Sewer Condition Assessment & Rehabilitation

Presented by
Elizabeth Ehret, PE

June 22, 2011
Agenda

• PACP Report (what to expect to receive from CCTV crew)

• PACP Grading System

• Using Grading System and Other Factors to determine sewer replacement/rehabilitation

• Recommendations & Conclusion
# PACP Report

## Survey Details

- **Upstream MH**: 0004C0361
- **Downstream MH**: 0004C0359
- **Surveyor’s Name**: JIM DAVIS
- **Certificate Number**: U-605-2253
- **Date**: 11/5/2009
- **Time**: 2:09 PM
- **Survey Customer**: MS CONSULTANTS
- **Street Address**: EAST CHERRY ST. & ZETTLER
- **City**: COLUMBUS
- **Direction**: Upstream
- **Height**: 60
- **Weather**: Dry
- **Material**: Brick
- **Total Length**: 368.8
- **Length Surveyed**: 366.7

## Additional Information

## Table

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- Multiple reports can be generated with software.
PACP Report

• Still photos of every logged defect provided

• Can quickly scroll to any defect or feature in pipe

• Video organization important for future use
PACP Grading System
Index Scores for Pipe Condition

• 5: Immediate attention needed
• 4: Poor; will become Grade 5 in near future
• 3: Fair; moderate
• 2: Good; has not begun to deteriorate
• 1: Excellent; minor defects
Likelihood of Failure as per Defect Grade (from NASSCO)

• 5: Pipe has failed or will likely fail within 5 years
• 4: Pipe will probably fail in 5-10 years
• 3: Pipe may fail in 10-20 years
• 2: Pipe unlikely to fail for at least 20 years
• 1: Failure unlikely in foreseeable future

WHAT DEFINES FAILURE?
Sewer Assessment – Defect Grading: Only the Beginning

• Pipe with a structural index score of 3.2 – Pipe is deformed for 50’
• Pipe with a structural index score of 5.0 – Pipe has 20’ of dropped invert

WHICH PIPE IS IN WORSE CONDITION?
PACP Structural Index Score: 5
PACP Structural Index Score: 5
PACP Structural Index Score: 5
PACP Structural Index Rating: NOT 5

Structural Index Rating: 3.2
PACP Structural Index Rating: NOT 5
Structural Index Rating: 2.6
PACP Structural Index Rating: NOT 5

Structural Index Rating: 3.4
What do defect grades mean for rehab/replacement?

- NASSCO notes that “Condition Grading System alone is inadequate for determining if a pipe segment should be rehabilitated or replaced”.

- Blanket statements have been rejected by municipalities looking to get the best value for their rehab dollars
  - E.g. “All sewers with an index score of 3 or higher must be rehabilitated/replaced”
How to align these seemingly different pipe scores?

- **Engineering Judgment**
  - All video should be reviewed by a qualified, experienced engineer

- **Remaining Useful Life Estimate (RUL)**
  - Based on defects (NOT scores), estimate the RUL of each pipe segment
  - Little data exists on this; there is difficulty in reaching a consensus on these values

- **Likelihood of Failure & Consequence of Failure**
  - Determine the value of each and adjust pipe rehabilitation recommendations accordingly
  - What value is “probably fail”? “may fail”?
The top pipe is the priority for rehabilitation. Why?
- There are many structural defects in this pipe section, including cracks, fractures, holes, etc.
- Brick sewer is over 100 years old ... not likely to catastrophically collapse soon

Applying values to these statements is the challenge!
Remaining Useful Life Estimate

- Estimate RUL based on number and severity of defects
- Clearly define pipe failure to determine when a pipe has failed
- No existing data on RUL for sewer defects; must be developed by engineer & accepted by client (how to accept with no numerical backup?)

![Graph showing Remaining Useful Life for Sewers with different parameters: k=2.5, λ=5, k=2.5, λ=10, k=2.5, λ=20, k=2.5, λ=40. The x-axis represents Time (years) and the y-axis represents Probability of Failure.](image-url)
RUL Estimating

• Existing data is scarce
• Very few studies have been done that accurately compare the condition of sewer segments over time
• The affect a defect has on RUL is largely unknown at this time as there is little to no data
Likelihood of Failure (LOF) vs. Consequence of Failure (COF)

- Calculate Likelihood of Failure
  - Factors include
    - Velocity, Deficiency Rating

- Calculate Consequence of Failure
  - Factors include
    - Diameter, Depth
    - Surface Access, Social Consequence
    - # Taps, # Complaints, # WIBs
    - Cleaning required, Trib WW Characteristics
LOF/COF

- Consult with owner on what constitutes LOF and COF
- Consult with owner on weights to be given to each factor

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Recommended Sewer Assessment Method

• Define “Pipe Failure”
• Decide which factors to include in LOF/COF analysis
• Agree on reasonable RUL for pipe segment scores
• Decide what % constitutes “probably fail” and “may fail”
Recommended Sewer Assessment Method

• Use all 4 factors:
  – PACP Score
  – Engineering Judgment
  – RUL Estimate
  – Likelihood of Failure vs. Consequence of Failure

• Communicate with owner throughout project

• Make a balanced, clear recommendation for sewer rehabilitation.
QUESTIONS

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