Presentation Objectives

1. Introduction to NEORSD’s Current Programs
2. Typical Excavation Support Methods
3. Contractor Proposed Method: Sinking Caissons
   a) A Brief “How-To”
   b) Design Considerations
   c) Project Results and Takeaways
4. Looking Ahead: Potential Uses in Permanent Work
5. Summary and Conclusions
Introduction

**NEORSD Project Clean Lake**

- Reduce Combined Sewer Overflows (CSO’s) through a 25 year, 3 billion dollar construction program.
- Project Clean Lake is designed to ensure that 98% of wet weather flows entering the CSO system receive treatment, therefore drastically reducing raw sewage discharges into Lake Erie and adjacent waterways.
NEORSD’s Influence on Northeast Ohio
Typical Excavation Support Methods

- Depths of 4 feet to 300 feet
- Unique Geotechnical Profiles throughout the region.
  - Soft Ground - Dry Gray Clay, Running Sand, Saturated Silt
  - Rock - Chagrin Shale, Granite Boulders, Sandstone
- Means/Methods typically Contractor choice.
- Seemingly Endless Choices...but...

*We can usually count on a few typical approaches.*
Typical Excavation Support Methods

Driven Steel
Sheet Piling

Steel H-Piles and
Wood Lagging
Typical Excavation Support Methods

Steel Liner Plates & Ribs
Typical Excavation Support Methods

Drilled CIP Concrete
Secant Piles
Contractor-Proposed Method – Sinking Caissons

- Contractor: Ward & Burke
- NEORSD Projects
  - Kingsbury Run Culvert Repair
  - Westerly Low Level Relief Sewer
- Microtunneling Shafts that Needed to be...
  - Watertight
  - Installed in Tough Geotechnical Conditions
Sinking Caissons – A Brief How-To

General Concept
- Open-Bottomed Reinforced CIP Structure (SEGMENT)
  - Circular
  - Cast on Surface
- Excavate Inside
- Let Gravity work for you
- Repeat
Sinking Caissons – A Brief How-To (Cont.)

Excavate Circular Footprint

Beveled bottom
With Steel Cutting Shoe
Sinking Caissons – A Brief How-To (Cont.)

Strip Forms

Place Concrete
Sinking Caissons – A Brief How-To (Cont.)

CRITICAL STEP

The Guide Wall
Sinking Caissons – A Brief How-To (Cont.)

Excavation
Sinking Caissons – A Brief How-To (Cont.)

Repeat, Repeat, Repeat
Sinking Caissons – A Brief How-To (Cont.)

Finished Product
General Design Considerations

- Geotechnical Conditions
  - Lubrication of Annulus
  - Obstructions
- Diameter and Depth
- Loading
- Mix Design
- Openings/Boxouts
Design Considerations - NEORSD Projects

*Kingsbury Run Culvert Repair*  
*Westerly Low Level Relief Sewer*

- Depths up to 65-feet
- Diameters up to 25-feet
- Concrete Mix Design – 4000 psi
- Wall Thickness – 2.25-feet Thick
- Lift Heights – Approx. 8-feet
- Bentonite Lubricant for Annulus
- ‘Soft-Eye’ Boxouts for Microtunneling
NEORSD Project Results

Generally Speaking...
- Robust Shoring System
- Water-tight
- Excavate in the Wet!
- Handled Environmental Issues
Sinking Caissons - Takeaways

Limitations

- Shallow Bedrock
  - Sinking Caissons = Soft Ground Solution.
  - Cobbles/Boulders can be addressed
  - Bedrock would inhibit Caisson Method.

- Existing Utilities
  - Avoid them!
  - Unforeseen Utilities??
Sinking Caissons - Takeaways

Benefits

- Safety
- A Tested Solution – Concrete
- Ability to Excavate in the Wet
- Open Work Area
- Customizable
Sinking Caissons - Takeaways

Cost

• Construction Cost
  • Varied: $1,000 - $10,000 per VLF
    • Size
    • Depth
    • Ease of Access
    • Complexity
    • *Cost Includes Excavation*

• Savings
  • No Ground Improvement Required
  • No Extensive Dewatering needed for installation.

• May be Cost-Prohibitive for Simple Shallow Excavations
Looking Ahead: Potential Uses in Permanent Work

1st Thought - Manholes
- Minimize Excavation Footprint (Guide Wall perimeter)
- Segment Design can be tailored to required permanent loading.
- Boxed Out Pipe Penetrations
- Custom-placed concrete base and invert.
- Bolt-on Weirs, other appurtenances
- THINK TRENCHLESS

Other Thoughts
- Wet Wells, Vaults, etc., etc., etc.
Looking Ahead: Potential Uses in Permanent Work

NEORSD

- **Use of Sinking Caissons**
  - Experience limited to Temporary Excavation Support
  - But...open to new ideas to efficiently achieve Hydraulic Improvements

- **History of creativity:**
  - Secant Pile Shafts
  - Curved Microtunneling
  - **Permanent Caisson Manholes?**
Summary and Conclusions

Sinking Caisson Method

- **Benefits**
  - Contractor-Proposed Solution to Earth Support in difficult Soft Ground
  - Tested, proven strength - Robust
  - Excavation in Dry or Wet
  - Worker Safety
  - Customizable

- **Limitations**
  - Existing Utilities
  - Bedrock

- **Possibilities**
  - Can be Designed for Permanent Use
  - Versatility for Numerous Applications.
Summary and Conclusions

Sinking Caissons - Another Tool in NEORSD’s ever-growing bag of tricks!
Questions?

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