CHICAGO RAIL YARDS EXPANSION INCLUDES UNDERGROUND STORM WATER MANAGEMENT SYSTEMS

HDPE Pipe Selected for Ability to Support Excessive Loads

CHICAGO - Two old industrial parks were converted into rail/truck intermodal yards here to accommodate increasing freight traffic both in and around the city and the region. Due to sandy soil and other considerations, a series of detention systems were constructed to provide for storm water drainage that was required for the yards. The designs for the systems, however, were not typical due to the extreme weight of the railroad cars that would pass over the pipe and the variable depths of cover throughout the installations. Rail car loads can exceed 250,000 lbs. High-density polyethylene (HDPE) pipe was critical to the projects because of the pipe’s ability to withstand the massive live loads from the containers and fork trucks that load and unload the trains, and its proven structural capacity under Cooper E80 Loading conditions. Additionally, because HDPE pipe is light weight there was not a concern about the pipe settling over time in the sandy soil, which could happen to heavy precast pipe.

The two projects were done during 2011 and 2012 at separate intermodal rail yards located a few miles south and west of Chicago. Both facilities transfer freight from one transportation mode to another -- trains to trucks -- without handling the freight itself.

The 47th Street Intermodal yard was a major construction and drainage project to reconfigure the entrance into the facility off Garfield Ave. The HDPE pipe used on the project improved the existing drainage for the entire southern half of the yard. The pipe lies beneath 13 feet of cover in some areas and is also under chassis storage and parking.

The 63rd Street project is a complete drainage upgrade to the entire 140 acre facility. Due to sandy soil the 63rd Street yard experienced problems with drainage, and the HDPE pipe was used in a series of detention systems throughout the entire facility. These detention systems are underneath the loading and unloading areas for inbound and outbound freight trains. The HDPE detention systems are also beneath all of the drive aisles and chassis storage areas. Currently, the yard handles 480,000 containers a year, with 12 inbound and 10 outbound trains, seven days a week.

"HDPE pipe was the only option for both of these projects due to the massive live loads, - the weight of the container and its handler, which can be 251,000 pounds," stated Daniel Currence, P.E., director of engineering for the Plastics Pipe Institute, Inc.'s (PPI) CPPA division. PPI is the major trade association representing all segments of the plastic pipe industry.
"After running the Load Resistance Factor Design calculations for the potential loads on both sites," he continued, "it was determined that the pipe would meet and even exceed the loading requirements. The southeast Chicago rail yard projects are proof that HDPE will not have issues with heavy live loads - even rail loading that is around 80,000 pounds per axle. This weight is well above the standard AASHTO H-20 or H-25 loading that would be experienced under a road or typical parking lot." The corrugated HDPE pipe used is called N-12® and is made by PPI member company, Advanced Drainage Systems, Inc. (ADS) (Hilliard, Ohio).

For both projects, approximately 10,000 linear feet of HDPE pipe, ranging from 8 to 60 inch diameters with the majority being 24-inch diameter, was used. According to the PPI, corrugated HDPE pipe is known for its ability to resist chemicals, road salts, abrasion, and repeated freeze/thaw cycles. The pipe's strength is due to its design, HDPE resin, and manufacturing process. The structural integrity of corrugated HDPE pipe can be validated using the design procedures outlined in the AASHTO LRFD Bridge Design Specifications. AASHTO LRFD Section 12 is a strain-based design procedure suitable for thermoplastic pipes such as HDPE, polypropylene, and PVC. The AASHTO LRFD code considers the actual failure modes of thermoplastic pipe such as thrust, wall buckling, as well as combined strain to ensure a viable design. Deflection is considered as a service limit and serves as confirmation of the design and ensures suitable long-term performance.

According to Tony Radoszewski, president of the PPI, "These railroad-related drainage projects also further support the FAST/AREMA study regarding the successful test and use of corrugated HDPE pipe under heavy rail cars. The use of corrugated HDPE pipe by the railroad industry has continued to increase during the past few years. This is due to many successful trial installations of HDPE pipe, a significant independent industry study, as well as the recent addition of HDPE pipe to the American Railway Engineering and Maintenance-of-Way Association (AREMA) (Lanham, MD) manual."

The study Radoszewski referred to was funded by the PPI and evaluated the successful use of corrugated HDPE pipe beneath heavy rail car loads with shallow cover. It is available on-line at the PPI website: www.plasticpipe.org/drainage/cppa_technical.html. The test was conducted by the Transportation Technology Center, Inc. at the Facility for Accelerated Service Testing (FAST) in Pueblo, Colorado where it operates a test bed for railroad track. The methodology of the project included repeatedly running a train consisting of four locomotives with eighty, 315,000 pound rail cars over 48-inch corrugated HDPE pipe with just four-feet of cover from the top of the pipe to the bottom of the rail.
In addition to the dynamic performance evaluation, the long-term impact of heavy, static loads on the pipe was assessed by parking the cars, with one set of wheels on the track directly over the same pipe for six weeks.

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"The culvert section of the AREMA manual includes standards and specifications for the use of corrugated HDPE pipe in 3- to 60-inch diameters for under track culverts and storm drain applications," Currence explained. "AREMA references for corrugated HDPE storm drainage pipe can be found in the April 2012 AREMA Manual, Chapter 1 (Roadway and Ballast), Part 4 (Culverts). This industry resource assists design engineers in reducing costs and increasing project longevity."

"With rail cars and locomotives weighing hundreds of thousands of pounds, it was critical that the proper studies be conducted and the pipe validated by a trusted industry resource," stated Radoszewski. "Now we’re seeing the major rail companies including Amtrak, Union Pacific, CSX, BNSF, and Norfolk Southern using corrugated HDPE pipe since the pipe’s inclusion in the AREMA manual. Matter of fact, Norfolk Southern used about seven miles of HDPE pipe in 2012 for the underground drainage system at its new Memphis Regional Intermodal Facility. After reviewing the AREMA specifications, they selected HDPE pipe. After the project was completed, they found that the pipe reduced costs, increased efficiencies and added longevity to the facility that will be heavily traveled and be subjected to hundreds of tons of weight from above, plus it also helped the system to comply with state and federal water quality regulations.

"In the past," he continued, "the railroad industry specified heavy gage, riveted, annular corrugated metal pipe with a bituminous coating, or reinforced concrete pipe. The benefits of using corrugated HDPE include improved corrosion resistance, favorable cost of construction, and proven structural capacity under Cooper E80 Loading conditions. We fully expect the trend to accelerate as repairs and expansion of the rail lines continues."

For more information, go to: www.plasticpipe.org.

**About PPI:**
The Plastics Pipe Institute Inc. (PPI) is the major trade association representing all segments of the plastic pipe industry and is dedicated to promoting plastics as the material of choice for pipe applications. PPI is the premier technical, engineering and industry knowledge resource publishing data for use in development and design of plastic pipe systems. Additionally, PPI collaborates with industry organizations that set standards for manufacturing practices and installation methods.