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National Research effort continues: IRC takes close, positive look at sliplining

By Lyne Daigle and Jack Zhao

Utility contractors will increasingly encounter a new method for rehabilitating buried pipelines (water, sewer and gas). It's called sliplining and it involves pushing and/or pulling a new liner pipe into a failing, existing pipe. Except for the need for access pits at intervals along the route of the pipe, excavation is not required. The technique, therefore, offers many advantages over traditional open-cut and cover methods – less traffic disruption, less disturbance to the environment, and less annoyance for the public.

The Institute for Research in Construction (IRC), part of the National Research Council, has studied the effectiveness of sliplining technology in an effort to find ways to improve the process. One study involved the rehabilitation of a large-diameter watermain in downtown Ottawa in which high-density polyethylene (HDPE) pipe was used.

Slipline rehabilitation of a 915-mm watermain in downtown Ottawa

HDPE pipe is ideal for sliplining because it is flexible enough to be threaded into the access pits. To ease the slipline pipe into the host pipe, installation pits are constructed at locations suited to storage, joining and installation of the HDPE pipe and where disruption to traffic can be minimized. The host pipe is demolished and removed in the installation pit so the slipline pipe can be inserted.

The slipline pipe is smaller in diameter than the host pipe. This means designers must ensure the new pipe will have enough capacity to handle the required flow. But because the liner pipe is usually smoother than the host pipe, the smaller flow area may be offset by less flow resistance.

The slipline liner must also be able to withstand soil pressure and the weight of traffic above. The slipline pipe inside a host pipe benefits from whatever strength remains in the host pipe. But where the host pipe has been destroyed, such as at access pits, the slipline must be strong enough to carry all the loads alone.

HDPE pipe sections join well. Properly made butt joints are as strong as areas of the pipe without joints. Still, the IRC study found that good joints require care (for example, proper

joining temperature, cooling period, and dust and moisture control). Some flanged joints are also required at locations where there is no access for fusing equipment like access pit joints and T-connections.

Most of the sliplined pipe is isolated from the soil by the host pipe and the grout, but those slipline portions in installation pits are not. Excavation may be the only option of installation at locations such as:

- connections of two segments inserted from opposite directions
- T-connections, elbows or abrupt changes in direction or elevation
- connections between two different sizes or different pipe materials

At such locations, the loading on the liner pipe changes suddenly and there is a critical zone at each end of the trench section where joints should be avoided due to the high moments and shear forces in this area. The critical zone is affected by the quality of bedding and by the pipe's stiffness, as well as by the length of the excavation.

To study the performance of the 915-mm sliplined pipe in Ottawa, IRC researchers installed strain gauges on the inner surface of the cast iron pipe and on the outside of the HDPE pipe to calculate the stress and deformation of the pipe structure. This information, in combination with the failure stress and the working stress, both of which are known, indicate how well the pipe structure is performing and is likely to perform in the future. In addition, IRC has conducted laboratory tests to assess the benefits of grouting the space between the old pipe and the new liner, and found that grouting can increase the strength of the pipe by up to 38%.

IRC is also investigating other aspects of slipline performance such as the different thermal contraction/expansion coefficients of the host and liner pipes, joint quality, the eccentricity of the liner within the host pipe, and behaviour in the trenched portions.

Water main rehabilitation projects using HDPE slipline technology are currently underway in Ottawa and Halifax in applications where surface disruption must be kept to a minimum. It is likely that this technology will be used more and more.

When all costs are considered – direct costs along with social costs (traffic delays, public inconvenience and effects on the environment) – sliplining has been found to be a cost-effective way of rehabilitating pipes, especially in downtown core areas. Meanwhile, IRC is working to learn more about slipline performance, reliability and performance.

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