

Houston's Experience with Steel and Prestressed Concrete Pipe

Hamlet Hovsepian, P.E.

Chief Engineer- Capital Projects
City of Houston, Houston, TX

Introduction

For the last 15 years, the City of Houston has expended in excess of \$220 million to transmit treated surface water in order to convert the City from primarily a groundwater supply to surface water. During the process of providing the citizens of Houston with an economical and reliable transmission system, various lessons have been learned regarding the use of steel and prestressed concrete cylinder pipe. This article describes some of Houston's experiences with these pipe materials and how the City has addressed concerns arising from these experiences

Background

The Harris-Galveston Coastal Subsidence District (HGCSO) has mandated that ground water pumpage be reduced in the Houston area and has set a schedule for such reductions due to subsidence. The Surface Water Transmission Program (SWTP) was established by the City of Houston as a response to a mandate issued by the HGCSO to increase usage of surface water and decrease use of groundwater. This mandate has target dates for various parts of the City to convert to 80% surface water and 20% groundwater with certain penalties (known as disincentive fees) for not meeting the required conversion schedule. In addition, the SWTP involves assisting the City's efforts to consolidate smaller groundwater pump stations while simultaneously increasing water system pressures and other related large diameter water main issues. The personnel of the SWTP consists of staff from the City of Houston's Public Works & Engineering Lockwood, Andrews & Newnam, Inc. (LAN) and several consultants.

Challenges

While facing the HGCSO's mandate for converting to surface water, Houston has been confronted with two main restrictions; funding and rights-of-way. For the last few decades, Houston, like other governmental agencies, has been experiencing the need to replace aging infrastructure. This demand plus the decrease in Federal funding for such improvements has forced municipalities like Houston to spend a greater portion of available funds on infrastructure renewal. As a result, funds to enhance the City's current water system and comply with the HGCSO mandate have been limited. The City's surface water supply and treatment plants are located in the eastern part of Harris County.

However, the greatest need for replacing the groundwater usage in the Houston area exists in the western part of Harris County. Extending the surface water supply across the City has required the proposed transmission system to be located within existing rights-of-way. In many parts of the City, the existing rights-of-way are narrow and most of the time occupied with a number of other public and private utilities. Further complicating matters is that some of the routes selected for the large diameter water mains have had to be residential streets with mature trees.

Experience

To deal with the challenges facing the SWTP, Houston has provided contractors with pipe material options for most projects. (Although, in restricted areas, the City has specified the use of certain

pipe materials.) By maintaining a competitive material specification and implementing more stringent quality requirements the City has realized both cost savings and improvements in the quality of the installed pipe. During the process of providing the citizens of Houston with an economical and reliable transmission system, various lessons have been learned regarding the use of steel and prestressed concrete cylinder pipe. Houston's experiences with these pipe materials and how the City has addressed concerns arising from these experiences are briefly described below.

Both Materials

1. The unit price for steel or PCCP materials is very dependent on the ability for both materials to be fairly specified.

Steel Pipe

2. The critical issues for steel pipe include; a) ambient weather conditions for lining and coating application and repairs, b) added cost for weld and test joints, and c) proper compaction of bedding.

3. Advantages include; a) easier field modifications b) multiple coating and lining options for special applications, c) lighter weight, d) smaller outside diameter, and d) easier to tap and make repairs.

4. Disadvantages include; a) joints must be welded in diameters larger than 66 inches, b) handling of pipe, and c) tendency to deflect.

PCCP

5. The critical issues for PCCP include; a) prestressing wire concerns, b) closure sections, and c) improper bedding due to rigidity of pipe.

6. Advantages include; a) more rigid and durable during handling, b) gasketed joints make for faster installation.

7. Disadvantages of PCCP include; a) field modifications due to differing site conditions, b) size of equipment required to install larger diameters, c) failure can occur in a catastrophic mode, and d) more sensitive to cathodic protection systems.

Changes to AWWA Standards

In an effort to address the critical issues and disadvantages for steel and PCCP, Houston has made several modifications to the AWWA and industry standard procedures. Changes include;

1. Permitting welding after the exterior completion of the joints for steel pipe. These changes have resulted in specifying heat resistant tape coating and special heat shrink seals.

2. Additional acceptance criteria has been specified for the mortar linings and coatings. These include the use of galvanized wire fabric for special fittings and allowing the use of only certain type of lining or coating application methods.

3. Better testing requirements for factory material testing are now part of the City's standards. These testing requirements include specific testing methods and a higher frequency of sampling.

4. Improve field repair procedures are now specified. These procedures have reduced unacceptable pipe sections and improved the final product.

Conclusion

During the process of providing the citizens of Houston with an economical and reliable transmission system, various lessons have learned regarding the use of steel and prestressed concrete cylinder pipe. As a result, modifications to the industry standards have been specified in

order to minimize the disadvantages of each of the pipe materials and address the critical issues associated with each pipe. Based on Houston's experiences with these pipe materials, the City has successfully addressed concerns arising from these experiences.

If you have any questions, please contact [Dr. C.Vipulanandan](#)
Copyright ♦ 1998 University of Houston