Pipe Installation & Inspection
Our Seminar

- Overview of Seminar
  - Communications
  - Learning

- Participation
  - Questions
  - Opinions

- Schedule
The Topics

- Available Products
- Rigid vs Flexible Pipe
- Causes of Pipe Failure
- Proper Pipe Installation
- Testing Requirements
- Inspection Requirements
- Acceptance Requirements
Available Products

Rigid Pipe Materials

- Asbestos Cement Pipe
- Reinforced Concrete Pipe
- Nonreinforced Concrete Pipe
- Vitrified Clay Pipe
- Grey Cast Iron Pipe
Available Products

Flexible Pipe Materials

Plastic Pipe
- ABS/PVC Composite
- Corrugated PE
- HDPE Profile Wall
- HDPE Solid Wall
- PVC Profile Wall
- PVC Solid Wall
- RPM Fiber Glass
- FRP Fiber Glass

Metal Pipe
- Corrugated Metal Pipe
- Ductile Iron Pipe
- Profile-Wall Metal Pipe
- Smooth-Wall Steel Pipe
Rigid & Flexible Pipes

- Rigid Pipe
  - Concrete
  - Clay

- Flexible Pipe
  - Metal
  - Plastic

- No Semi-Rigid Pipe
- No Semi-Flexible Pipe
Rigid vs Flexible Pipe

Flexible Pipe

Rigid Pipe
The Differences

Rigid Pipe
- Load Bearing Structure
- Load Transfer Down
- Structure Designed, Built, & Tested in Pipe
- Structure Arrives on Truck
- Not Soil Structure Dependent

Flexible Pipe
- Load Transfer to Side Support Soil
- Must Deflect to Function
- Prime Structure in Soil
- Soil Dependent
- Structure Built & Tested in Field
Failure Modes

- Different for Different Pipe Materials
- Great Difference - Flexible vs Rigid
- Essential Considerations in Design
- Design for Critical Failure Mode
- Demonstration
- Level Playing Field ??
Rigid Pipe Failure Modes

- Flexure
- Shear
- Radial Tension
- Crack Control
  - 0.01 Inch Crack
  - Location & Length
  - Orientation
- Wall Crush
Flexural Failure

Rigid Pipe

Failure

Quarter-Point Cracking
Radial Tension Failure

Rigid Pipe

Failure
Shear Failure

Rigid Pipe

Failure
Wall Crush

Rigid Pipe

Failure
Flexible Pipe Failure Modes

- Deflection/Distortion
- Ring Buckling
- Point-Load Buckling
- Wall Thrust
- Wall Strain
Elliptical Deflection

Flexible Pipe

Functional
Nonelliptical Distortion
Flexible Pipe

Loss of Arch

Failure

Inverse Curvature
Ring Buckling

Flexible Pipe

Failure

Hydrostatic Load
Wall Thrust
Flexible Pipe
Failure
Wall Strain
Flexible Pipe

Strain Crazing

Failure

Excessive Wall Bending
Pipe Zone Materials

- Sand
  - Coarse Grained
  - Fine Grained
- Cement Stab. Sand
- Gravel
  - Pit-Run with Fines
  - Pit-Run with Voids
  - River Gravel
- Crushed Rock
  - Coarse Grade
  - Fine Grade
- Flowable Fill
- Concrete
- Native Soil
Pipe Test Requirements

- Pipe Material Properties
- Pipe Structural Strength
- Joint Performance
3-Edge Bearing Test

Rigid Pipe

Load

Rigid Pipe
Pipe Stiffness Test

Flexible Pipe

Load

Flexible Pipe
Inspection Requirements

- Pipe Specification
- Joint Specification
- Pipe Product
- Pipe Joint
- Bedding Material
- Construction
  - Trench
  - Embankment
  - Tunnel
- Pipe Installation
- Joint Assembly
- Pipe Bedding
  - Placement
  - Compaction
  - Density
- Safety
- Pipe Backfill
Project Acceptance

- Pipeline Line & Grade
- Pipeline Appearance
- Pipeline Obstruction
- Pipe Joint Seals
- Deflection Testing
- Manhole/Structure Connections
- Infiltration
Deflection Testing

Flexible Pipe

Critical!
LIABILITY
In Summary

- The Products
- Rigid vs Flexible Pipe
- Causes of Pipe Failure
- Proper Installation
- Testing Requirements
- Inspection Requirements
- Acceptance Requirements
THANK YOU!