USING TRENCHLESS TECHNOLOGY TO SEAL PRIVATE LATERAL CONNECTIONS TO MAINLINES-POST REHABILITATION (LATERAL JUNCTION REPAIRS)

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ABSTRACT:

Why do lateral connections in rehabilitated pipelines need to be sealed and how to assess the associated risks?

The rehabilitation of sewers using trenchless technology in is growing rapidly in New Zealand. Within the last few years several different lining technologies have become available for the rehabilitation of pipelines. The uptake in the use of trenchless rehabilitation methods is due to the reduction in costs (both direct and environmental costs) and the reduction of inconvenience to the public. The annual spending and turnover on trenchless rehabilitation has almost doubled in past five years.

The North Shore City Council (NSCC), since 1998 have been implementing "Project Care", a 20 year project to reduce wastewater overflows and beach closures. As part of this project, NSCC is using trenchless technology to rehabilitate sewers to reduce inflow/infiltration into the sewer network. All the public network assets' including mainlines, public laterals and public manholes in the leakiest mini catchments are rehabilitated.

The lateral connections on all rehabilitated mainlines are cut open using remote cutting technology after the mainline lining has been completed. However the re-opened junctions are not sealed and have potential risk of infiltration, as the gaps between the new liner and the host pipe are not sealed at this point. The sealing and repair at these connections is known as "Lateral Junction Repair" (LJR).

ProjectMax Ltd, has been working closely with North Shore City Council in providing the most suitable and practicable engineering solutions to control inflow/infiltration issues. This paper will discuss a case study on sealing the incoming lateral connections onto the rehabilitated sewers in North Shore City. This case study will look at:

- What is a lateral junction repair (LJR)?
- What is the benefit of doing this repair (LJR)? i.e., what is the advantage and how does it differentiate to physically excavating at the connection and sealing it?
- What equipment is required?
- Two different methods of installing a LJR, with and without access from private lateral.
- How and what are the risks involved while installing LJR(s)? How to mitigate these risks? What care and information is required before installing an LJR?.
- Remedial works involved in case of failure to install an LJR and who bears the cost of remedial works?

KEYWORDS

Infiltration/Inflow; Sewer Rehabilitation; Lateral Junction Repairs; Risk Assessment

1 INTRODUCTION

Various techniques are available to rehabilitate different pipes. Selection of a particular technique is influenced by several factors such as;

a. Material, size and shape of pipe
b. Type of defects in the pipe
c. Depth of pipe
d. Location (i.e., under a road, park, bush or a building etc.)
e. Existing gradient of pipe and bends (if any)
f. Other services in vicinity etc.

North Shore City Council (NSCC) has been undertaking Project Care for several years to improve beach water quality. This project involves reducing infiltration and direct inflow of stormwater into the sewer network as well as other works, such as installation of storage tanks, amplification of pipes and pump stations and improvements to wastewater treatment plant. Leaky catchments are initially identified by the planning department through flow-gauging and modeling. These catchments are then divided into mini catchments and further flow-gauging and modeling is undertaken to identify the leakiest mini catchment suitable for rehabilitation. Each mini catchment generally has around 4km of mainlines with about 300 private properties connected to these mainlines, as lateral connections.

Two main trenchless techniques to rehabilitate the mainline currently being used by NSCC are CIPP lining (Cured in Place Pipe) or Ribloc lining.

The first technique of rehabilitation (CIPP) is done by inverting/inflating a resin impregnated glass fibre liner inside the existing host pipe and then cured through introducing heat inside the new liner.

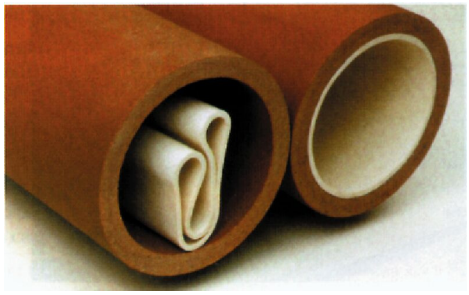

Figure 1: Host pipe with CIPP liner

Figure 2: RIBLOC liner inside the host pipe

In the second technique the system consists of a single strip of PVC, which is spirally wound into the existing pipeline via a patented winding machine positioned in the base of an existing access chamber. The edges of the strip interlock as it is spirally wound to form a continuous liner inside the host pipe.

In both of the above cases a small annulus is left in between the host pipe and the newly installed liner. And when the lateral connections in to the mainline are re-opened after lining, inflow and infiltration can still come into the mainline through these gaps.

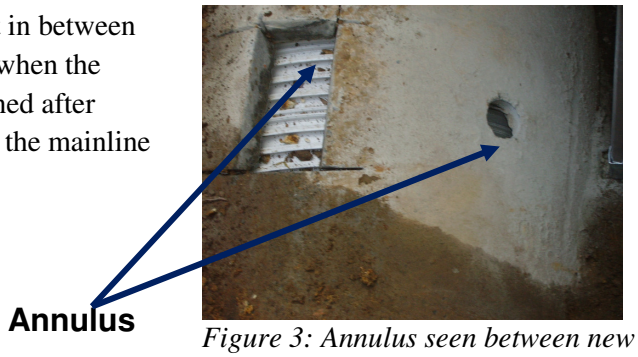

Figure 3: Annulus seen between new RIBLOC liner & Concrete (Host) Pipe

Groundwater is still able to infiltrate and travel through this annulus (gap) between the new liner and the host pipe. This gap is manually sealed at the ends (inlets & outlets in the manholes) to stop this infiltration from the manholes. However when the lateral connections to the properties are re-opened after lining, this annulus is open again and groundwater infiltration coming in from broken joints or the cracks in the host pipe can still enter into the sewer mainlines. It is therefore necessary to repair and seal this gap at the re-opened lateral connections. Such a repair to a reopened lateral connections is called **Lateral Junction Repair (LJR)**.

2 ADVANTAGES OF COMPLETING A LATERAL JUNCTION REPAIR:

As noted above the repair done to seal the gap between the new liner and the host pipe is called a LJR. This repair can be done in two ways:

(a) By excavating and installing a saddle at the connection; or
(b) By remote installation method using trenchless technology

Excavating at the lateral connection has various environmental and economic issues associated to it. Also, often, it may not be possible to excavate at all locations, such as, under or close to structures, footings or other issues related to depth and health & safety. Therefore using trenchless technology to repair these lateral connections remotely is widely acceptable and advantageous.

Different rehabilitation contractors use separate methods to repair lateral connections and each one is assigned a different name, by an individual company. Some of the most common nomenclature is “Top Hat”, “LCR (Lateral Connection Repair using EPROS)” or “LJR”. Some of the contractors even brand it by their company’s name, such as “Interfit” by Interflow Ltd in Australia. The basic principle and purpose of each is to seal the gap between the new liner and the host pipe.

In all the methods, it is fundamentally a packer carrying a wrapped-around, resin-wetted hat profile. It is pushed with air push rods or a carriage, or pulled by means of a rope, to the point of repair.

3 EQUIPMENT REQUIRED:

In general, two main pieces of equipment are used to install an LJR.

a. A specially made LJR packer
b. CCTV camera

A LJR packer is typically around 1.2 to 1.5m long made up of steel tubes covered with a special rubber on top. The inside of a packer would generally contain a steel skeleton and inflatable rubber tubes with air hoses. The packer inflates like a balloon when the air is blown inside.

Figure 4: LJR Packer

Figure 5: LJR Packer

4 METHODS OF INSTALLATION:

There are two basic methods of installation:

a. Pull and inflate the packer
b. Pull and invert the sealing liner inside the lateral.

In the first method, the packer, with resin impregnated felt on its top surface is pushed into the mainline. Once the packer reaches the lateral connection, compressed air is blown into the packer which inflates to such a level that the outer felt sticks firmly to the inside surface of the host pipe. Thereafter it is left under compressed air pressure for a length of time (generally between 90min to 120min) while the resin is curing. Once the resin is hardened and firm the packer is deflated and pulled out of the mainline.

Figure 6: Inverted liner inside the lateral

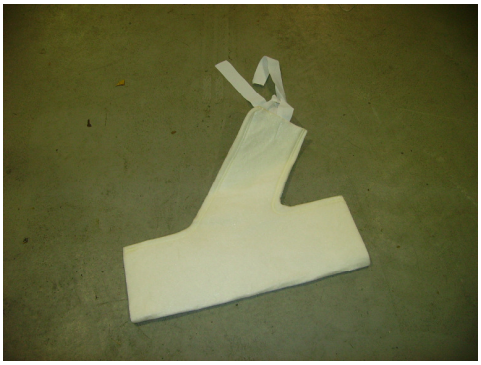

Figure 7: Y-Junction Felt Sample

A quick CCTV will confirm the appropriate sealing of the junction. While, in the second method of installation the packer is pulled by ropes between manholes and once it has reached the lateral's point, the felt is inverted inside the lateral using compressed air. In both situations, the felt is held tight up against the inner wall (of the host pipe) and then cured till the resin is hard enough for the felt to hold in its place.

While some contractors send a CCTV camera inside the lateral connection to actually see the placement of their felt inside the lateral, other contractors place a small CCTV camera at the edge of packer to confirm the placement of packer in its correct location and position.

It is also seen that some contractors induce heat, as well, to fasten the curing process.

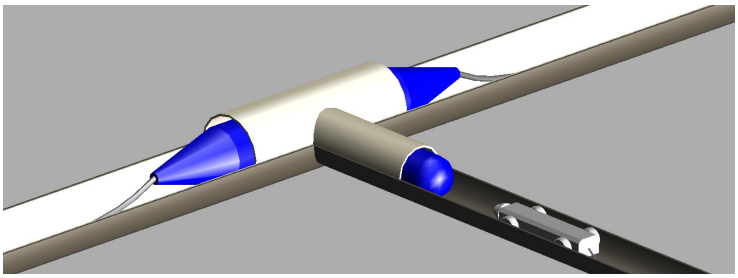

Figure 8: CCTV from inside the lateral capturing placement of the felt

5 RISKS INVOLVED:

Technical Risks: There are a few technical risks involved that can be dealt with as mentioned below:

1. Epoxy resin is generally used for this repair work and is ambient cured. Therefore, there is a limited time (20 – 25 minutes) available to position and place the packer and LJR correctly. The crew has to be well prepared and have completed all pre-checks before the felt is impregnated. If for any reason, the crew cannot place or position the felt in place within this period then it is simply pulled out and the process is restarted using new felt.
2. Sometimes, the felt gets bunched inside the pipe due to a loss of air pressure through the packer. Therefore, the air pressure should be constantly monitored until the resin is fully cured. This can also happen if the packer is worn out or damaged. Thus, the packer should be first tested outside for some time prior to pushing it into the mainline. For this reasons, most contractors put a limit to the re-use of their packer.

Figure 9: LJR with a small wrinkle caused due to RI

3. There are occasions when the packer gets stuck inside the lateral or mainline. This can happen for various reasons, such as, displacement at first the joint inside the lateral connection. The installation crew should complete a pre-installation CCTV both from the mainline and lateral to confirm that a LJR can be successfully installed. A flag raised for any issues before commencing the works, can mostly be dealt with. Whereas, it is too late to find a fault after failing to install an appropriate LJR.

4. Often roots are observed at the connection coming from inside of the lateral. Such roots must be removed and dealt with prior to installation of the LJR.

5. There are times when the connection is at such a depth that it is difficult to excavate. Or the lateral connection under an important building/structure that cannot be excavated upon. These types of cases have high risks and are difficult to deal with (if there is a problem). Once the LJR has been installed and fully cured, it cannot be removed except by excavation. Therefore the risk of a faulty installation should be weighed against the benefit of a LJR, in a case when it is not possible/extremely difficult to excavate and repair.

Figure 10: RI should be removed before LJR

6 SUMMARY:

Installing an LJR post mainline rehabilitation by lining is extremely useful in most of the situations, especially when dealing with issues such as infiltration/inflow. However, the remedial costs of any faulty installation can be very high, in most cases. The basic principle to mitigate all of above risks is to carry out a detailed pre-check and re-confirm that an LJR can be properly installed. The biggest question to ask ourselves before installing an LJR is "Are we able to live with the situation if this LJR turns out to be faulty, and who bears the cost to repair?"

Figure 11: View of proper LJR from Mainline

Figure 12: View inside the lateral connection

Glossary of Terms:

CIPP	Cured in place pipe
LJR	Lateral junction repair
RI	Roots intrusion
NSCC	North Shore City Council, Auckland

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