Lessons Learned Installing a Critical Large Diameter Spiral Welded Steel Water Pipe under New York Harbor


Ronald S. Brown, Senior Technical Sales Representative Northwest Pipe Company.
Presentation Breakdown

Manufacturer’s Perspective-Presented by Ronald S. Brown

Installation Perspective and Closing-Presented by Gedas Grazulis

Q & A-Both Presenters
ANCHORAGE CHANNEL

Port Authority of New York/New Jersey

Owns this “Roadway” and all Ports in NY & NJ metro area

Takes in nearly 1/3 of all goods entering Eastern U.S.

$125 Billion Dollars worth of goods and Commodities
PROJECT HISTORY

• Two water main siphons built in 1917 & 1925 in Channel
• Supplied NYC Reservoir Water from Brooklyn to Staten Island—50 feet deep.
• 1970 10 FT Diameter Richmond Tunnel built as main supply
• Siphon #1 and #2 became important redundancy lines
With new mega ships coming through the Narrows—siphons need to be removed and replaced with new larger and deeper 72” siphon

**TIMELINE FOR PROGRESS**

- New York City EDC and DEP joined forces with Port Authority
- Mott Macdonald & CDM commissioned to provide Engineering and Design Services for new 72” Potable Water Trans Siphon Main
STUDIES COMPLETED TO EVALUATE

• How to cross the Narrows?
• Options and Issues:
• Dredging, Coffer Dams, Micro tunnel, HDD, Conventional TBM
• Schedules, Constructability, Risk, Environmental Impacts, Cost of Construction & Navigational Impacts
• Outcome: Utilization of Conventional TBM approach
Study to Evaluate Carrier Pipe System

- Pipe Material Options: Prestressed Concrete Cylinder Pipe, Fiberglass Reinforced Pipe, Spiral Weld Steel Pipe per AWWA C200
- AWWA C200 Spiral Weld Steel Pipe Selected
RATIONALE FOR SELECTION OF AWWA C200 SPIRAL WELD STEEL PIPE

• TENSILE STRENGTH
• INHERENT TOUGHNESS COMPARED TO OTHER MATERIALS
• DUCTILITY
• FLEXIBILITY
• LONG TERM CORROSION RESISTANCE WITH BONDED COATINGS AND CATHODIC PROTECTION
• SUPERIOR BOTTLE TIGHT LAP WELDED JOINT
• EXCELLENT HISTORY IN NYC—GO TO PRODUCT FOR DIRECT BURY FOR TRUNK MAINS 36” AND UP
AWWA SPIRAL WELD STEEL WATER PIPE
PARTICULARS IN NYC

• NYC DEP –50 year history with spiral weld steel water pipe bell by spigot lap welded joints in tunnels and direct bury
• Steel Water Pipe Use in NYC--- 125 year successful history
• Bell by spigot ends allow for angular joint deflection
• Bell by spigot ends allow for easy fit up compared to butt weld type joints
• Lap weld bell by spigot joints are structurally adequate to resist anticipated loadings from thrust from max pressures, thermal cycling and bending issues.
DESIGN AND PIPE MANUFACTURE

- NYC DEP and DDC finalized approval of Hatch Mott and CDM steel pipe design
- Design Considerations: Pressure, Surge, Thrust and Thermal loadings, Grouting pressures, External Unconstrained Loads
- 73.25” OD
- .625 wall thickness –beyond basic design criteria
- Single lap weld bell by spigot
- Northwest Pipe Company manufactured all Pipe
AWWA C200 SPIRAL WELD MANUFACTURING PROCESS
### Joint: WB x WS, CML, Bare

<table>
<thead>
<tr>
<th>RUN PIPE</th>
<th>LC THICKNESS</th>
<th>JOINT</th>
<th>GRIND BACK</th>
<th>HOLD BACK</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L-Ext</td>
<td>M-Int</td>
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**Notes:**
- All dimensions are in inches unless otherwise specified.
- See specification sheet for material specifications.
- All fillet welds to be the size of the thinner of the two materials being welded.

### Pipe Lining and Coating

<table>
<thead>
<tr>
<th>LINING</th>
<th>COATING</th>
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<tbody>
<tr>
<td>Cement Mortar Lining, AWWA C205</td>
<td>Bare</td>
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NORTHWEST PIPE COMPANY
183 Northwest Drive, Washington, WV 26181-3611 (304) 863-3316

Siphon Replacement Project, Shafts and Tunnel
Judlau Contracting Inc., GE-343

BY: RLF
DATE: Feb 09, 2012
DRAWING #: PK-11-545-Z-5001
REV
Installation Perspective by Gedas Grazulis
Launch Pit Construction, Excavation and Welding

Two shafts were designed for the project.
• Launch pit/shaft on a vacant lot in Staten Island.
• Receiving shaft across New York Harbor in a Brooklyn Park.

Construction began with a slurry wall and welding of the shaft whalers in August 2011.
Tunnel Boring Machine Begins Mining

- 300 foot long.
- 110 tons.
- Pressurized TBM.
- 12 foot Ø.
- 10 foot Ø finished tunnel.
TBM descends to 100 feet
Liquefiable Soil Conditions
Create “The Dip”
• On October 28, 2012 in advance of Hurricane Sandy, tunneling was suspended.
• The historic storm surge flooded the Staten Island Shaft and filled the tunnel with sea water.
• After remaining submerged in sea water for several months the tunnel was dewatered, the damaged assessed and months of repairs and testing followed.
• Tunneling resumed on April 14, 2014 without incident until the last 700 feet when soil conditions again caused the front of the TBM to dip on two occasions creating the 2\textsuperscript{nd} and 3\textsuperscript{rd} dip.
• Tunneling was completed in February of 2015 almost 3 years behind schedule.
Evolution of Pipe Carrier Design

• The pipe carrier was designed in 2012 with the expectation of setting pipe at a height of 17 to 25 inches from the invert of the tunnel.
• The installation height for the final product now varied from 17 to 43 inches in height due to the variations of the mined tunnel.
Pipe Bracing

The pipe bracing design needed to allow for:

• Retraction of the pipe carrier.

• Support of pipe dead load and buoyant forces during grouting operations.

• Quick adjustments for varying pipe elevations.

• Support of the pipe at just one end.
Welding and Inspection

- Field adapted high production welding processes were needed to deposit over 4,000 pounds of required weld metal.
- Flux Core Arc Welding (FCAW) was selected due to its high deposition rate and low fume emission characteristics.
- A high voltage cable transmitted 13,700 volts to a mobile step down transformer to supply a welding cart with 480 volt 3 phase power.

  - Step down transformer to power small hand tools and workspace lighting.
  - Four Inverter type welding power sources.
  - Shielding gas supplied via 3/8”Ø pressure hose.
  - All girth welds subject to 100% Magnetic Particle (MT) inspection per AWS D1.1 Table 6.1 by a third party inspection company.
Accelerated Installation and Welding

• With the project being so far behind crews worked day and night 6 days a week to complete the installation and welding within 9 weeks.

• Installation was halted several times due to flooding, inadequate ventilation and power issues.
Conclusion

• This project showcased the adjustability of bell and spigot welded joints.
• This adjustability frequently becomes a necessity as mining or excavations deviate from the planned alignment.
• Since pipe is usually manufactured well before completion of tunneling numerous headaches and delays can be avoided with adjustable joint designs, installation methods, bracing and a team willing to adapt to changing conditions.
• Even with all the difficulties experienced, the pipe installation and welding was completed within the 9 week window.
• The entire run of pipe under New York Harbor passed the pressure test on January 22, 2016.
Questions???

Gedas Grazulis
Operations-Welding Engineer

Ronald S. Brown
Senior Technical Sales Representative

NATIONAL WELDING CORP.

Northwest Pipe Company