Beating I/I With Effective 21st Century Sewer Rehabilitation — Good Ideas And Successful Outcomes

Thursday, May 21, 2020
1:00 PM – 3:00 PM ET
How to Participate Today

• Audio Modes
  • Listen using Mic & Speakers
  • Or, select “Use Telephone” and dial the conference (please remember long distance phone charges apply).

• Submit your questions using the Questions pane.

• A recording will be available for replay shortly after this webcast.

Today’s Moderator

Tim Sumner, PE, CFM, CSM
Project Manager

CMT
Crawford, Murphy & Tilly
Today’s Presenters

• Ted DeBoda
  • Back To Basics: An Overview of Sewer Rehabilitation Technologies

• John Matthews
  • Selecting a Sewer Rehabilitation Technology

• Nick Domenick
  • Constructability Considerations for Private Property I/I Reduction

Our Next Speaker

Ted DeBoda, P.E.
Chief, Bureau of Utilities,
Department of Public Works
BACK TO BASICS
An Overview of Sewer Rehabilitation Technologies

Ted DeBoda, P.E.
CHIEF, Bureau of Utilities
Baltimore County Department of Public Works

BACK TO BASICS: OUTLINE

• RESOURCES
• REHABILITATION TECHNOLOGIES
• PRIORITIZING PROJECTS
BACK TO BASICS: RESOURCES

• PRWEF I&I TECHNICAL ACTICES GROUP – FACT SHEETS
  • SANITARY SEWER REHABILITATION-2017

• NASSCO MOP
  • UPDATED IN 2019
  • PEER REVIEWED BY WEF CSC

• PIPELINE INFRASTRUCTURE RENEWAL AND ASSET MANAGEMENT – NAJAFI/NASSCO
  • JOINT EFFORT – 2016

• NASSCO INSPECTOR TRAINING AND CERTIFICATION PROGRAM (ITCP)
  • CIPP – VERSION 4, 2017
  • MANHOLE REHAB – VERSION 1, 2013

BACK TO BASICS: FACT SHEET

SANITARY SEWER REHAB (PIPE REHAB)

• OVERVIEW AND DISCUSSION OF DEFECTS

• METHODOLOGIES
  • NON-STRUCTURAL REHAB
  • STRUCTURAL REHAB
  • SPRAY OR SPUN CAST SYSTEMS

• SUMMARY MATRIX
  • STRUCTURAL/NON-STRUCTURAL
  • SERVICE LIFE
  • ADVANTAGES/DISADVANTAGES
  • APPLICATIONS
    • SIZE
    • MAIN/LATERAL/MANHOLD
BACK TO BASICS: FACT SHEET

SANITARY SEWER REHAB (PIPE REHAB)

• OVERVIEW AND DISCUSSION OF DEFECTS

• SUMMARY MATRIX
  - STRUCTURAL/NON-STRUCTURAL
  - SERVICE LIFE
  - ADVANTAGES/DISADVANTAGES
  - APPLICATIONS
    - SIZE
    - MAIN/LATERAL/MANHOLE

• LIMITED TO REHAB (NOT RENEWAL)

BACK TO BASICS: NASSCO MOP

MANUAL OF PRACTICE (MOP)

• SEWER INSPECTION TECHNIQUES

• KEYS TO SUCCESS
  - ASSESSMENT
  - TECHNOLOGY SELECTION
  - SPECIFICATIONS
  - CONSTRUCTION INSPECTION

• REHAB
  - PIPE REHAB
  - MANHOLE REHAB
  - LATERAL REHAB

• CONSTRUCTION
  - SPECIFICATIONS
  - INSPECTION

www.nassco.org
BACK TO BASICS: PIPELINE INFRASTRUCTURE

RENEWAL AND ASSET MANAGEMENT

• DECISION FACTORS
  • WHAT IS THE PROBLEM AND POSSIBLE SOLUTION(S)?
    • INFLOW, INFILTRATION, OR BOTH
    • STRUCTURAL
  • TECHNOLOGY SELECTION

www.nassco.org

BACK TO BASICS: INSPECTOR TRAINING AND CERTIFICATION PROGRAM – (ITCP)

• ITCP CIPP
  • CHAPTER 5- PIPELINE RENEWAL TECHNOLOGIES AND THEIR APPLICATION

• ITCP MH REHAB
  • CHAPTER 3- MANHOLE REPLACEMENT AND REHABILITATION TECHNOLOGIES

www.nassco.org
BACK TO BASICS: SPECIFICATIONS

NASSCO SPECIFICATION GUIDELINES

• CIPP
• LATERAL REHAB
• GROUTING
• FOLD AND FORM
• MANHOLE REHAB
• ETC.

www.nassco.org

BACK TO BASICS: REHABILITATION TECHNOLOGIES
BACK TO BASICS: REHABILITATION

CHEMICAL GROUTING

- PIPELINES WITH FAILED JOINT SEALS
- LEAKING MANHOLES
- LATERAL CONNECTIONS
- NOT STRUCTURAL

CURED-IN-PLACE PIPE (CIPP)

- INSERTION OF FLEXIBLE RESIN-IMPREGNATED TUBE
- TUBE IS CURED TO FORM A “PIPE WITHIN A PIPE”
- LATERAL CONNECTIONS ARE CUT OUT
- AMBIENT/HEAT/UV CURED
BACK TO BASICS: REHABILITATION

TRENCHLESS SPOT REPAIRS
- COMMONLY CIPP OR MECHANICAL
- LEAKING MANHOLES (CHIMNEY SEALS)
- LATERAL CONNECTIONS

BACK TO BASICS: REHABILITATION

FOLD AND FORM PIPE
- 6-24” HDPE or PVC
- WINCHED INTO PIPE AND UNFOLDED
- GROUT ANNULAR SPACE
BACK TO BASICS: REHABILITATION

SPIRAL WOUND PIPE
• PVC STRIP WITH INTERLOCKING EDGE

SLIPLINING
• HDPE OR OTHER MATERIAL
• WINCHED INTO PLACE
• SEAL ENDS
• REDUCED DIAMETER
BACK TO BASICS: REHABILITATION

SPRAY-ON

• GUNITE/SHOTCRETE
• GEOPOLYMERS
• SEAL ENDS
• SMALLER DIAMETER

BACK TO BASICS: REHABILITATION

PIPE BURSTING

• 3-36” (AND MORE)
• NOT FULLY TRENCHLESS
• CAN UPSIZE PIPE
  • COMMONLY 0-25%
  • CAN DO 25-50% AND LARGER
BACK TO BASICS: PRIORITIZING PROJECTS

• EMERGENCIES

• PROJECT BACKLOG
  • PRIORITIES AND SEQUENCING
    • LIKELIHOOD OF FAILURE (LOF)
      • PACP/MACP "QUICK RATINGS"
      • NO INSPECTION
      • AGE*
    • CONSEQUENCE OF FAILURE (COF)
      • SIZE, DEPTH, CUSTOMERS
      • TRIPLE BOTTOM LINE
    • RISK = LOF X COF
BACK TO BASICS: PRIORITIZING PROJECTS

Risk Matrix

3x5 Risk Matrix

Highly Probable

Probable

Possible

Likely

Rare

Very Low
Low
Medium
High
Very High

Impact

5/21/2020
BACK TO BASICS: UNDERSTANDING THE IMPORTANCE OF...

1. CONDITION ASSESSMENT (PACP, MACP, LACP)

2. SELECT THE RIGHT TECHNOLOGY FOR THE JOB!
   ▪ ADVANTAGES/DISADVANTAGES
   ▪ IS IT PRACTICAL?

3. QUALITY SPECIFICATIONS

4. TRAINED/KNOWLEDGEABLE CONSTRUCTION INSPECTION

PROJECT PRIORITIZATION
FOLLOW-UP ASSESSMENT

BACK TO BASICS: REHABILITATION

*If all you have is a hammer then everything looks like a nail.*

- Abraham Maslow
BACK TO BASICS: REFERENCES

WEF I&I TECHNICAL ACTIVES GROUP – FACT SHEETS
- SANITARY SEWER REHABILITATION-C2017

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- MANHOLE REHAB – VERSION 1, 2013

NASSCO SPECIFICATION GUIDELINES

NASSCO PIPELINE ASSESSMENT AND CERTIFICATION PROGRAM (PACP) VERSION 7

BACK TO BASICS: FOR MORE INFORMATION

WWW.WEF.ORG
WWW.NASSCO.ORG
FACT SHEET, ADDITIONAL RESOURCES
BACK TO BASICS
AN OVERVIEW OF SEWER REHABILITATION TECHNOLOGIES

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Our Next Speaker

John Matthews, Ph.D.
Director,
Trenchless Technology Center
Associate Professor,
Louisiana Tech University
Selecting a Sewer Rehabilitation Technology

John C. Matthews, Ph.D.
Director, Trenchless Technology Center
Associate Professor, Louisiana Tech University

Agenda

• Critical Selection Factors
  • Structural Integrity
  • Hydraulic Capacity
  • Pipe Characteristics
  • Lateral Connections
  • Longevity of Repair
  • Accessibility
  • Contractor Availability

• Summary of Technology Applicability

• Available Resources
Critical Factors

- Structural Integrity
- Hydraulic Capacity
- Pipe Characteristics
- Lateral Connections
- Longevity of Repair
- Accessibility
- Contractor Availability

Structural Integrity

- Defect types vary and impact type of repair
- ASTM F1216 used for designing liner thickness
- Partially deteriorated vs fully deteriorated
Hydraulic Capacity

- Inflow from drains, cleanouts, manholes, etc.
- Infiltration through cracks, breaks, faulty connections, etc.
- Under or over designed due to population shifts

Pipe Characteristics

- Diameter, Shape, Length, Depth, Bends, Appurtenances, etc.
- Flow chemistry, soil type, bypass requirements, diameter transitions, etc.
Lateral Connections

- Internal reinstatements via robotic cutters
- External mechanical or fused saddles
- Not applicable for some methods

Longevity of Repair

- Repair material (PVC vs HDPE vs RCP vs CIPP vs Grout vs etc.)
- Chemical and abrasion resistance
- More retrospective data needed to confirm for more methods/conditions
Accessibility

• Some methods can be installed through a standard manhole
• Others required access and receiving pits
• Some methods can be customized to be installed in a MH through not commonly

Contractor Availability

• Experience level of contractors
• Cost of mobilization
• Availability of competitive quotes
• General contractor costs can also skyrocket
## Summary of Technology Applicability

<table>
<thead>
<tr>
<th>Methods</th>
<th>Structural Repair</th>
<th>Hydraulic Capacity</th>
<th>Lateral Connections</th>
<th>Repair Longevity</th>
<th>Access</th>
<th>Contractor Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIPP</td>
<td>Yes</td>
<td>May Improve</td>
<td>Internal</td>
<td>50+ Years</td>
<td>Manhole</td>
<td>Nationwide</td>
</tr>
<tr>
<td>Chemical Grout</td>
<td>No</td>
<td>No Impact</td>
<td>N/A</td>
<td>&lt;25 Years</td>
<td>Manhole</td>
<td>Nationwide</td>
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<tr>
<td>Fold and Form</td>
<td>Possible</td>
<td>May Decrease</td>
<td>External</td>
<td>&gt;20 Years</td>
<td>Manhole</td>
<td>Regional</td>
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<tr>
<td>Pipe Bursting</td>
<td>Yes</td>
<td>Can Increase</td>
<td>External</td>
<td>50+ Years</td>
<td>Access Pit</td>
<td>Nationwide</td>
</tr>
<tr>
<td>Sliplining</td>
<td>Yes</td>
<td>May Decrease</td>
<td>External</td>
<td>50+ Years</td>
<td>Access Pit</td>
<td>Nationwide</td>
</tr>
<tr>
<td>Spiral Wound Lining</td>
<td>Yes</td>
<td>May Decrease</td>
<td>External</td>
<td>50+ Years</td>
<td>Manhole</td>
<td>Regional</td>
</tr>
<tr>
<td>Spot Repairs</td>
<td>Possible</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
<td>Both</td>
<td>Nationwide</td>
</tr>
<tr>
<td>Spray-on Lining</td>
<td>Yes</td>
<td>May Decrease</td>
<td>Internal</td>
<td>Variable</td>
<td>Manhole</td>
<td>Both</td>
</tr>
</tbody>
</table>

## Available Resources

- **WEF** [www.wef.org](http://www.wef.org)
- **NASSCO** [www.nassco.org](http://www.nassco.org)
- **NASTT** [www.nastt.org](http://www.nastt.org)
- **TTC** [www.ttc.latech.edu](http://www.ttc.latech.edu)
- **EPA** [www.epa.gov](http://www.epa.gov)
Thank You

John C. Matthews, Ph.D.
Director, Trenchless Technology Center
Associate Professor, Louisiana Tech University
matthews@latech.edu

Our Next Speaker

Nick Domenick, P.E.
Project Manager,
Division of Sewage & Drainage

THE CITY OF COLUMBUS
ANDREW J. GINther, MAYOR
DEPARTMENT OF PUBLIC UTILITIES
Constructability Considerations for Private Property I/I Reduction
Nick Domenick, P.E.
City of Columbus, Ohio Division of Sewerage & Drainage
Sewer Systems Engineering Section

Agenda

• Background
• Private Property Approach
• Current Project Area
• Quality Assurance
• Public Relations
• Bidding Documentation/Process
• Quality Control
• Results
• Lessons Learned
Background

- 2005 Wet Weather Management Plan (WWMP)
- Gray improvements
  - Plant upgrades
  - Tunnels/relief pipes (CSO)
  - Inflow redirection (CSO)
  - Pipe upsizing (SSO)
  - Pipe rehab (SSO)
- Lining Mainline/manholes alone had widely varying effect

Private Property Approach

- 2015 WWMP update
  - Integrated solutions approach
- Lateral lining (90% of homes)
- Redirect 50% of the roof area
  - (not already to the street)
- Install sump pumps in 25% of homes
- GI to handle additional runoff
- City Ordinance granting authority
Current Project Areas

- Clintonville 1 project area
  - Previous I/I studies
  - Previous pilot projects
  - 1,000 acres
  - 3,000 homes
  - 2 active, 3 complete lining projects
  - 1 active, 4 complete roof redirection projects
  - 1 active, 2 complete sump pump projects

Quality Assurance

- CIPP Lining Specs
  - New product committee approval required for materials/suppliers
  - Both one step & two step processes allowed
  - Minimum qualifications for contractors
  - Submittals
    - Liner calcs (street level)
    - Resin volume calcs (using carrier material void ratios)
    - Curing cycle (2-3 hours)
Quality Assurance

• Downspout redirection
  • Minimize excavation limits/area of disturbance (Mud Mats, Tarps, sod cutter)
  • Restoration allowances
    • For landscaping items only
    • $500/house budgeted
    • Some more/some less

Public Relations

• Work hours restrictions
• Notification process/protocols
• Homeowner meetings
• Work plan development

<table>
<thead>
<tr>
<th>Notification</th>
<th>Timeframe</th>
<th>Method</th>
<th>Responsible Party</th>
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<tbody>
<tr>
<td>Notification to schedule</td>
<td>Immediately after NTP</td>
<td>Mailed to all residences and landlords in Project Area</td>
<td>Contractor</td>
</tr>
<tr>
<td>schedule inspection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Notification to</td>
<td>10 days after 1st Notification</td>
<td>Mailed to all non-responsive residents and landlords in Project Area</td>
<td>Outreach</td>
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<tr>
<td>schedule inspection</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5-day Notification of</td>
<td>5 days prior to inspection</td>
<td>Mailed to non-responsive residents and landlords and hand-delivered to</td>
<td>Contractor</td>
</tr>
<tr>
<td>inspection</td>
<td>commencing</td>
<td>residences scheduled for inspection</td>
<td></td>
</tr>
<tr>
<td>24-hr Notification of</td>
<td>24-hours prior to inspection</td>
<td>Hand-delivered to non-responsive residences scheduled for inspection</td>
<td>Contractor</td>
</tr>
<tr>
<td>inspection</td>
<td>commencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary of work to be</td>
<td>After inspection completed</td>
<td>Verbal and/or mailed to resident</td>
<td>Contractor</td>
</tr>
<tr>
<td>completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-day Notification of</td>
<td>5 days prior to work</td>
<td>Mailed to non-responsive residents and landlords and hand-delivered to</td>
<td>Contractor</td>
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<tr>
<td>private property work</td>
<td>commencing</td>
<td>residences scheduled for work</td>
<td></td>
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<tr>
<td>24-hr Notification of RR</td>
<td>24-hours prior to work</td>
<td>Hand-delivered to non-responsive residences scheduled for work</td>
<td>Contractor</td>
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<tr>
<td>inspection</td>
<td>commencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notification of completed RR</td>
<td>Immediately after work</td>
<td>Hand-delivered to residence</td>
<td>Contractor</td>
</tr>
<tr>
<td>work</td>
<td>completed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bid Docs/Process

- 500 homes per contract
- 1 year Duration
- Scheduling/Sequencing special provisions
- Online bids
- Construction management information system (CMIS)
- Unit price vs performance based lump sum

“The contractor shall sequence the activities to complete all work...within 7 days of mobilizing to the property.”

Bid Docs/Process

• Exhibits
  - Investigated every property to determine “directly connected impervious area” (DCIA)
  - Characterized all downspouts (by cost) in to “low”, “medium”, “high” difficulty
  - Perform all “Lows”, and select “mediums”
  - Pay quantities structure
  - Cleanout locations
Bid Docs/Process

• Downspout Redirection
  ▪ Bond funded
  ▪ Redirect Beyond 7’ buffer area
  ▪ Options for Inadequate grade/curb reveal
  ▪ Roof drain televising/site documentation
  ▪ Verify/revise Work plan

Bid Docs/Process

• Lateral Lining
  ▪ WPCLF funded
  ▪ Videos
  ▪ Sewer maps (Access/work hours/MOT/Bypass)
  ▪ 4.0 mm min thickness
  ▪ Lump sum for wye and first 35’
  ▪ Leave 4”/6” transition in place
  ▪ Cleanouts optional
  ▪ Hydrophilic end seal materials
  ▪ Air tests (adjacency)
Bid Docs/Process

<table>
<thead>
<tr>
<th></th>
<th>Columbus</th>
<th>Suburb</th>
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<tbody>
<tr>
<td>Connection Seal Price</td>
<td>$4,950/EA</td>
<td>$4,350/EA</td>
</tr>
<tr>
<td>Lateral Unit price</td>
<td>$10/LF</td>
<td>$60/LF</td>
</tr>
<tr>
<td>Cleanout Price</td>
<td>$0/EA</td>
<td>$1,800/EA</td>
</tr>
<tr>
<td>Total</td>
<td>$5,250</td>
<td>$6,180</td>
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<tr>
<td>Difference</td>
<td></td>
<td>$900</td>
</tr>
</tbody>
</table>

* For 65 foot CIPP lateral liner and full wrap seal at wye connection

Quality Control

- Pre/post lining videos
- Test Plate sample for all liners
- Air test Cleanouts after liner installed
  - Allows obtaining insitu samples
  - Test 10%
  - Escalating penalties for failure
  - Stop liner short to Leave room for installation
Quality Control

• Lining inspector
  ▪ Training
  ▪ Video review protocols
  ▪ 34-point field Checklist

• CM for continuity
  ▪ Apply go/no-go dollar thresholds consistently
  ▪ Monitor performance goals

SANITARY LATERAL LINING CHECKLIST

<table>
<thead>
<tr>
<th>Liner Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify resin/catalyst and felt liner materials are consistent with the approved submittals</td>
</tr>
</tbody>
</table>

| Note production date of resin/catalyst to ensure that it is within the recommended shelf life |

| Verify that the resin/catalyst has been stored in the proper containers and at the appropriate temperatures |
| Verify liner material cut to length, including 1’ for CIPP sample and 1’ for test liner used to note resin activation. Note time resin preparation (mixing) is initiated |
| Verify resin application during wet-out process, i.e. full saturation of liner material with no spotting or dry patches noted. (Note time wet-out process completed.) |

Quality Control

• Wet weather televising
• Emphasizes the need for strict enforcement of specs and well trained personnel
• 4.0 mm bag specified; 5.0 mm bag and resin volume run through a 4.0 mm pinch roller
• **Should 100% leak free be expected?**

• Relined some at contractor’s expense
• Reduced payment on others
“Results”

• Flow monitoring still being collected
• Lining = $5,500/lateral
• Downspouts = $4,200/house
• Sump Pumps = $6,500/house

56% I/I Peak Reduction

“Results”

• Few failing CIPP Tests (structural/thickness)
• Few failed air tests
• Under budget
• Productivity rates
  • Laterals: 2-3/day/crew
  • Downspouts: 6 houses/day
• Latter contracts way behind schedule
• Lack of bidders/competitiveness
Lessons Learned

• Programmatic
  • Reduce lateral televising
    • $250/lateral
  • Reduce property exhibit effort
    • 4-6 hours/exhibit = $1.1M
    • Aerial photography
    • Statistical projections
  • Monitor post downspout redirection for effectiveness

Lessons Learned

• Roof redirection
  • Verify roof drain capacity calcs
  • Clarify expectations for deliverables
  • Clearly defined roles/responsibilities for decisions
  • 99% positive public feedback
Lessons Learned

- Lateral lining
  - Lining during wet weather
  - Point repairs (arborist evaluations/Tree removal indemnification letter)
  - Resin saturation at liner seams
  - Monitor inhibitor volumes
  - Calibration tubes lengths
  - 90' Max
  - No more than two 45 degree bends

Lessons Learned

- Lateral lining
  - Issues discovered/revealed beyond limits of work
  - Lateral Cleaning (root saw vs. jetter)
  - Contractor training (Soft skills)
  - Inspector training
  - Equipment clearance in previously rehabbed 8” main
  - Get more producers/products approved (Full wrap vs “tophat”)
  - Both upstream & downstream manhole required
  - Goofy stuff will happen
Questions?

Ted DeBoda
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