Going Trenchless

By John J. Struzziery

America's storm water infrastructure is in desperate need of upgrades and rehabilitation. Across the country, culverts and storm sewers are reaching the end of their useful design lives. Aging or inadequately maintained, these structures are often eroded and deteriorated, stricken with abrasion and rust and suffering from severe flow restriction.

Effective storm water upgrades and rehabilitation with trenchless technologies

ARTICLE SUMMARY

Challenge: Many U.S. cities risk high-cost environmental and economic consequences due to the imminent failure of deteriorating storm water infrastructure.

Solution: Trenchless technologies (e.g., CIPP, spiral-wound lining, shotcrete lining, fold and form, coatings and linings, and pipe bursting) are being more widely applied and valued by transportation agencies.

Conclusion: These methods can help cities streamline and limit the cost of infrastructure update and rehabilitation projects while minimizing public disruption.

The options for repair traditionally have been expensive and disruptive to the public. Meanwhile, the environmental and economic costs incurred when this infrastructure fails are extremely high. Municipalities no longer can afford to delay the necessary updating and rehabbing of their storm water systems. U.S. cities and towns need comprehensive and effective solutions that ensure infrastructure remains properly maintained. One such solution is the utilization of trenchless technologies.

Unlike Traditional Methods

Across the country, municipal, county and state transportation agencies are seeing the value of trenchless technologies in rehabbing culverts and storm sewers, often using pipe-lining methods. Some of these methods include:

Cured-in-Place Pipe-Lining. Cured-in-place pipe-lining (CIPP) is the installation of a resin-impregnated tube into an existing pipe. The tube fits the inside contours of a pipe through the application of pressure and heat. Created with minimal cross-sectional area loss, the pipe is structurally strong, flexible, sealed and leakproof. Additionally, its smooth inner surface increases flow capacity.

CIPP is used to rehabilitate sewer pipes ranging in diameter from 6 to more than 100 in. In sewer rehabilitation projects, the technology often is applied to damaged reinforced concrete pipe. It also can be used in the rehabilitation of culverts. Discharge of cure water is of primary concern in drainage system applications. Air inversion with steam cure generally is used for this application.

Spiral-Wound Lining. Spiral-wound lining is a renewal process used generally for large-diameter, noncircular and irregular-shaped pipelines. The technology involves the insertion of a liner material into a host pipe and is comprised of steel-reinforced interlocking PVC profile panels held in place with a grouting material.

The PVC profile is fed through a manhole into the winding machine, which is placed in the host pipe. The machine winds the PVC profile inside the pipeline and then interlocks it to create a new watertight pipe. The machine's forward-winding motion ensures it can be shifted continuously to the next downstream length without dismantling. Grouting material is injected into the annular space between the host pipe and the PVC profile.

Spiral-wound lining frequently is used in reinforced concrete or corrugated metal pipes 6 to 144 in. in diameter. The technology offers the convenience of working in flow with little or no bypass, as well as the ability to provide full structural rehab to curved pipelines.

Shotcrete Lining. Another way to repair older storms and culverts—or extend the life of newer ones—is by utilizing shotcrete lining. This technology involves lining corrugated steel pipes with a 1-in.-plus-thick layer of high-strength shotcrete. Specially designed equipment allows the shotcrete to be applied remotely in a consistent thickness, even in storm drains or culverts that feature deflections and angles. It is typically implemented in large-diameter sewers ranging from 6 to 20 ft in diameter and can be carried over directly for use in storm sewers and culverts.

The shotcrete is impermeable to water and features high abrasion- and acid-resistance properties, making it ideal for pipes that carry large amounts of solids and acidic flows.

Fold and Form. Fold-and-form techniques use the deformed memory ability of PVC or other plastic pipe material that reduces the cross-sectional area of the pipe. It can be inserted in the drain line to be renewed, and then expanded with air and heat to reshape the deformed pipe to its original configuration and fit tightly inside the host pipe. This technique can be used in drain lines up to 30 in. in diameter.

Coatings and Linings. Coatings and linings have proven to be useful in the rehabilitation of culverts. These methods involve coating a pipe's interior surface with polymeric or cementitious materials. This improves the durability of the pipe, protecting it against corrosion and abrasion. Surface preparation and proper application techniques are essential for a successful project.

Pipe Bursting. With pipe bursting, a bursting head/expander is pulled through an existing pipeline, breaking it into fragments. The bursting head is attached to a new replacement pipeline that is then installed in the interior of the fragmented main. Pipeline diameters typically vary from 3 to 36 in. This technique is used frequently for sewerage systems and drainage systems, particularly where upsizing is desired.

A Multitude of Benefits

A storm water upgrade or rehabilitation project often impacts road traffic, public utilities and other municipal infrastructure. Any disruption to traffic and/or public utilities typically results in significant disturbances to the public.

Trenchless technologies allow storm water infrastructure to be rehabilitated with reduced impact to adjacent utilities or properties, or in the case of dense urban areas, disruption to traffic, businesses and pedestrians. Trenchless applications have proven to be beneficial in those sewer infrastructure projects located near busy thoroughfares or underneath major highways, for example.

Cost reduction is another positive result. In areas where hazardous soils are encountered, trenchless applications will lower the volume of excavated materials, resulting in cost savings due to the decrease of soil classification and necessary handling and disposal fees. Also, the economic impact of the public disruptions detailed above is avoided, as are the heavy monetary investments associated with the digging and replacing of deteriorated pipelines.

Finally, trenchless technologies can enhance relations between project teams and communities due to the reduction of negative effects associated with traditional open-trench projects. It also can expedite the permit process, as projects featuring trenchless technologies have minor individual or cumulative environmental effects.

Wise Decisions

Culverts and storm sewers are generally "out-of-sight and out-of-mind" components of a community's overall infrastructure. The reality, however, is that such systems deteriorate over time due to corrosion, aging, environmental factors and operating conditions.

In the U.S., a significant portion of the storm water infrastructure has been in service for more than a century and deteriorated significantly. More federal, municipal, county and state transportation agencies are utilizing trenchless technologies in their efforts to update and rehabilitate these valuable assets. The benefits of reduced cost, surface disruptions, construction duration and permitting, plus overall public acceptance, may be sufficient reasons for decision-makers to consider the use of trenchless technologies for the renewal of storm water infrastructure. WWD

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