complete it was decided that a heavy duty pre-liner should be towed into place to offer additional support during the installation of the liner. This was particularly prevalent around the void area where standard designs for lining would traditionally rely on the

existing pipe structure to provide side support during installation, and where increased strain is put upon the pipe through the inversion and curing process.

Utilising design equations that incorporate ground loading, ovality reduction factor, hydrostatic head of pressure and required long term flexural modulus as a minimum it was assimilated that a liner with an installed wall thickness of 14.5mm was required.

It was proposed that two separate liners should be installed; a 4.5mm liner acting as a support liner and a 10mm liner offering the required structural reinforcement. Utilising this method a declared value for full post cure of 550 N/mm² could be offered. This more than adequately covered the required structural strength.

In order to fill the external voids it was proposed that pressure grouting a reinforced acrylic grout through the wall of the liner should be employed. This method would consist of firstly installing a winch wire bond through the sewer to enable the towing of an inflatable packer through the sewer. Due to the severe vertical deformation that had occurred to the structure this was deemed necessary to prove that the packer could traverse the pipe and where the best points of contact for gel injection could be maintained.

Once the points of injection had been decided a 15mm hole would be drilled through the wall of the liner in order to access the void. The packers would then be towed into place and inflated to 8psi above contact pressure. The grout would then be pumped through the centre of the packer, through the injection hole and into the void and pressure maintained until 8psi of contact pressure was reached within the void area. This process would be repeated until such time until sealing was deemed to be complete. Any excess grout would then be removed utilising a cleansing swab.



Completed Liner.

These works were subsequently approved and carried out successfully in May 2008.

