Innovations in Resilient Underground Utility Design and Construction Methods and Materials

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Available Clean Water Requires Energy

• NO SHORTAGE OF WATER ON EARTH
  • WATER IS A RENEWABLE RESOURCE
  • BUT... ONLY 1% OF THE WATER ON EARTH IS FRESH WATER (UNFROZEN) AND USABLE FOR DRINKING WATER

• WATER ENERGY DEMAND
  • WATER TREATMENT: Raw or Salt Water to Potable Water
  • WASTEWATER TREATMENT: Wastewater to Raw Water
  • TRANSPORTATION: Areas of Excess to Areas of Need
  • DISTRIBUTION: Pumping, Storage

• INADEQUATE OR FAILING INFRASTRUCTURE = INCREASED ENERGY CONSUMPTION

AVAILABLE POTABLE WATER REQUIRES ADEQUATE ENERGY & INFRASTRUCTURE
Resiliency is an Ideal to Strive for in Utility Systems and their Design

RESILIENCE

“The ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use.”

Coastal Risk Reduction and Resilience: Using the Full Array of Measures. US Army Corps of Engineers (2013)

ENGINEERING RESILIENCE

“The ability of a system to anticipate, resist, recover, and adapt to achieve functional performance under the stress of disturbances.”


RESILIENT DESIGN

“Incorporating potential effects of adversity in the specification and planning of systems in addition to factors impacting normal operating requirements.”
Adversity to Utility Systems Can Be Anticipated in Design

NATURAL
- SEISMIC
- NATURAL DISASTERS
- EROSION
- SEA LEVEL RISE
- CORROSIVE ENVIRONMENTS

MANMADE
- NEGLECT
- POLLUTION / CONTAMINATION
- INCREASED DEMAND
- INCOMPATIBLE MATERIALS
  - ENGINEERS AND OWNERS RESISTANT TO CHANGE
- ACT OF TERRORISM
Effects of Adversity on Utilities

- LOSS OF SERVICE
- CONTAMINATION
  - POTABLE WATER QUALITY
  - GROUNDWATER
- INCREASED ENERGY DEMAND
- LEAKS/ BREAKS
- STRUCTURAL FAILURE
- CORROSION
- LOSS OF LIFE

Flint Michigan
Northridge, California
Seaside Heights, New Jersey
Horizontal Directional Drilling To Install Piping and Conduit Deep and Cost-Efficiently

- Piping secure at depth
- Redundant lines at critical locations
- Multiple pipe/ conduit materials available
- Piping/ conduit resistant to storm damage
- Reduced construction resources/ energy

HDD is often chosen where open cut is also an option.
Horizontal Directional Drills Are Utilized To Install Piping, Conduit, and Cable
Horizontal Directional Drills Can Exceed One Mile In Single Pulls

- 7,000 linear feet of 30” DR21 Fusible PVC™
- Design Engineer – Power Engineers
- HDD Contractor - Mears Group, Houston, TX

FLORIDA POWER & LIGHT

Port St. Lucie, Florida
Sliplining and Pipebursting Replaces Pipes with Minimal Excavation

**SLIPLINING**

- Reduced construction resources/energy
- New piping improves water quality
- Minimize disturbance and restoration
- Reduce utility conflicts/change orders
- Multiple pipe materials available

**PIPEBURSTING**

Pipebursting allows installation of same or larger piping.
Tight Fit Liners and Coatings Rehabilitate Piping With Little to No Excavation

- REDUCED CONSTRUCTION RESOURCES/ENERGY
- ELIMINATE INFILTRATION AND EXFILTRATION
- MINIMIZE DISTURBANCE AND RESTORATION
- REDUCE UTILITY CONFLICTS/CHANGE ORDERS
- MULTIPLE PIPE LINING MATERIALS AVAILABLE

LINING PIPES PROVIDES ADDITIONAL STRUCTURAL SUPPORT AND CORROSION RESISTANCE
Carbon Fiber and Fiberglass Lining Systems Provide Increased Strength

Linings / Coatings are being utilized on other infrastructure to provide additional resilience to structures.
Fused Thermoplastic Piping Has Made Advancements In the Industry Possible

- Fully restrained
- Corrosion free
- Eliminate infiltration and exfiltration
- Compatible with several trenchless methods
- Multiple pipe materials available
  - Choose compatible product(s) for use

Fused joints are as strong or stronger than pipe stick itself
Resilient Utility Design Provides Robust Systems With Lower O&M Cost

Schofield Barracks and Wheeler Army Air Field (AAF)
Pipe: 62,000 LF, 4” – 24” Fusible PVC®
Installation: Open Cut, Horizontal Directional Drilling

Oahu, Hawaii
Relatively Minor Upfront Efforts and Cost Can Provide Significant Long Term Savings

- Anticipate adverse factors to utility systems during design
  - Natural and manmade

- Research and specify resilient construction materials that are suited for particular use

- Research and consider multiple construction methods prior to finalizing design

- Inquire with multiple vendors for input during design- they are experts on their products
  - Fact check vendors and other team members

- Lowest design and construction cost does not always equal lowest life cycle cost
  - Consider operations & maintenance costs
  - Consider early life failure exposure

Resilient design and materials ultimately save cost not just disruption
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Discussion

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