GATHERING DATA AND APPLYING APPROPRIATE TECHNOLOGY: THE KEYS TO COST EFFECTIVE SEWER REHABILITATION

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OVERVIEW

Planning for Rehabilitation

Collecting Data

Inspection Technologies

Rehabilitation Alternatives
PLANNING FOR REHABILITATION
THE GOAL

AVOID CATASTROPHIC EVENTS

www.epa.gov/earth1r6/6en/w/sso/sso.htm
FAILURE OF PIPELINES CAN HAVE SUBSTANTIAL CONSEQUENCES...

- Impacts service to customers, overflows, back-ups
- Often under major roads
- Potential impact to public health
- Potential impact to environment
- Repairs can be costly

Public perception of utility also suffers damage.
ARE UTILITIES SPENDING DOLLARS ON CRITICAL PIPELINE INFRASTRUCTURE?

- Broadly held view that a crisis is required to motivate spending
- Competition for funding with visible, tangible, and immediate benefit projects
- Requires a sustainable program based on known pipe conditions

\[ R^3 = \text{Replace } \text{RIGHT pipe, RIGHT time, RIGHT material.} \]
Knowing condition of pipelines is key to the rehabilitation of the system

- Life expectancy for a pipeline system is shorter than design life
  - Water Quality (i.e., corrosion)
  - Construction / installation practices
- System performance is dependent on critical pipelines
- Determine condition of critical segments system

Prioritization of Work
COLLECTING DATA
MANY FACTORS IMPACT LIFE OF A PIPE

**WHY PIPES FAIL**

- External Loads
  - Soil
  - Traffic
  - Overburden
- Internal Corrosion
- External Corrosion
- Soil Characteristics
- Water Quality $H_2S$
- Design and Construction Practices
  - Leakage
  - Bedding Condition and Material
  - Internal Pressures
  - Contraction Loads
  - Temperature
  - Movement
COLLECTING DATA

Analysing all the data provides the bases for selecting the proper inspection technology and Rehabilitation Alternatives.
VARIOUS TECHNOLOGIES EXIST FOR CONDITION ASSESSMENT OF PIPELINES

Traditional Methods
- Visual inspection
- Closed circuit TV (CCTV)
- Smoke testing
- Dye testing
- Flow monitoring

“Newer” Technologies
- Sewer scanning evaluation technology (SSET)
- Laser scanning
- Sonar profiling
CLOSED CIRCUIT TV

- Side scanning evaluation technology
- Pan & tilt optical zoom
- Push camera
- High Definition Digital camera
EROSION OF CONCRETE WALL
PIPE WALL DETERIORATION

Distance: 51.6
Surface Damage: Erosion in the pipe
Clock front 7 Clock top 10
Rating:
Comments: Acero Excavates
SEWER SCANNING EVALUATION TECHNOLOGY (SSET) (PANORAMA)

From Hydromax
ADVANTAGES OF SIDE SCAN

12”, Reinforced Concrete

Unwrapped” side scan image

- The SSET unwrapped side scan image identifies an intact joint with only superficial surface defects. No repairs needed!

Frontal view

- Frontal view identifies what appears to be a severely deteriorated joint in need of repair
ADVANTAGES OVER CCTV

• Faster than conventional CCTV (70 fpm vs 30 fpm)
• More Digital storage (16,000 ft on a single DVD)
• No stopping or panning / tilting for defects
• Accurate and detailed annotation
• Lower cost of ownership
• Consumes less digital capacity/ bandwidth for archiving and sharing
LASER & SONAR TRACTORS

Hydromax USA

Redzone Robotics
FLOATING ROBOTIC INSPECTION

• Inspects 24”-48” Pipes
• Range around 5,000 feet
• Can be mounted with CCTV, laser, sonar, and H2S sensors

• Advantages:
  • Uses all types of sensors
  • Provides inspection during varying flows

• Disadvantages:
  • Controlled by a cable
  • Does not work in small pipes
  • Does not work in high flows
BENEFITS OF LASER SCANNING

• Enables inspection with minimum lighting requirements
• Measurement of the exact shape of the conduit
• Identification of connection location and position
• Measure cross sectional area and perimeter of conduit
TYPICAL LASER RESULTS

From Hydromax USA

From RedZone
WHICH PIPE NEEDS REPAIR
CCTV VS. LASER

LASER PROVIDES PRECISE DATA ON CORROSION
PROFILING SONAR

• **Used in**
  - Submerged pipe
  - Pressurized pipe

• **Creates a cross section of the pipe**
  - Quantifies sediment deposition
  - Quantifies pipe geometry
  - 3D pipe model generation

• **Advantages**
  - Low cost high volume pipe inspection with no bypassing costs
SONAR SCAN INSPECTION

- Provides profile of interior of pipe below water surface
- Discover obstructions not visible below water surface
- Can be used to show amount of sediment in the pipe
- Provides accurate estimate of quantities to clean the pipe
CRAWLING ROBOTIC INSPECTION

• Inspects 6”- 48” pipes
• Ranges of approximately 800’ for 6” and 8” pipes and 5,000’+ for 10” and larger pipes
• Can be mounted with CCTV, laser, sonar, and H2S sensors

• Advantages:
  • Uses all types of sensors
  • Easily controlled from surface to allow inspection in any direction
  • Largest range of pipe sizes

• Disadvantages:
  • Flow must be shallow enough for sensors to be above water
  • Cannot pass through deep sediment or blockages
CRAWLING ROBOTICS
SWIMMING REMOTE OPERATED VEHICLE (ROV)

- Inspects 30” and larger pipe
- Range of 6,000’+
- Can be mounted with CCTV and sonar

**Advantages:**
- Inspects flooded pipe segment
- Outfalls/Siphons
- Can inspect in any direction

**Disadvantages:**
- CCTV is only useful for clean water
- Does not work in small pipes
- High flows will not allow for upstream inspection and can make video unstable
DESIGN BASED ON INSPECTION PREVENTS DEFECTS IN LINER

- Determine loss of Ovality
- Identify Defects and Impact on Rehabilitation
- Evaluate Alternative Methods
CIPP LINER WRINKLES RESULT FROM VARIATION OF WALL
REHABILITATION TECHNIQUES
PROCESS FOR REHABILITATION SELECTION

R3 = replace RIGHT pipe, RIGHT time, RIGHT material
PIPE REPAIR REHABILITATION TECHNIQUES

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<th>Non-Structural</th>
<th>Semi-Structural</th>
<th>Fully-Structural</th>
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<tbody>
<tr>
<td>Cement mortar</td>
<td>CIPP</td>
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<tr>
<td>Epoxy lining</td>
<td>Roll down (thin PE)</td>
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<tr>
<td>Joint sealing</td>
<td>Fold &amp; form</td>
<td>Fold &amp; form (reinforced)</td>
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<td>Woven hose lining</td>
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<td>Spiral Pipe Renewal</td>
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Non-Structural: Non-structural rehabilitation techniques
- Cement mortar
- Epoxy lining
- Joint sealing

Semi-Structural: Semi-structural rehabilitation techniques
- CIPP
- Roll down (thin PE)
- Fold & form
- Woven hose lining
- Polyurea / Epoxy
- Reinforced Cement

Fully-Structural: Fully-structural rehabilitation techniques
- CIPP
- Roll down (thick PE)
- Fold & form (reinforced)
- Reinforced mortar lining
- Sliplining
- Pipe bursting
- Spiral Pipe Renewal
CURED-IN-PLACE PIPE (CIPP)

• Advantages:
  • 1,000+ ft. from a single access point
  • Laterals can be reinstated quickly
  • Hydraulically equivalent or better than old pipe

• Disadvantages:
  • Bypass pumping required
  • Large lines take many hours to fully cure and cool before flow is returned
  • Specialized labor is required
SLIPLINING

• Advantages:
  • Bypass pumping not required (typ.)
  • 4,000+ ft. from a single access point
  • Fast and easy to install

• Disadvantages:
  • Access point disturbs a large area
  • Reconnecting laterals requires separate excavation
  • Reduces effective diameter
SPIRAL WOUND PIPE (SPR)

• Machine winds a strip of material (PVC or HDPE) into the existing pipe and assembles it into a smaller pipe inside the existing pipe

• Space between the two pipes
  • Filled with grout similar to sliplining or
  • Expanded to match diameter of existing pipe to create a fully structural rehabilitated pipe

• Use to rehabilitate odd shaped pipes and go around bends

• Any type of pipe is suitable for SPR rehabilitation
SPR (CONT.)

• Advantages:
  • Bypass pumping not required (typ.)
  • 3,000+ ft. from one access point
  • Laterals can be reconnected from within pipe

• Disadvantages:
  • Specialized labor
  • Reduces effective diameter / Grouting
  • New technology
PIPE BURSTING

• Advantages
  • Improves Hydraulics
  • Can Increase diameter
  • Trenchless method reduces overall excavation

• Disadvantages
  • Large insertion pits
  • Reconnection of laterals
  • Limited application from existing soil conditions
  • Some pipe materials are difficult to split/burst
• Condition Assessment Inspection
  • *Right Pipe*

• Prioritized / Planned
  • *Right Time*

• Engineering Analysis
  • *Right Material*
Find and fix the pipe before catastrophic failure

**ORANGE ST. TRUNK SEWER**
Salt Lake City, Utah
Inspected using combined CCTV, sonar and laser
Identified 3 rehabilitation alterations
Experienced a failure before and during inspection
Est. rehabilitation cost: $10.5 million
Saved $20 million by rehabilitating instead of replacing

OGDEN CANYON PIPELINES CONDITION ASSESSMENT

City of Ogden, Utah
Condition assessment & leak detection
4.4 miles of 24-inch and 36-inch pipelines
Identified Rehab/Replace alternatives
Developed cost estimates for alternatives
Rehabilitation selected as best alternative
QUESTIONS?

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