Cured-in-Place Pipe (CIPP) for Pressure Pipe

Presented by:
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CIPP Proven Technology

• Introduced over 45 years ago
• Most used trenchless technology for the rehabilitation of gravity flow pipeline
• Features
  – Minimally invasive
  – Extends existing asset life through structural renewal
  – Cost effective
• Evolution of technology for pressure pipe
## Applications

### Gravity
- Storm
- Sanitary
- Combined
- Open System
  - Access by manholes, structures or outfalls
- Circular or Non-Circular
- Flexible or Rigid
- Typically in straight alignment
- Uniform Slope
- Residential Services

### Force Main
- Sanitary
- Closed System
  - Access through ARV’s, junction boxes, lift stations, or traditional excavation
- Circular Pipe
- Flexible or Rigid
- Alignment Typically Follows Terrain
- Radial Bends
- No Services (ARV’s)
# Design Considerations

<table>
<thead>
<tr>
<th>Condition</th>
<th>Gravity Pipe</th>
<th>Pressure Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Renewal (capacity)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Structural Renewal (design life)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Abrasion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Corrosion</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Soil Loads</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Live Loads (H20, E80)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Groundwater Loads</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vacuum</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Internal Pressures (operating, surge)</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
## CIPP Material

<table>
<thead>
<tr>
<th></th>
<th>Gravity</th>
<th>Pressure Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Liner (Felt/Resin)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Reinforced Liner (Felt/Glass)</td>
<td>To reduce liner thickness in large diameter</td>
<td>Required to attain tensile properties</td>
</tr>
<tr>
<td>Resin Systems</td>
<td>UP, VE, Epoxy</td>
<td>VE, Epoxy</td>
</tr>
<tr>
<td>Operating Pressures</td>
<td>&lt;40 psi</td>
<td>Up to 200 psi</td>
</tr>
<tr>
<td>Flexibility (Bends)</td>
<td>Up to 90°</td>
<td>Up to 45°</td>
</tr>
</tbody>
</table>
## Product Considerations

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Gravity</th>
<th>Pressure Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Properties*</td>
<td>4,500 / 250,000 psi</td>
<td>4,500 / 250,000 psi</td>
</tr>
<tr>
<td>Tensile Properties*</td>
<td></td>
<td>3,000 psi</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hydraulic Capacity</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*ASTM F1216 Table 1
Enhanced Tensile Properties

CIPP for pressure pipe applications should be designed with enhanced tensile properties
Enhanced Flexural Properties

CIPP for pressure pipe applications may need to be designed with enhanced flexural properties.
Materials – Liner and Resin

Host Pipe
Impregnated Felt with Glass Layer(s)
Coating
Pressure Pipe CIPP Process

- **Equipment**
  - CIPP liner impregnation
  - Installation and cure

- **Materials**
  - CIPP liner and resin
  - Fittings/connections

- **Process**
  - CIPP field manufacture
  - Ancillary construction
CIPP Pressure Pipe Solutions

• Engineered System Solutions
  – Design: ASTM F1216
  – QA/QC: ASTM F2994

• Performance and Strength
  – Tight fit equally distributing stress and achieves watertight system
  – Long-term retention of high-strength composite to extend useful life of pipeline 50+ years

• Efficient and Effective
  – Minimally invasive proven trenchless technology
  – Less construction time, social and economic disruption
  – Costs less when compared to dig, especially in urban areas
Project Considerations

- Pipe diameter and thickness
  - Operating pressure
- Site access
- Existing pipe condition and alignment
  - Cleaning requirements
  - Bends, offsets
- Project scope
  - Economies of scale
- Quantity and location of setups
- Service density
- Line depth
  - Access pits
CIPP Pressure Pipe Considerations

• **Fittings**
  - End seals
  - Bends, ARV’s

• **Temporary By-Pass**

• **Testing requirements**
  - Hydrostatic testing
    - ASTM F1216: 2 times operating pressure OR operating pressure plus 50 psi (whichever is less)

• **Traffic control**
Reinforced Liner Technical Envelope

- **Application:** potable water and sewer
- **Dimensions:** 6” to 48” diameter pipe
- **Operating Conditions:** up to 200psi, vacuum
- **Pipe Type:** DI, CI, PCCP, AC, PVC and more
- **Pipe Condition:**
  - Access: small trench at valves, hydrants, bends
  - Bends: up to 45° (3D radius recommended)
  - Installation lengths: by project, average 300-500 ft
CIPP Standards and Certifications

• ASTM F1216 - Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

• ASTM F1743 – Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

• ASTM F2994 - Standard Practice for the Utilization of Mobile, Automated Cured-In-Place Pipe (CIPP) Impregnation Systems
Rehabilitation Process

- Setting temporary bypass
- Creating access points to host pipe to facilitate installation of liner, fittings and connections
- Pipe cleaning and inspection
- Verification of pipe and liner dimensions
- Liner impregnation process
- Installation of liner into host pipe

- Post-lining inspection
- Pressure testing
- Liner termination at Pits (End Seals)
- Surface restoration
Access Pits

The original pipe should be cut to allow access for installation of CIPP. A minimum of 2.5 to 3 times the internal diameter of the host pipe should be provided as open access to facilitate proper installation.
Pipe Cleaning and Inspection
Wet Out / Impregnation Process

- **Materials**
  - Climate controlled storage and work area

- **Equipment**
  - Computer controlled mixing unit with static mixers and fail safe for emergency stop
  - Computer controlled system to regulate resin temperatures.
  - Data Logging
  - Vacuum system for liner impregnation
  - Integrated calibration roller

- **Installation and Maintenance**
  - Engineered processes and procedures
Water or Air Inversion
Site Footprint
End Seals

Finishing:

The flanged ends are re-coupled in-line with a new short spool piece of pipe.
Mobile Wet Out System
Computer Controlled Mixing

- Data Logging
  - Logged in short time intervals (typ. 10 secs)
  - Stored on a USB flash drive and backed up on an SD Card
  - Batch files are downloaded and imported into an Excel spreadsheet template for reporting

- Remote Communications
  - Remote monitoring, programming and troubleshooting by factory technician or contractor’s personnel
Recap
Consideration of CIPP for Pressure Pipe Rehabilitation

• Operating pressures up to 200 psi
• Installation lengths may change (based on config.)
• Bends based on location and degree
• Host pipe capability to withstand rigors of cleaning and CIPP installation
• Grade and alignment of host pipe
Objectives for Pressure Pipe Rehabilitation

• Stop water loss / leaks
• Structurally renew existing pipeline
• Improve hydraulic characteristics
• Extend service life of existing pipeline
Thank You

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