photo courtesy of Hobas Pipe

Installation of large-diameter pipeline takes place beneath a highway.

Pipelines Being Surveyed, Refurbished to Meet Expanding Demand

SPECIAL ADVERTISING SECTION

With the nation facing a potentially enormous bill for modernizing, expanding, and refurbishing its water infrastructure, pipeline owners and specifiers are exploring new ways to get a better understanding of the condition of their assets, as well as ways to meet increased demand for efficiency.

The condition of America's water infrastructure—whether for storm, waste, or potable water—has gotten a lot of publicity in recent years, particularly in light of the large estimated cost of repair and expansion. Within this national context, individual communities, developers, and designers are developing their own approaches.

Kimberly Paggioli, P.E., marketing manager for Hobas Pipe, in Houston, Texas, cites a trend toward larger diameter pipes. "Population drives diameters," she says. "Many cities are moving toward larger, deeper lines and taking the smaller lines with lift stations off line. This eliminates the maintenance associated with lift stations."

Paggioli cites recent instances in which local jurisdictions have opted for a single larger-diameter pipeline in place of two or more smaller pipes. A key part of this approach is the "gravi-force" concept, she explains. "The design is a gravity sewer system sized for near-term capacity, which can be pressurized in the future to function as a force main." In this manner, near-term demand can be met by a pipeline that can also meet the higher requirements of the future.

The large-diameter pipes might need their full capacity only occasionally, but it's still wise to have that capacity available. "Sure," Paggioli says, "lines might have extra capacity sometimes, but they need to be designed for the maximum demand. Overflows are no longer tolerated, and fines can add up quickly if an undersized system causes environmental distress."

For example, Paggioli notes that the city of Lincoln, Nebraska, recently needed to expand its wastewater system, and chose between two options for pipe diameters. The first option used a single thirty-six-inch gravity outfall sewer that could meet existing flow capacity requirements and in the future be surcharged in keeping with the "gravi-force" concept. The second alternative was to install a new twenty-four-inch force main immediately and a second twenty-four-inch main in the future.

Using projected growth rates and flows, the Lincoln wastewater system calculated the first option would have a lower life-cycle cost.

Inspecting pipe in the field

Jurisdictions faced with having to expand their sewer capacity certainly need to be sure the pipes already buried in the ground aren't nearing failure. Often in the past, though, the first sign of a pipe failure has been a major leak or collapse.

A variety of new techniques are taking hold in the market to help owners and their engineers evaluate the condition of infrastructure in place and make appropriate, prioritized repairs.

Matt Childs, the president of the American Concrete Pipe Association, in Irving, Texas, noted—in a recent article in the association's *Concrete Pipe News*—that more and more attention is being paid to inspecting buried pipe. "Designers, regulators, specifiers, and contractors are collectively taking a renewed interest in buried infrastructure," Childs says. "Inspectors are becoming vital elements of design and construction to help infrastructure owners determine if they are acquiring, or have acquired, an asset that will perform as expected for the life of the project. In addition, inspectors are being asked to report on the condition of sewers and culverts that have been functioning for various periods [of time] under a range of site situations."

Although concrete pipe products are extensively tested before they leave the manufacturing facility, additional assessment in the field is often necessary. "Buried pipe must perform as a conduit and a structure," Childs says. "Deflected pipe can negate the very purpose of a pipeline or culvert by reducing its hydraulic performance and causing the structure itself to fail prematurely."

One tool finding increasing favor is laser video profiling. This automated process moves a device through the interior of a buried pipe. This device uses video and lasers to create a very accurate map of the pipe's surface, identifying the exact location and extent of corrosion, cracks, and other potential failure points.

Mo Ehsani, Ph.D., the founder of QuakeWrap, Inc., in Tucson, Arizona, also teaches civil engineering at the University of Arizona. He notes that soil conditions, installation methods, and other factors can all contribute to cracking a pipe, and once water comes in contact with the steel coils typically found in prestressed concrete pipe, corrosion can progress rapidly.

Mapping pipe conditions from inside the pipe can provide exact information on the number and size of leaks in each pipe section. "If there are too many, you have to do something about it for sure," Ehsani says.

Effective repairs to limited areas

One solution is to apply a material to the inside of the pipe that both plugs the leaks and strengthens the structure. QuakeWrap's fiber-rein-forced polymers (FRPs) are often applied in one or two layers to meet both needs, Ehsani says. The coating provides a chemical barrier that bonds to the pipe material, acting both to strengthen the pipe and limit the impact of any damage.

"It does not reduce the pipe's diameter, and may even improve hydraulic performance by smoothing the interior surface and reducing friction," Ehsani adds.

Refurbishment of pipes in this way or by similar methods is going to be a key part of future water infrastructure strategies, Ehsani says. "Clearly there is more and more demand for water and sewer resources everywhere," he says. "Larger diameter pipes are the way to go."

Heath Carr is the president of Fibrwrap Construction, Inc., in Ontario, California. He reports that although pipeline strengthening is only "a small piece of our business," he's still finding that "business is overwhelming."

It's vital for many pipeline owners to be able to do refurbishments and repairs without excavation, Carr says, because excavation can often be extremely disruptive to paved, built-on, and occupied property.

Once again, much of the refurbishment work that

Fibrwrap undertakes is being done in larger diameter pipelines. "We actually put people in the pipe and use hand layup methods," Carr says. Once again, the repair uses FRP materials, and is designed both to help pipes resist bursting and to remediate the effects of corrosion.

"Most of the pipes that are failing prematurely are large-diameter pipes," Carr says. Moreover, he adds, Fibrwrap often works in combination with an effort to survey and catalog the condition of underground pipe systems. With automated inspection and detection systems, Carr says, municipalities "can go in and find out what pieces of pipe are bad, and rather than digging them up, which can be very costly and dangerous, we design a carbon fiber to repair these sections."

Municipalities considering a major expansion or even replacement of their pipelines also must reckon with the risk of replacing pipe that doesn't need it. "Some of these pipes aren't failing," says Carr. "They're still healthy and in good shape. There's not enough money in the world to replace all of it."

As a result, inspections offer an opportunity to prioritize repairs, and tools like FRP coatings, applied to the inside or the outside of the pipe, offer the chance to make limited but effective repairs at reasonable cost.

Working in an environment of limited funds will be necessary in the future, observers say, because local government resources are unlikely to be adequate for all needs and federal funding may not close the gaps. The National Association of Clean

Water Agencies, for example, reports that "the U.S. Environmental Protection Agency, the Government Accountability Office, and the Water Infrastructure Network estimate that the funding gap for this critical infrastructure at $300 billion to $500 billion over twenty years, and it is clear that existing mechanisms for addressing this enormous funding gap fall far short."

The Water Infrastructre Network has also forecast a funding shortfall of about $23 billion annually, and stressed that meeting this need through raised utility rates will not be feasible.

As this effort ramps up in the future, local governments, private developers, and other stakeholders will give more and more attention to methods of refurbishing infrastructure already in place, and to designing more efficient and economical new systems to support expansion. ❖