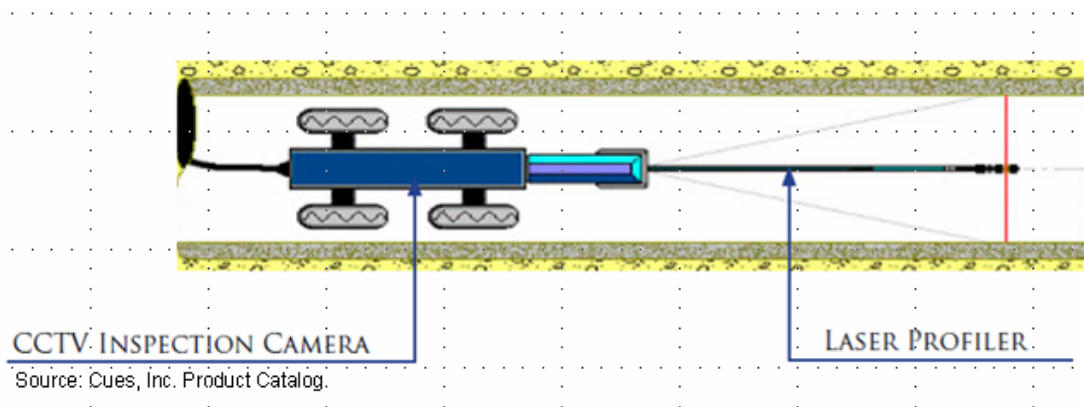


STORM SEWER PIPELINE LASER PROFILING

Pipeline laser profiling is rapidly becoming an economical and superior alternative to traditional video inspection of installed storm sewer and culvert pipe.

Though the technology has been around for 10 to 15 years, recent developments in digital video analysis have made it a truly viable improvement over traditional video inspection and mandrel deflection testing.

Laser profiling is an enhancement to traditional video inspection where a ring of laser light is projected onto the interior of a pipe wall in a plane perpendicular to a video camera's line of site. As the video camera and laser ring move through the pipe, the video image is recorded, and the video image is digitally processed to develop vast amounts of information that cannot be accurately discerned from traditional video inspection. Such data can include: deflection, pipe ovality, corrugation depth, and pipe capacity. Some software even has the ability to create a fully interactive 3D model of the pipe.



NATIONWIDE ACCEPTANCE

Approximately 60% of the state departments of transportation require deflection in flexible pipe systems to be measured. Several states either require or allow laser video testing. At time of publishing, such states include: Florida¹, Arizona², South Carolina³, Kentucky^{4,5}, Nebraska⁶, Ohio⁷, Virginia⁸, and Tennessee⁹.

TECHNOLOGY AVAILABILITY & COST

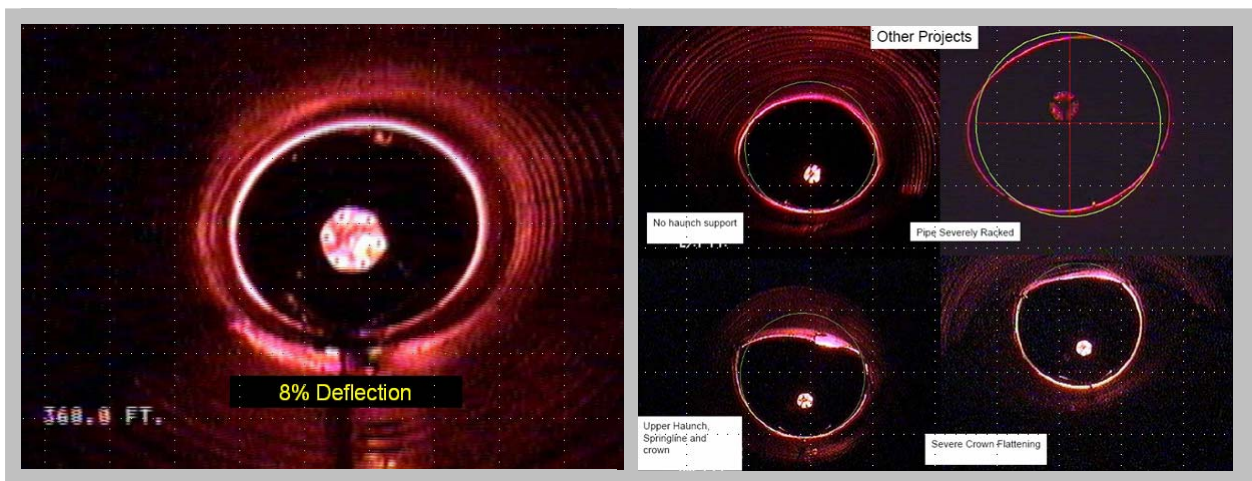
Initially, laser profiling was only available for specialized projects or for research applications. However, now that it is becoming more commonly specified, an increasing number of contractors are equipped to perform the work. Many contractors that are equipped to perform video inspection have enhanced their capabilities simply by adding laser profiling equipment. There are currently several manufacturers of laser profiling equipment and associated software systems. Equipment is readily available nationally, and new systems continue to come onto the market.

Not surprisingly, pricing will vary. When performed in conjunction with traditional video inspection, laser profiling can be performed for a relatively small incremental cost. Compared to traditional mandrel testing and video inspection, laser profiling is very competitively priced, especially considering the wealth of information that is available by utilizing this technology.

BENEFIT TO OWNER & ENGINEER

Proof of design and proper installation are critical for buried flexible pipe performance. Inadequate design considerations and improper installation lead to over deflected flexible pipe which severely reduces performance and life expectancy. Consequently, the owner of a project can justify the modest cost of laser profiling to ensure that a pipeline was designed and installed according to specification. This results in a relatively small investment to ensure the performance of the project infrastructure.

Flexible pipe design should be performed, though the process is cumbersome and only a small handful of engineers are familiar with it. The process includes calculating theoretical deflection, buckling, bending strain, bending stress, and wall thrust. Most designers, however, prefer to forgo the full array of necessary calculations and instead simply require a 5% maximum post installation deflection test as an indicator of the performance potential of the completed installation.

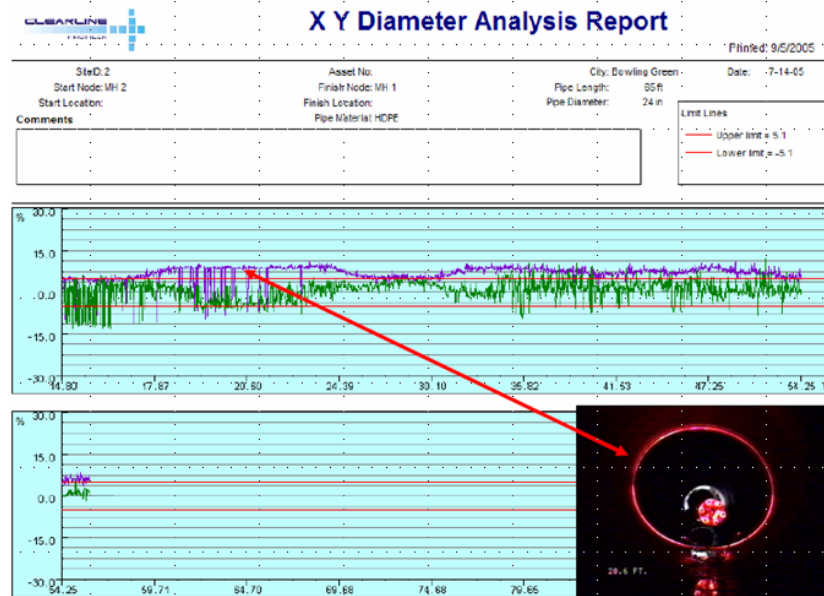


Once designed, flexible pipe installation is difficult if done properly because it requires more stringent backfill and compaction levels. In many cases, contractors don't take all the steps to properly install flexible pipe. Considering the complicated design and difficult installation associated with flexible pipe, comprehensive post installation inspection for deflection is critical.

Laser profiling is now providing many owners this **Proof of Design / Installation.**

BENEFIT TO CONTRACTOR

Laser profiling can be advantageous to the pipeline contractor as well. Traditional mandrel testing can typically only identify the first point in the line where excessive deflection has occurred, since an appropriately sized mandrel cannot be pulled any further through the line. Subsequent testing is required after the first repair is completed. If another problem is identified, the process must continue. However, if equipped with the comprehensive information from laser profiling, the pipeline contractor can pinpoint the exact location of all problem areas and complete the repairs in an efficient manner.



USE IN ACADEMIA

The technology is also being employed for research work. For example, the University of Texas – Arlington is in the process of conducting a multi-state investigation of performance of buried high density polyethylene (HDPE) culvert and storm sewer pipe¹⁰. Without the use of a laser profiling equipment and software, the necessary data collection would be virtually impossible to obtain.

References:

1. Implemented Modifications to the 2007 Standard Specification for Road and Bridge Construction, Subsection 430-4.8, [http://www.dot.state.fl.us/specificationsoffice/Implemented/WorkBooks/Julworkbook2008/Files/SS4300000.pdf], Florida Department of Transportation, July 2008.
2. Special Provision MA1010HDPEP, Subsection 1010-8.03, [http://www.azdot.gov/highways/Roadway_Engineering/Roadway_Design//Special_Provisions/Docs/RSP_HDPEP_MA1010HDPEP.doc], Arizona Department of Transportation, 24 July 2005.
3. Supplemental Technical Specification SC-M-714, Subsection 3.3.10, [http://www.scdot.org/doing/pdfs/sup_tech_specs/SC-M-714_080728.pdf], South Carolina Department of Transportation, 2 September 2008.
4. Supplemental Specifications to The Standard Specifications for Road and Bridge Construction, Subsection 701.04.07, [http://transportation.ky.gov/materials/download/kymethods/km11408.pdf], Kentucky Transportation Cabinet, 29 August 2008.
5. Kentucky Method 64-11-08, [http://transportation.ky.gov/construction/spec/supp/supp082908.pdf], Kentucky Transportation Cabinet, 24 July 2008.
6. Standard Specifications for Highway Construction, Subsection 719.03, [http://www.nebraskatransportation.org/ref-man/specbook-2007.pdf], Nebraska Department of Roads, 2007.
7. Supplemental Specification 802, Subsection 802.12, [http://www.dot.state.oh.us/Divisions/ConstructionMgt/Specification%20Files/802_10202008%20for%202008.pdf], Ohio Department of Transportation, 20 October 2008.
8. Virginia Test Method 123, [http://www.virginiadot.org/business/resources/Materials/bu-mat-VTMs.pdf], Virginia Department of Transportation, November 2008.
9. Supplemental Specifications of the Standards for Road and Bridge Construction, Subsection 607.09, [http://www.tdot.state.tn.us/construction/Supplemental%20Specs%202006/SS600.pdf], Tennessee Department of Transportation, 1 March 2006
10. Dr. Ali Abolmaali, P.E., Evaluation of HDPE Pipelines Structural Performance [http://www.uta.edu/ce/aareports2.php]