City of Fort Myers Uses RCP to Fix Decade-Old Storm Sewer Problem

October 6, 2011

Fort Myers, Florida – In September 2011, the City of Fort Myers replaced approximately 150 feet of 18-inch diameter corrugated high density polyethylene (HDPE) storm sewer pipe with reinforced concrete pipe (RCP) along McGregor Boulevard near Stadler Drive. The corrugated HDPE storm sewer has failed and undergone repairs and replacements in various locations since it was initially installed by the Florida Department of Transportation in 1999, and the city has been mitigating community impacts for the last decade.

Figure 1. 18-inch ASTM C76 Class III RCP replaces less-than 15-year old corrugated HDPE pipe.

The replacement pipe materials and construction services were provided by companies with a local community presence. Denco Construction, based in Fort Myers, was the installation contractor. New concrete pipe was supplied by Rinker Materials Concrete Pipe Division, which has a pipe plant on Ortiz Avenue in Fort Myers.

The McGregor Blvd. pavement had depressed in this section, and video inspections verified deformation of the HDPE pipe.[1] Upon excavation, it was discovered that the HDPE pipe had developed longitudinal cracking completely through the walls of the inner liner and outer corrugations along the invert and obvert. Longitudinal cracks traversed the springline of the outer corrugations, and circumferential cracks were observed in the inner liner at the junction with the outer corrugation. Corrugation growth had developed in various sections along the longitudinal axis and circumference of liner sections.

Figure 2. Upon excavation, some of the 18-inch HDPE pipe remained deformed, with horizontal dimensions of 19 to 20 inches and cracks along the invert.

According to the city, one of the longitudinally cracked invert sections had hinged upward at the haunches resulting in an inverted heart shape in the pipe. In-situ conditions along McGregor generally appear typical for Florida storm sewer installations. According to the City of Fort Myers, the natural groundwater elevation fluctuates and is generally two to three feet above the pipe crown. Pipe cover height was approximately six feet from the pipe crown to roadway surface. When using flexible pipe, contractors should verify that engineering indicates the pipe will structurally perform and not deform 5% or more, as required by the FDOT.

Figure 3. RCP joints were efficiently installed and tightly homed.

The replacement pipe was 18-inch diameter ASTM C76 Class III RCP, which has a minimum design load supporting strength of 1,350 pounds per foot diameter per foot length (lbs/ft/ft) and minimum ultimate load strength of 2,000 lbs/ft/ft. Based on American Concrete Pipe Association (ACPA) Fill Height Tables, RCP in similar conditions should be specified based on a design service load of approximately 600 lbs/ft/ft.[2] Clearly, RCP has a significant structural safety factor. For installations such as required by FDOT specifications, the ACPA Fill Height Table indicates that 18-inch Class III RCP may be specified to an installation depth of 22 feet. Unlike flexible pipes, rigid RCP supports the entire overburden. Therefore RCP is in-plant strength tested to certify that the product was manufactured to support the design and yield loads required of the installed service conditions.

Figure 4. Longitudinal cracks developed through HDPE corrugation pierce punch holes.

Flexible thermoplastic pipes, such as corrugated HDPE, polypropylene (PP), and polyvinyl chloride (PVC) pipes, are essentially liners that lack the stiffness and strength capacity to support service loads unless properly installed within an engineered soil embedment. Flexible pipes distribute the overburden load into the soil embedment, which functions as the primary structural support required for the installed service conditions. For this reason, strength certification of flexible plastic pipe installations is a comprehensive process that should include engineering design for thrust, buckling, and combined strain, as well as verification of geotechnical / groundwater conditions, proper installation, and post-installation inspection for cracks, defects, and shape control.

HDPE pipe cover height tables published by the plastic pipe industry and by the FDOT indicate acceptable structural performance of 18-inch HDPE pipe at depths ranging from 17 feet[3] to 21 feet.[4] It is logical to ask, "how can a pipe fail at a depth of only six feet if standard design tables indicate acceptable performance at depths of 17 feet or deeper?" Without a comprehensive forensic evaluation, the answer may never be determined. The lesson in this scenario is that all stakeholders (the community, owners, contractors, and engineers) are at risk when flexible pipe installations are not properly engineered and specified, constructed, and/or inspected.

Notes and References

Article by Rinker Materials Concrete Pipe Division, West Palm Beach, Florida, Sept, 28, 2011.

1. Information from on-site observations and discussions with City of Fort Myers staff, Sept. 14 – 15, 2011.
2. LRFD Fill Height Tables, Resource 16-201, July 2009, American Concrete Pipe Association, http://www.concrete-pipe.org/pages/fillheight.html. (Type 1 Embankment Installation)
3. Cover Height, Index 205, Revised July 2007, 2010 Design Standards, Florida Department of Transportation, http://www.dot.state.fl.us/rddesign/rd/rtds/10/2010Standards.shtm
4. Maximum Cover Heights, Table 5-5, *Corrugated Polyethylene Pipe Design Manual & Installation Guide*, Plastics Pipe Institute, http://plasticpipe.org/pdf/chapter-5_design_method.pdf (Class III soil, 95% compaction)