Trenchless Rehab from the Engineer's Perspective

By James W. Shelton

From my perspective, sewer rehabilitation programs tend to fall into two main categories.The first — and by far the most common — is driven by the need to reduce peak infiltration-and-inflow (I&I) flows in the collection and conveyance systems and at the head works of the treatment plant during and following significant rain storms.

The second type of program is driven principally by structural failures and seems to be primarily limited to older urban systems, typically those constructed of brick or other older materials and often in proximity to badly leaking old water pipes or to combined sewer overflows (CSO) systems.

For a structural-based program, once you decide not to dig, the selection of which trenchless technologies to use becomes a function of cost, contractor availability, owner preference and, in the case of interceptors, what is the acceptable loss of inside diameter and/or the flow carrying capacity.

When the primary intent is to reduce I&I, the engineer's decision-making becomes a little more involved. First, do the pipes/laterals/manholes in a given area leak significantly enough to warrant rehab? We've seen many sewer rehabilitation programs whose purported purpose is to eliminate the sources of the peak flows that cause wet weather sanitary sewer overflows (SSOs), yet they simply, blindly, systematically line mainline after mainline, never first ascertaining how much (or even whether) the lines actually leak significantly.

The next question becomes: "Is the pipe structurally sound?" In my experience, most I&I leakage does not come through structural defects; it enters via leaking joints in structurally sound pipe. This is especially true in the two primary piping materials for sewer collections systems — old terracotta/clay pipe and new SDR 35 pipe — but for two different reasons. Clay pipe, because the joint gasket materials were often inferior, and SDR 35 pipe, because only an extremely dedicated pipe layer can bed that pipe without deforming its thin walls, especially near the male joint.

In our experience, the best fix for structurally sound pipe with leaking joints is packer injection grouting. Many pooh-pooh this approach, having unsuccessfully tried it in the past. It has failed for me in the past too, but only because I misapplied it. When I was younger, my clients grouted thousands of joints on myrecommendation...mostly with less than a pint of grout and usually without grouting the tap connections.These programs failed because we failed to specify a grouting program and implement a measurement and payment approach that required and incentivized our grouting contractors to pump grout.

The recent ASTM on packer injection grouting goes a long way to establishing sound practices for this approach and, if used properly, can significantly reduce I&I and extend the life a sewer collection system. New grout flooding techniques hold promise for even more systemic approaches along these same lines. Most agree that grouting won't last as long as a newly installed pipe, so for an apples-to-apples approach based on life cycle costs, we and our clients have generally settled on a 10- to 15-year life cycle for grouting. However, at less than a one-sixth of the cost of replacement and one-fourth of the cost of lining, this approach is easy on the pocketbook, quickly reduces I&I flows and stabilizes the structural condition of the pipeline.

If a line has structural damage, grouting alone is not enough. If there is only one defect in a pipe segment, it is often cost-effective to install a cured-in-place point repair (CIPPR) to address the structural defect and then follow that up with a grouting approach.

On the other hand, if a line segment requires more than one CIPPR, or if it is pipe with 3-ft joints or if it has a high criticality rating (i.e., in front of a hospital, behind City Hall, etc.), we typically opt for cured-in-place pipe lining (CIPPL). It's a well-proven approach with a generally accepted life cycle of 50 years.

However, merely lining a mainline pipe is practically useless from a flow reduction perspective. I practically cry every time we install a CIPPL liner with hydrophilic end seals hermetically sealing out all the leakage that had been pouring into the pipe, only to watch the water pour in even faster than before when we cut holes into the liner at every house connection. Post-rehabilitation video visually confirm that once the mainline is lined, the groundwater simply migrates to the lateral tap cuts in the liner (through the annular space between the host pipe and the liner), to the laterals and to the manholes. Post rehab-flow meter data quantitatively supports these observations.

Therefore, mainline lining is never a stand-alone fix when reducing I&I flows. If we are to prevent annular space leakage and migrating groundwater leakage, then the lateral tap connections and the laterals themselves must also be lined. And because liners don't stick to each other too well, each of these components also require hydrophilic end seals to prevent the water from migrating back into the sewer.

We've even seen water leaking into a lateral from the annular space of the lateral liner — at the cleanout end of the liner — because groundwater migrated that far up the lateral once we blocked off its entry at the mainline, at the tap and at the lateral and there was no end seal to block it.

When you add up the cost for the systemic mainline lining, lateral lining and manhole rehab needed to significantly reduce peak I&I, you begin to approach the costs for complete replacement. The beauty of trenchless rehab is the minimal impact on residents and businesses; this reduction in social costs often dictates that even in those instances where trenchless is slightly more expensive, trenchless methods prevail.

However, nothing is more disheartening than to complete a trenchless rehabilitation project only to see the water, gas or stormwater utility open up the road to replace their infrastructure. Only when we consider all of the buried infrastructure, will we truly make the best decisions regarding when and why to use trenchless rehabilitation approaches.

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