



Lining a 2,500 mm sewer with a Flexible Spiral Liner.

Renewal of Culverts with Flexible Liners

by Ian Bateman, Director of Interflow

Interflow Director Dr Ian Bateman looks at the rise of pipeline and culvert rehabilitation using flexible liners, predicting a bright future ahead for the subset of Trenchless Technology.

RENEWAL OF MUNICIPAL sewer and stormwater networks by trenchless relining methods has been happening for over three decades across Australia and New Zealand. Initially, a small percentage of the deteriorated pipes were renewed with trenchless relining products. Since the early 2000s, however, deteriorated pipes have been almost exclusively lined using Trenchless Technology.

Whilst there have been various lining products used, all of the products are classified as *flexible* liners. Further, all of these systems have performed very well

from a structural point of view. There can therefore be little doubt about the suitability and effectiveness of flexible liners to renew a deteriorated sewer or stormwater pipe. In fact, given that some of these liners are up to 30 years old and still in good condition, it is quite likely that in the coming years it will be able to be proven that pipes relined with flexible liners have a longer service life than the original pipe.

This will give real meaning to the description of the industry as being pipeline *renewal* rather than repair or rehabilitation.

A RANGE OF TYPES AND SIZES

Throughout this 30-year period it has become commonplace to line pipes ranging from 100-3,000 mm in diameter. In one of the higher profile examples, Interflow lined a 2,500 mm sewer pipe with Ribline spiral wound product. For this, Interflow was awarded the ISTT Project of Year Award in 2013.

The majority of all sewer relining projects have involved putting flexible liners into rigid host pipes. There are relatively few examples of needing to line flexible host pipes and it is quite rare for rigid liners to be used in rigid

pipes. In the case of new pipelines, the last 30 years has seen a shift from traditional rigid materials such as concrete and clay to flexible materials. Today, flexible pipes dominate the world in terms of usage.

Whether it be for sewer, stormwater, water or gas, flexible materials vastly outnumber rigid materials in terms of both sales value and meterage.

CONVERTING THE CULVERTS

With tens of thousands of culverts currently in service in Australia, there is a growing need to address the number of road and rail culverts that are approaching the end of their service life.

The majority of these culverts are made from corrugated metal with the balance typically being concrete. Corrugated metal pipes are classified as – and behave like – flexible pipes. As such, these pipes have proven to be very satisfactory from a structural point of view.

The major end-of-life failure mode is erosion and/or corrosion, which leads to holes in the corrugated metal pipe (very commonly in the invert and haunches). The holes then enable the surrounding soil to be washed out, which eliminates the support and can ultimately lead to deflection and collapse.

It is essential that corrugated metal culverts are renewed prior to any significant loss of surrounding soil. Putting any type of liner inside a host pipe without sufficient soil support still leaves a significant risk of subsidence and/or collapse of the ground above.

If it is accepted that a corrugated metal culvert should be renewed prior to any significant loss of surrounding soil, then what types of liners are suitable? In the case of sewers, the industry routinely uses flexible liners to great effect. There is no obvious reason why flexible liners are not also suitable for culverts.

SPIRAL WINDING A GROUT SUCCESS

For the last 15 years, Interflow has been successfully renewing culverts with grouted spiral wound systems. These systems have proven to be structurally sound and are performing in a manner commensurate with sewer liners.

Two positive aspects of grouted flexible pipe systems are the grouting in place of the liners and the fabrication of the liners on-site. The former is advantageous in locations where there has been some localised washout of the soil behind the pipe. The grout will flow into the gap and reinstate the surrounding support. The latter, meanwhile, ensures the cross-sectional area can be maximised to fit the diameter of the host pipe.

FLEXIBLE VS RIGID

Whether putting a flexible or a rigid pipe inside a flexible culvert, both liner types are designed as though the host is completely deteriorated, has no strength left, and is essentially on the verge of collapse. This scenario, however, is a conservative one and almost never the case – especially with flexible hosts. Flexible host pipes generally have significant load bearing capacity remaining due to the manner in which they bear the load by interacting with the surrounding soil.

When a rigid liner is put in a flexible culvert, deflection loads in the host pipe are transferred entirely to the rigid liner. Put another way, any remaining strength in the culvert will not contribute to the strength of the rigid liner.

There is therefore no 'extra' safety factor associated with the host pipe still having significant load bearing capacity left. It is essential that rigid pipes be designed in a very conservative manner, both in terms of the strength of the pipe itself and the assumed condition of the surrounding soil (E's).

GREATER THAN THE SUM OF ITS PARTS

When a flexible liner is put inside a flexible culvert, the two pipes will interact to yield a liner that has a strength greater

than the flexible liner alone. Any deflection load in the host will be transferred to the liner, which will in turn be held restrained by the host and the surrounding soil.

In essence, despite the fact that the flexible liner is designed as if the host has no strength and can bear the loads by itself anyway, the fact that the host is flexible automatically adds to the strength of the liner and provides an 'extra' safety factor.

A BRIGHT FUTURE AHEAD IN CULVERT RENEWAL

The emerging need to renew corrugated metal culverts will present a further set of challenges and opportunities for the Trenchless Technology industry. With an excellent track record over the last 30 years of structurally renewing rigid sewer and stormwater pipes with flexible liners, a very successful reference point for how to meet these challenges has been established.

Based on this history and the track record of the culvert renewals performed to date, it seems that there will be a prominent place for the same type of flexible lining systems in the emerging culvert market.

