PIPELINE INTEGRITY ASSESSMENT USING GPR

Ground-penetrating radar (GPR) is a high-speed NDT method that **GEO***Vision* applies to a number of engineering problems associated with aging concrete structures, including:

- identification of deteriorated concrete - caused primarily by corrosion of reinforcement within reinforced concrete decks, and
- intrusion of chlorides into the concrete matrix.

COMPARE TRADITIONAL CAMERA METHODS WITH NEW APPROACH

Traditional CCTV Surveys.	**GROUND PENETRATING RADAR GPR**
• Used for many years • Can only provide visual assessment based on surface indications • Mixed results! (unable to accurately locate deterioration, estimate quantities, or define boundaries)	• New technology • Highly successful • Marked improvement in the precision of location, accuracy of quantity estimates, and boundary definition

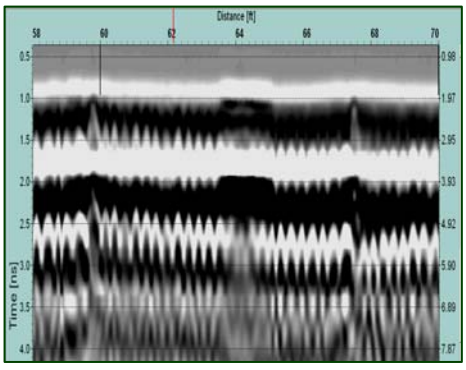
KEY QUALITIES

- "Sees" beyond surface, behind the liner, and is not influenced by liner damage
- extremely dense signal sampling along each GPR line—***and a method for removing compromising influences of shallow cover, liners, overlays, and the variable presence of longitudinal steel***
- extensive successful and practical experience on bridge decks, balconies, slabs, and other structures

These are what make this high-speed method more accurate, repeatable, reliable and versatile than the traditional single-polarization surveys that have been performed over the last decade.

PROFESSIONAL EXPERIENCE IS VITAL

- Proper collection of GPR data, including filtering, gain control, and range settings requires significant experience
- The figure at the right shows what properly collected "raw" data looks like. Even this product requires additional analysis to obtain the best result



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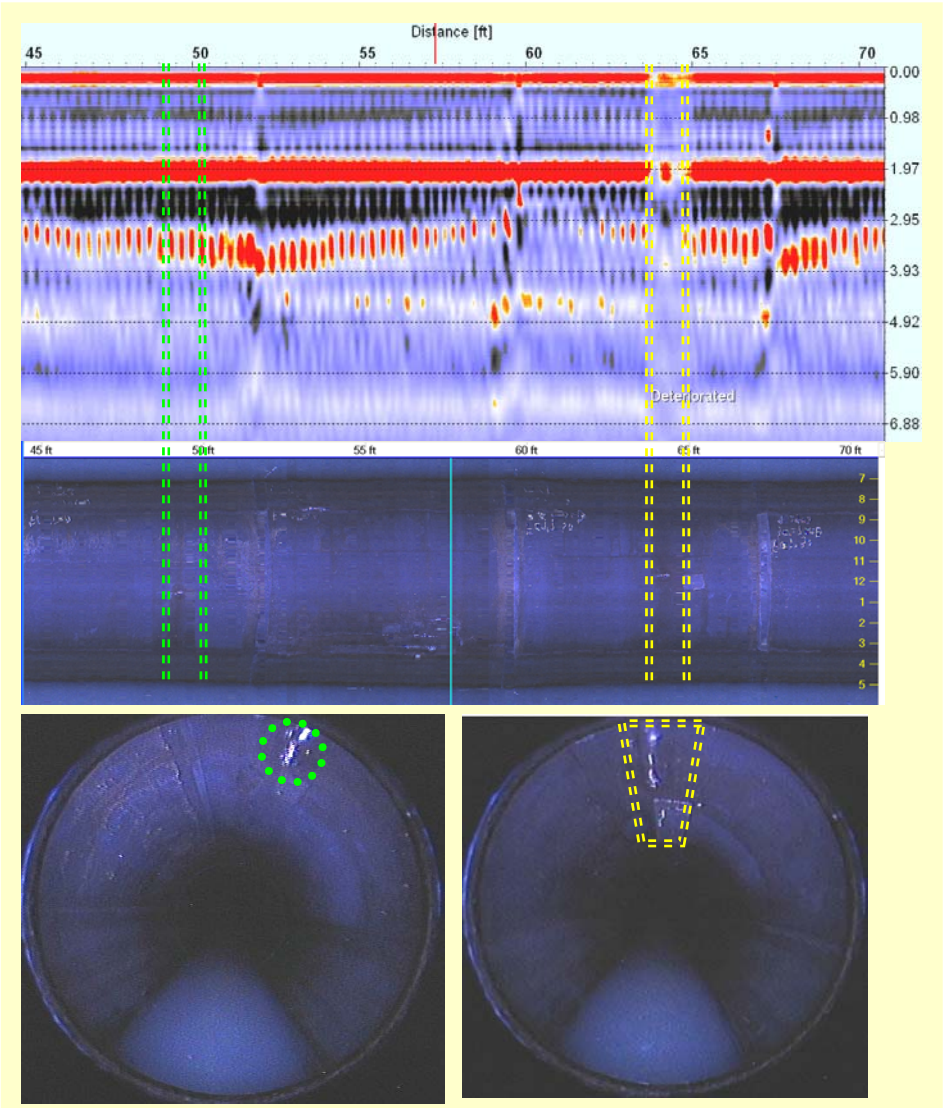

Top - shows processed data with rebar reflectivity response in red highlights

Middle – The circular pipeline view from the camera below has been "unwrapped" and processed to show the inner surface of the pipe as a flat area. The near and far to the camera are now left and right, with linear lengthwise footage progressing from left to right, and the top and bottom are the "seam" created at the bottom. The clock positions on the right go from 6:00 at the top (bottom of the pipe) to 12:00 in the middle (crown) and back to 6:00 at the bottom again.

Bottom – shows the camera view from the center of the pipe looking down the pipe. 12:00 is at the top, and 6:00 at the bottom. This pipe has a black liner, so distressed areas have been high-lighted with green and yellow dashed lines.

Above left – this section of pipe is an example where visual indications show distress in the liner and predict damage to the reinforced concrete pipe. Each red blip in the processed radar above represents a rebar. The results of the GPR survey show <u>no deterioration</u> near the liner anomaly.

Above right – this section of pipe is an example where visual indications show distress in the liner and predict damage to the reinforced concrete pipe. Each red blip in the processed radar above represents a rebar. In this case the results show a definite loss of signal due to deterioration near the location of distress in the liner.

SUMMARY OF BENEFITS

- Accurate, specific location information for better planning
- Rapid data acquisition – less inconvenience and liability for owner
- Cost benefit due to better estimation of repair project costs, lower cost of planning, speed and safety
- Better quantification of repair zones will
    - extend pipeline service life by minimizing future repairs and frequency of maintenance
    - improve ability to plan extent of daily maintenance activities and estimate material quantities