CLEARLINE PROFILER CASE STUDY
CIPP RELINING FAILURE

G.I. Logan and P.R. Anderson
CleanFlow Systems Limited, Albany, Auckland, New Zealand

Location: Portland, Oregon, USA
Pipe Size: 30"/24"
Pipe Type: Concrete
Pipe Length: 500ft
Customer: City of Portland

Overview

The City of Portland wanted confirmation of how much CIPP liner had distorted after the liner imploded during the installation process. The pipeline in question ran down the middle of a busy road with a gradient of about 10 degrees. The first 300ft (91m) of the pipe was 30" (762mm) at which point the gradient increased and the pipe size reduced to 24" (610mm) for the next 200ft (60m) or so. A loss of pressure in the steam curing process had caused the far end of the liner to implode. Twenty-five meters of the liner had already been removed. This process had taken 72 hours, requiring full flow bypass. Hence, the City of Portland was anxious to obtain an accurate assessment of the extent of the liner deformation.

Method

Due to the high flow levels during the day, the inspection was held in the early morning. A pump station holding tank was also used to minimise the flow during the inspection. A Cues inspection truck equipped with their OZ II CCTV camera system was used for this inspection. The CCTV inspection camera was configured for a 24" pipe size, since it was this section of pipe that had the liner deformation. The ClearLine Profiler, configured for 24", was bolted to the camera transporter. A triple laser module was selected to ensure that a clear, bright and complete laser profile was created on the liner for this sized pipe.
The camera and profiler were lowered into the manhole, which was about 8ft (2.5m) deep, using the truck-mounted crane. No one was required to enter the manhole during the entire inspection.
The first part of the inspection was to travel downstream with the lights on. On completing the forward inspection the lights were turned off and the camera reversed back out of the pipe at a constant speed. The software that digitizes the laser profile performs best with minimal or no camera lighting.
The video of the inspection was recorded on the inspection truck's computer in MPG1 format. The video file was later analyzed using the ClearLine software.

Results and Discussion

With the CCTV camera configured for a 24" pipe, the top portion of the laser profile swas missing for the 30" section of pipe (see figure 1). The profile that was in view, allowed measurement of features such as lifts and ridges that were found during the 30" pipe inspection. In fact, the presence of the laser profile made it easier to see where the lifts and ridges were.

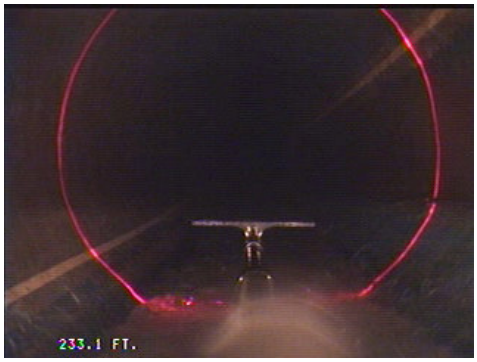

Figure 1: An example of the laser profile within the 30" section of re-lined pipe

During the forward inspection of the 30" pipe, we observed many ridges in the liner. We were able to measure, with ease, these ridges in the liner. In several areas the ridges were as high as 2" (50mm). In many cases, because of the position and angle of the ridges, no estimate of the height of the ridge could be made without the use of the laser profiler.

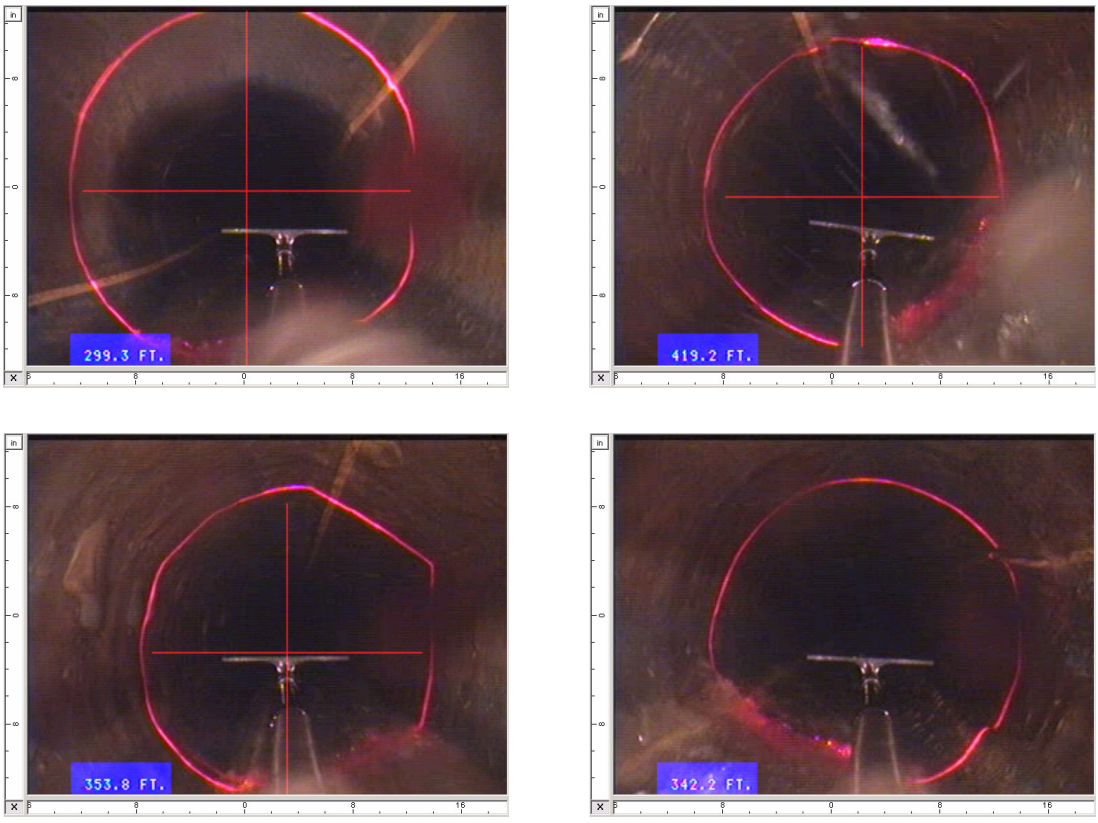

Figure 2: Examples of the laser profile at 299.3ft, 342.2ft, 353.8ft and 419.2ft

At 300ft the pipe size reduced from 30" to 24", figure 2. Serious deformation of the liner started at 340ft. By 350ft the started to ride up the side of the pipe. At 419.2ft the forward inspection was terminated as the CCTV camera was very close to tipping over.
Although the profile video could have been processed on site, in this case it was decided to process the video at a later date.
Back in the office the video was analyzed with the ClearLine software. The machine vision function of the software was able to obtain a near perfect profile for the section of pipe inspected. In figure 3, note that there is no profile for the water level part of the pipe profile. The turbulent water had to be removed from the digital profile so that it would not affect the pipe center and Delta calculations.

Figure 3 shows an example of one location where maximum liner lift was found.

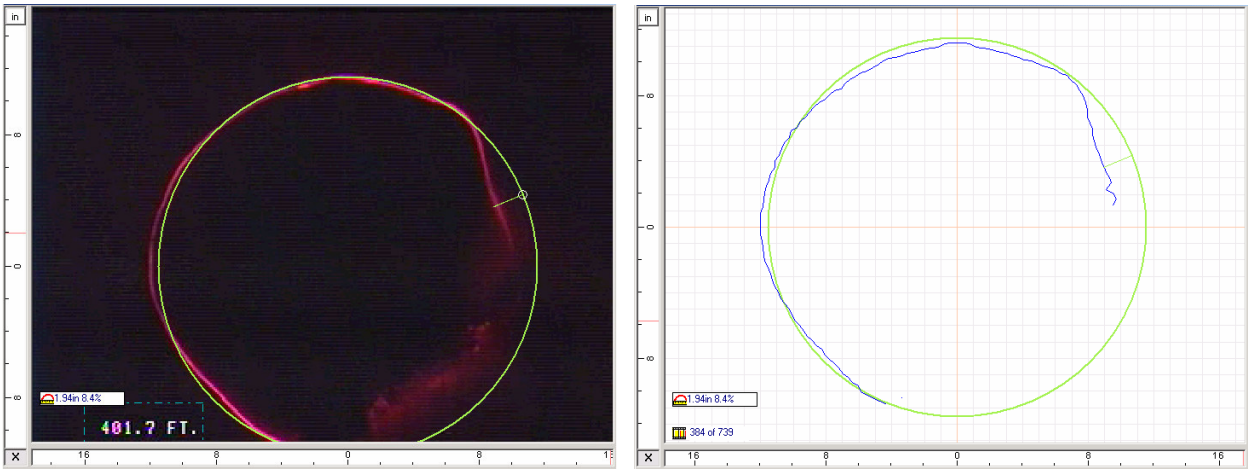

Figure 3: At 401.7ft, lift in liner measured 1.94" (8.4%) for both the manual and digital methods

The green circle in the images shown in figure 4 is the expected internal diameter of the lined pipe, in this case 23" (584mm). Accurate manual measurements were done where specific points in the profile required measurement. The software's built-in functions currently only cover cross-sectional area, ovality and the maximum radius and minimum radius for each pipe profile.
The Delta report is a graph of the maximum and minimum radius for each pipe profile. This report was used to determine the extent of the liner lift along the 24" section of pipeline.

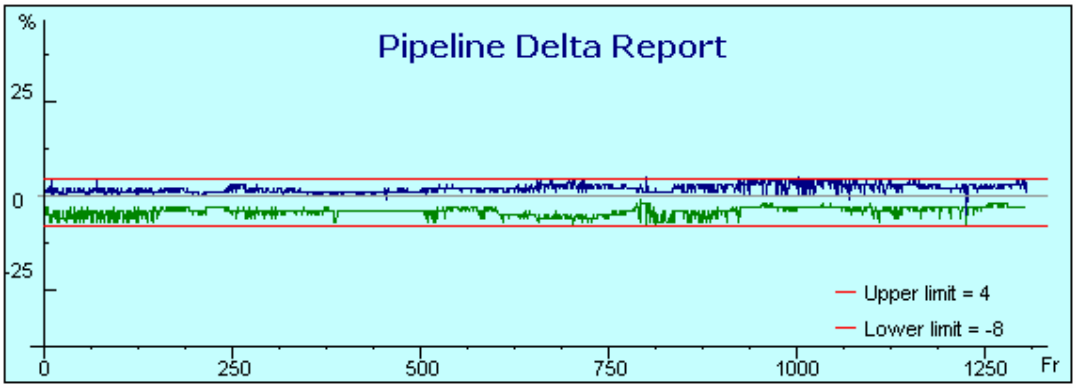

Figure 4: Delta report for a section of the 24" pipe, from 419.2ft to 373.0ft

Along the length of the 24" section of pipe surveyed, the maximum lift measured was 1.9" (48mm) or 8.4%.

3D graphical representation of the pipeline helps to better visualize the defects in the pipeline. In this case, the addition of environmental factors, including roads, buildings and vegetation, were added to provide an enhanced dimension to the inspection.

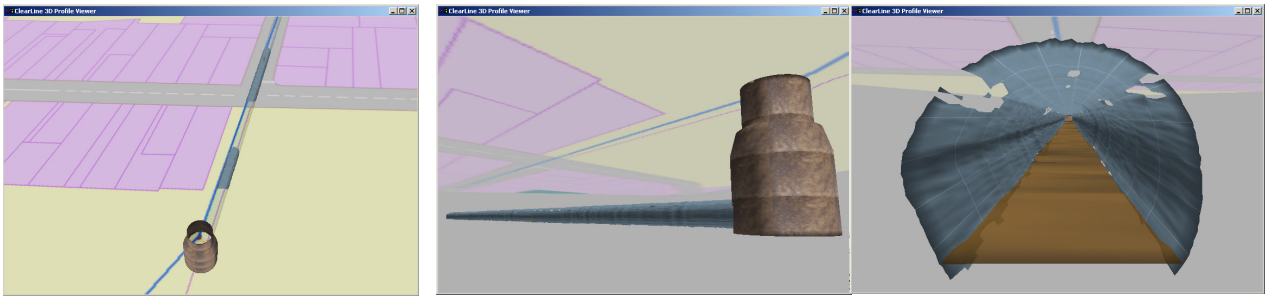

Figure 5: 3-Dimensional representation of digital pipe profile

The ClearLine Profiler was able to determine the amount of deformation of the liner along the 24" pipeline. Therefore removing any doubt as to how much of the liner needed to be removed.
Also encouraging in this project was the clarity of the profile for the 30" section of the pipeline. With the appropriate CCTV camera setup the 30" re-lined pipe section could also have been profiled.