IN WITH THE NEW

CULVERT REPAIR USING SPIN-CASTED CONCRETE

Presented by Brad Boyer
Corrugated metal culverts are a common feature

- Widespread use, Inexpensive – used by many DOTs
- Lifespan of approximately 50 years
- Culverts installed in the 1950s and 1960s have reached their design lifespan – outlasted design life
- The most common failure location is at the invert and up to the spring line
- ODOT routinely paves failing metal inverts with concrete
CORRUGATED METAL CULVERTS

Many Styles
- Round
- Arched
- Squashed

Many Types
- Small corrugations
- Large corrugations
- Spiral wound
- Multiplate
TYPES OF REHABILITATION

• CCCP – Centrifugally Cast Concrete Pipe
• CIPP – Cured In Place Pipe
• Geopolymers
• HDPE – High Density Polyethylene
• Rehab needs to be:
  • Long lasting
  • Structural
  • Versatile
  • Scalable

• Two (2) Standards
  • S.S. 833 - Structural
  • S.S. 834 - Non-Structural
CULVERTS

Rehabilitation

- Difficult to rehab
- Rehab needs to extend the life of the asset
- Rehab needs to be structural & waterproof
- Ideal repair is a trenchless repair with a small footprint
ITEMS TO CONSIDER FOR REHAB

• Location makes a difference

• Size of culvert makes a difference

• Type of material makes a difference

• Type of corrugations makes a difference

• Condition makes a difference
ATTEMPTS AT REHAB

- ODOT tried several different rehab techniques
  - Expanding Foam
  - Welding in rebar as a structural member
- Solutions were not long lasting nor structural
- Not effective approaches for long pipe sections
TRIAL WITH SPRAY APPLIED STRUCTURAL LINING

- ODOT selected twin arched culverts to rehab
  - 12’ 6” wide x 7’ 11” tall with a length of 90’
  - Under two-lane rural road near Cincinnati
- Inverts had previously failed and were paved with concrete
- Significant rusting and leaking from the upper arched section were occurring
- Bypass pumping was easy because of the twin culverts
CHOSEN SOLUTION - CCCP

- Centrifugally cast concrete pipe rehabilitation solution
- Typically applied to large diameter pipes – CMP, clay, brick & RCP for storm and sanitary applications
- Forms a structurally sound pipe within the original pipe
- Strong, rigid, but not “ceramic” like – a little “flexible”
- 75 – 100 year design life
- Admixtures can be included
  - Crystal-X® for waterproofing
  - ConShield for MIC protection
CentriPipe®

- CentriPipe is a type of CCCP
- Spincaster (spray head) applies several thin layers of cementitious grout – ¼” to ½” per pass
- Final design thickness is ½” to 2” depending on site conditions
- There must be an invert. If the pipe is gone, a new invert must be created before spin-casting.
- Corrugations must be filled and then the designed liner is added
- In multi-plate applications, the bolts that protrude inward must be covered with ½” of cementitious liner
If the surrounding arch culvert were somehow removed, the new CentriPipe liner would be structurally sound.

- Cementitious material cures quickly
- Staging is minimal
- No traffic closures required
- Strong – minimum 8000 psi
- Enhanced flow
  - Mannings N = .014
- Orange peel texture
### CENTRIPIPE®

- **Set Time at 70°F**
  - ASTM C-403
  - Initial Set: Approx. 170 minutes
  - Final Set: Approx. 300 minutes

- **Flexural Strength**
  - 24 hours: min. 1,200 psi
  - 28 days: min. 1,530 psi
  - ASTM C-293

- **Compressive Strength**
  - 24 hours: 4,000 psi
  - 28 days: 10,000 psi
  - ASTM C-109

- **Split Tensile Strength**
  - ASTM C-496
  - 835 psi

- **Shear Bond**
  - ASTM C-882
  - 2,900 psi

- **Modulus of Elasticity**
  - ASTM C-469

- **Freeze Thaw**
  - ASTM C-666
  - 300 Cycle

- **Chloride Permeability**
  - ASTM C-1202
  - <50 Coulombs
• Frequently Asked Questions
  • Will it crack?
  • Will anything leach into the environment?
  • Is it structural?
  • What materials can be lined?
  • What is the cost?
  • What is the lifespan?
  • What if there is no invert?
CentriPipe®

- New approach for ODOT
- A Proven & Cost-effective solution
- Cast concrete – standing up to Mother Nature & winning!
QUESTIONS