ON THE BEAM

Laser profiling is gaining recognition in North America as a valuable tool for measuring newly installed pipes and sewers scheduled for rehabilitation

By Peter Kenter

Laser profiling is a relatively new technology that uses a laser beam to scan the interior of a pipe and accurately determine its ovality, alignment, diameter and capacity.

It's not the type of information collected on an ongoing basis. Instead, laser profiling is usually conducted just once before handover on pipe projects where the contract specifies the roundness of the installation.

Now required on government projects in just two states, laser profiling continues to gain acceptance as one criterion by which to judge a pipe installation. It also has potential as a tool for measuring pipes scheduled for rehabilitation, such as by cured-in-place pipe lining.

Municipalities and contractors that want to use the technology need to understand how laser profiling is developing as more and more jurisdictions specify it.

Deadly accurate

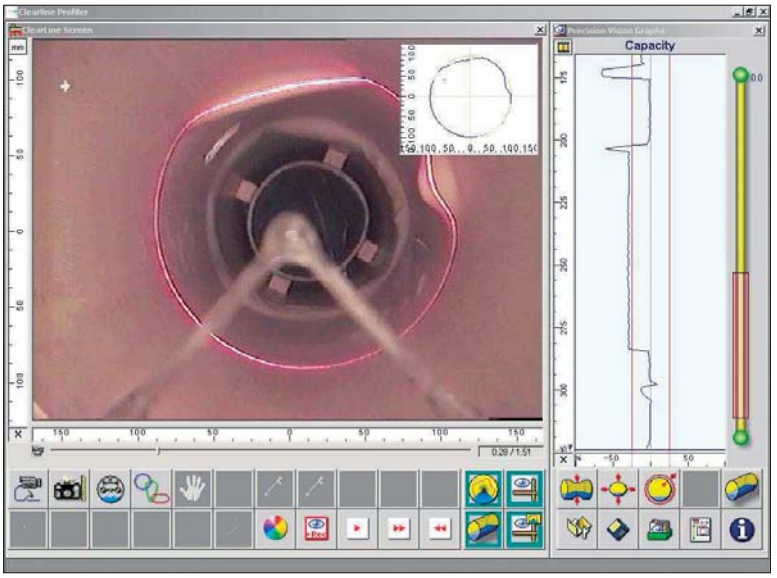
A laser profiler is essentially a CCTV camera inspection unit with a slim laser probe mounted to the front. The laser projects a ring of light around the pipe interior, while software processes the information it receives from analyzing the ring.

While a television image helps to estimate the dimensions of a pipe, a laser profiler provides hard data and dead-accurate readings within a fraction of a percentage point. And while the position of a CCTV unit is estimated by the length of cable fed into the pipe, the laser profiler can determine its own location within inches. Laser profiling devices now range in price from about $25,000 to $80,000, but prices are declining as the technology becomes more widespread.

A ring of laser light is shown inside a pipe free of roundness defects.

"It's only been on the market in North America for a year or two, and people are just starting to see the benefits of the technology," says Gerry Muenchmeyer, technical director with the National Association of Sewer Service Companies (NASSCO).

"Initially, we've seen the sale of quite a few units in Florida, where any project under Florida Department of Transportation (FDOT) auspices is laser profiled for ovality before being handed over to the owner. The test applies equally to concrete pipes or flexible PVC pipes that might collapse beyond acceptable tolerances if trenches are improperly backfilled."



A laser profiler with video camera is shown inside a pipe with defects. (Photos courtesy of CUES Inc.)

The technology was promoted to the FDOT Pipe Advisory Group (PAG) at an October 2005 presentation by Orlando-based laser profiling equipment manufacturer CUES Inc. and Pipeline and Drainage Consultants of Lexington, Ky. FDOT moved quickly to include the technology in specifications on all projects with pipe diameters from 8 to 48 inches let after July 1, 2006.

The Arizona DOT has a similar mandate, insisting that 10 percent of all pipes on construction projects be scanned before project handover.

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Gerry Muenchmeyer

NASSCO

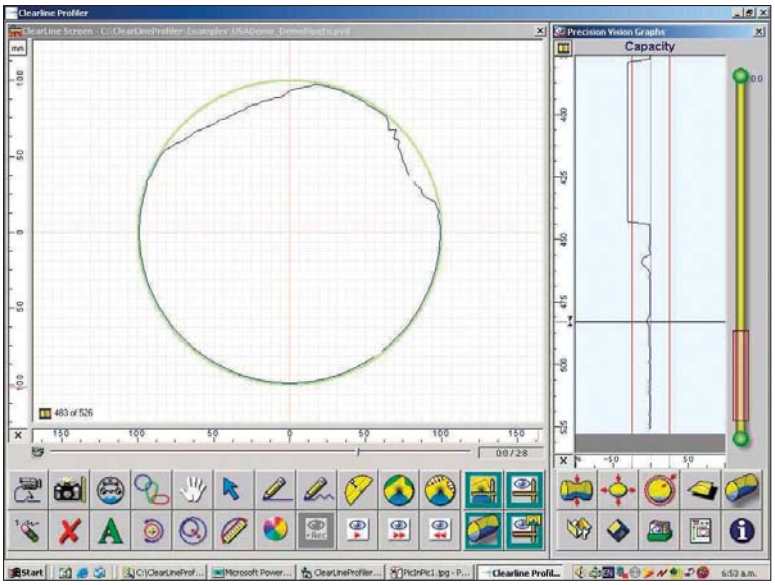
Making an impact

Laser profiling is better established in Europe, where it has been used for about five years. The reason is simple, says Mark Knight, associate professor in the Department of Civil Engineering at the University of Waterloo in Waterloo, Ontario, and executive director of the university Centre for Advancement of Trenchless Technologies (CATT).

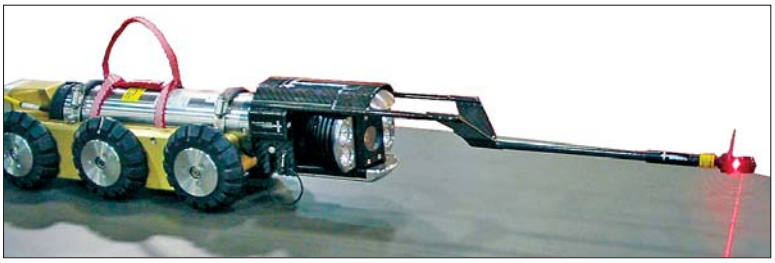
"In Europe, pipes are buried closer to the surface so live loads are more likely to affect the pipes," says Knight. "In North America, we bury them 10 feet or more, and the loads dissipate."

The technology has made an impact. A benchmarking project designed to test side scanning evaluation technology (SSET) in a dozen Canadian municipalities under the auspices of CATT and the Buried Asset Management Institute International in Atlanta, Ga., has been postponed in light of the newer laser equipment, says Knight.

But laser profiling devices have more uses than checking pipes for government project owners. A laser scan will show rehabilitation contractors where pipes are undersized, or oversized. "If you want to design a liner to rehabilitate that length of pipe, you can take every defect into consideration," says Muenchmeyer. "Afterward you can profile the liner and determine within a reasonable tolerance how thick the liner is and how well it fits into the existing pipe."



A pipe measurement diagram shows the desired shape of the pipe and the actual shape as determined by laser profiling.



In this common laser profiling configuration, a CUES LP917 laser profiler is shown coupled with an OZII video camera.

Sensitive to environment

The technology isn't without growing pains. Some units are sensitive to moisture and temperature variations, and even slight deviations in laser angles give false results.

"If you're riding on sand in the pipe and the inclinometer is off, it distorts the readings even more than it would if you were using just a CCTV camera," says Joe Vannieuwenhoven, product manager with Aries Industries Inc., a laser profiling equipment maker in Waukesha, Wis.

"The inside circle of the pipe will read as an ellipse, which is exactly the problem you're trying to identify. We solve that problem by equipping the profiler with an internal inclinometer."

The technology also doesn't work well in pipes filled partially with water — it provides information only on dry sections of the pipe. The solution here involves the addition of a sonar device to read the information below the waterline. Software integrates the two readings into a single result.

"These tools are becoming multi-sensory," says Knight. "We're seeing units that provide CCTV images, laser profiles and sonar readings on a single pass. Keeping all of those units calibrated with respect to each other could be a chore."

The first tool to become widely integrated with laser profilers is the laser micrometer, a laser scanner that accurately measures the dimensions and depths of pipe defects, scanning all pipe joints in 360 degrees. The laser micrometer has already been incorporated into FDOT standards.

More to come

Laser profiling technology is still developing. "We're going to see inspection units that offer more capabilities, including laser scanning and micrometry," says Vannieuwenhoven. "But as the technology becomes more complex, we're going to see a compensating demand for simplicity in operating these units. Contractors will expect a tool that doesn't require a high-level technician to do number-crunching or data analysis. They want something that can be run using an existing truck and existing operators."

Demand for laser profiling is expected to continue as government agencies look for new ways to ensure that they are getting value for its construction dollar. Likewise, laser profiling equipment manufacturers, and pipe manufacturers who might benefit from tougher standards, are lobbying state and municipal governments to adopt laser profiling.

"I think that what's going to happen is that, as the industry becomes more familiar with the capabilities of laser profiling, you're going to see it used more and more," says Muenchmeyer. "We're going to see a lot more success stories using this technology." ✦

ONE CONTRACTOR'S STORY

When the Florida Department of Transportation (FDOT) made laser profiling mandatory on all new pipe projects on July 1, 2006, some state contractors saw a business opportunity.

Mike Dean, president of Rockline Vac Systems Inc. of Dania, Fla., purchased a laser profiler from CUES Inc. with a laser micrometer in July 2007. The business added the specialty to its slate of other services, including CCTV inspection, chemical and pressure grouting, PVC slip-lining and cured-in-place pipe lining.

"We use the laser profiler only for FDOT projects," says Dean. "It's really used only as a method to determine whether pipes have been installed properly. When the general contractor takes on a construction project, the cost of laser profiling is already part of the contract.

"We're hired by the prime contractor or one of the subs to report to the government engineer on the project. It's crucial at that point because the manufacturer of the pipe — either concrete or PVC — is out of the picture. The test determines whether the work performed by the installer is going to be accepted or rejected."

Dean says that his company has performed laser profiling inspections five times. "It's not the type of service you can convince people to add to normal inspections without a good reason," he says. "We promote the service by sending flyers to local construction contractors to make them aware we offer it, and it's also something I make people aware of at trade meetings."

While there's no current standard by which to judge various laser profiling products, contractors looking to invest in a unit should examine the requirements of potential clients to ensure that the equipment delivers the degree of accuracy required. FDOT, for example, wants to see readings with an accuracy of plus or minus 0.5 percent.

While Dean knows the technology has wider applications beyond road building projects, the opportunities to use it haven't yet arisen. "I'm sure the technology could be used on a sanitary line as well, but you're not going to convince the client to simply add a laser profile inspection to a CCTV inspection unless they're willing to pay for it," he says. "Right now, outside of road work, it's considered an extra."