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On the Cover: 10-foot x 3-foot boxes supplied by Geneva Pipe for City Creek Aqueduct in Salt Lake City.

American Concrete Pipe Association

Editorial

"The more things change, the more they stay the same."

Matt Childs, P.E., President
American Concrete Pipe Association

It is said that the title of this editorial is of French origin, but regardless from whence it came, the fact is, it has relevance in our industry. Concrete pipe[1] is a time-tested high value asset in America's network of sewers and culverts. Many concrete pipelines and culverts have surpassed the coveted 100-year milestone[2], and many more are close behind. The pipe that comprises these 100-year pipelines were not produced with modern high tech equipment and concrete mixes, yet they perform beyond expectations. Some pipelines are excavated when undersized and unable to meet modern needs, and then reused elsewhere, generating substantial savings in capital costs.

Corrugated steel pipe was once the darling of specifiers and contractors looking for cheap alternatives to concrete pipe. Now it is thermoplastics. History strongly suggests that thermoplastics will have their day in the sun, until specifiers and contractors recognize where they can be used best to complement America's concrete pipe sewerage and inventory of precast concrete pipe and box culverts.

ACPA history suggests that in 1929, the clay pipe industry was lobbying cities to not allow the use of precast concrete pipe, and the manufacturers of corrugated steel conduit were making progress selling their products for the construction of sewers and culverts. By the 1960s, concrete pipe producers and corrugated steel conduit manufacturers were in fierce competition to supply products for widespread road building[3] stimulated by the federal government. ACPA began documenting and reporting on failing and damaged corrugated steel installations.

In the 1980s concrete pipe producers were able to prove to specifiers, regulators, and contractors that culverts made with corrugated steel had a much shorter service life than expected. With documented failures and failing culverts in play, the concrete pipe industry was able to compete successfully for culvert and sewer projects.

At the same time, the thermoplastic conduit industry was targeting projects traditionally specified for steel. HDPE first used for agricultural drains became an option for sewers and culverts. It was during this period that ACPA introduced the notion of life-cycle cost to demonstrate that concrete pipe is the best economic choice for long-term installations. The gloves were off for a protracted conflict with thermoplastic conduit.

Fast forward to 2011. Competition between concrete, steel and thermoplastics continues for culvert applications, but storm and sanitary sewers remain hotly contested markets between concrete pipe producers and thermoplastic conduit manufacturers. ACPA is successfully telling the story of the performance of thermoplastic installations with education, applied science, contemporary research, and modern inspection devices and procedures[4]. This is what our industry had to do over 50 years ago when steel was at its zenith to ensure that America received a durable infrastructure of concrete pipe that increases in value as it ages.

Concrete pipe continues to set new benchmarks for quality and long-term performance. Concrete pipe producers know that they are producing pipe that can last well beyond 100 years. While the thermoplastics industry dreams of reaching a high quality 100-year installation with low-cost materials, the concrete pipe industry is aiming for 150 years. It is up to the end users of concrete pipe to decide for the future. Do they want short-term solutions for sewers and culverts, or long-term high value concrete pipe assets?

LINKS

1. www.concrete-pipe.org/pages/why.html
2. www.concrete-pipe.org/pdfcpn/CP-News-Spring-2011.pdf
3. http://en.wikipedia.org/wiki/Interstate_Highway_System
4. www.uta.edu/ce/abolmaali/hdpe%20report.pdf

Bridging The Technology Gap

Data collection, information, and knowledge set the accuracy of crack measurement in RCP

There appears to be an information gap between manufacturers of inspection equipment and inspection contractors that extends beyond the technology gap. A 1/32 inch or 0.03-inch crack is at least three times larger than most cracks in an in-service concrete pipe[1]. Inspectors are expected to report on the width of cracks that are typically one fifth of the thickness of a dime or less, but our experience suggests that this is not practical. One fifth of the thickness of a U.S. dime is the approximate width of a 0.01-inch crack. When cracks occur in new reinforced concrete pipe (RCP) installations, they are typically equal to or less than 0.01 inch wide. "*Some engineers insist that a crack in a concrete pipe in excess of 0.01-inch represents a failure or partial failure situation. Such a conclusion is utterly ridiculous and represents a disservice, not only to the concrete pipe industry, but taxpayers as well*." This quote from Professor M.G. Spangler[2], a well-respected authority and early pioneer in the design of concrete pipe, should be taken into consideration when inspecting a project using reinforced concrete pipe. ASTM C76 - 11[3] further states; "*The 0.01 inch crack is a test criteria for pipe tested in the Three-Edge-Bearing test and is not intended as an indication of over stressed or failed pipe under installed conditions.*" Many municipalities and DOTs require the measurement of cracks, joint gaps, and defects in all pipe types for 48-inch diameter and smaller.

Pipe utility contractors tend to accept and support final inspection. The inconsistency of accurate crack measurements, however, threatens the confidence of pipe utility contractors and prime / paving contractors in the inspection procedure. This lack of confidence may in turn jeopardize the future of assessing pipe conditions and approximating crack widths. Pipe inspectors and contractors must understand fully, the practical accuracy of using precision crack measurement technology. Experience suggests that more crack widths are over-estimated than under-estimated. An article by Douglas Holdener, P.E., Florida Region Engineer, Rinker Materials Concrete Pipe Division – CEMEX notes, "*The National Association of Sewer Service Companies (NASSCO)[4] and its Pipeline Assessment Certification Program (PACP)[5] have no bearing on whether an inspector reports crack width measurements accurately using precision crack measurement technology*."[6]

As more post installation inspection data is generated and presented to owners, engineers, and inspection professionals, the decision maker must be trained to differentiate between items that are purely aesthetic from conditions that require remediation to maintain the intended service life for the installed pipe system. Needless repair of minor aesthetic imperfections will lead to unnecessary cost increases. Failure to remediate a deficiency may lead to unanticipated maintenance and/or replacement.

ACPA has published, *Post Installation Evaluation and Repair of Installed Reinforced Concrete Pipe*[7]; a document that addresses possible issues identified in post installation inspection reports and/or video documents of newly installed RCP, including commentary on possible remediation and repair techniques. Owners, inspectors and design professionals should not be overly concerned when hairline cracks, or cracks up to 0.01-inch in width are visible in collected inspection data. It is very important to close the information gap related to crack width to produce data, information, and knowledge about the performance of reinforced concrete pipe. Contact the ACPA for a schedule of pipe inspection demonstrations.

LINKS

1. www.concrete-pipe.org/pages/why.html
2. www.concrete-pipe.org/pdfdd/DD_9.pdf
3. www.astm.org/Standards/C76.htm
4. www.nassco.org/
5. www.nassco.org/training_edu/te_pacp.html
6. www.nassco.org/publications/times/0511.pdf (pages 14 and 16)
7. www.concrete-pipe.org (contact a member of the ACPA for a copy)

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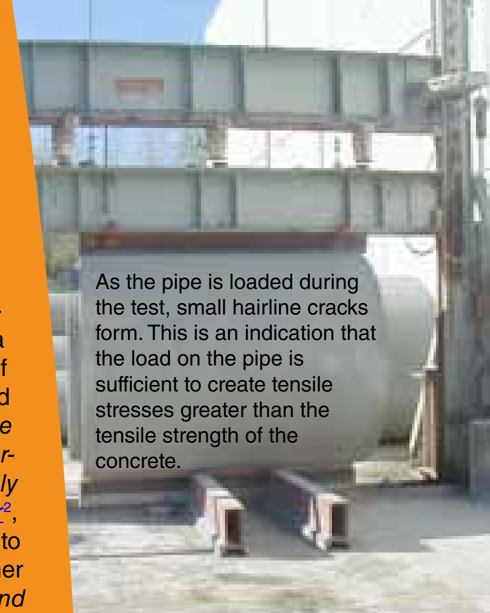
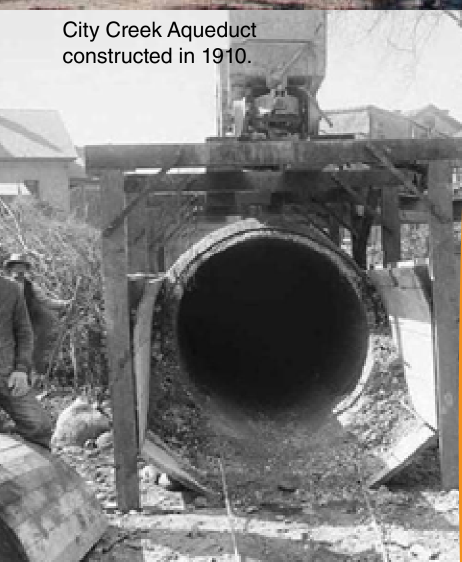


As the pipe is loaded during the test, small hairline cracks form. This is an indication that the load on the pipe is sufficient to create tensile stresses greater than the tensile strength of the concrete.

Transverse or circumferential cracks may be caused by poor bedding.

Circumferential crack with autogeneous healing.

84-inch diameter RCP being prepared for installation.



City Creek Aqueduct constructed in 1910.

Excavation of a section of the 100-year cast-in-place aqueduct.

One-hundred Year Concrete Pipe Aqueduct Setting Performance Record

By Randy Wahlen, Former Director
Mountain States Concrete Pipe Association

The City Creek Aqueduct[1] that was constructed in 1910 in Salt Lake City, Utah provided a rare opportunity to evaluate how an underground structure had fared after 100 years. The aqueduct is an 84-inch diameter cast-in-place concrete storm water outfall that runs along North Temple Street. It carries constant flow from City Creek, as well as storm water from a large urban area. Despite its age, the pipeline functions well and had not been scheduled for replacement until planning for a light rail transit line drew attention to its structural integrity. The viability of the pipeline became an issue due to the construction of a light rail transit line (TRAX) along North Temple that would connect the international airport to downtown Salt Lake City. The light rail live loads would not exceed the highway loading on the pipeline, but the prospect of having to replace an already aged pipeline, that would closely parallel or run under the transit line, created the need for a detailed analysis.

Precast concrete pipe[2] was not available when the pipeline was first constructed, so it was cast using an outer frame of round wood staves, with an inner frame of four, removable, quarter-sections. Excavation was by hand. The condition assessment by Ensign Engineering[3], of Salt Lake City showed portions of the pipeline that looked new, but other sections had experienced spalling or reinforcing corrosion. Scour, from the constant flow of water, was also observed in some sections. Core samples showed compressive strengths of the concrete ranging from 2,830 psi to 5,750 psi. Some samples showed voids and larger aggregate than would be allowed in concrete mixes today. Reinforcement was a single cage triangular steel, that had an area of approximately 0.103 in^2/ft (somewhere between a #2 and #3 bar).

The compressive strength and reinforcement area of the century pipe are less than what would be required today. A newly designed concrete pipe of the same diameter would have the same 7 inch wall but steel reinforcing nearly four times greater. Concrete pipe of today has a design strength of 4,000 psi, but 28 day compressive strength often reaches 8,000 to 9,000 psi. The pipeline's stability was mostly a result of the soil compaction around the pipe. Based on the performance of the century pipe, modern concrete pipe should easily last 100 years.

The replacement project consisted of 1,128 feet of 84-inch diameter reinforced concrete pipe and 320 feet of precast reinforced concrete 10-foot x 3-foot box supplied by Geneva Pipe[4]. The pipe is used for the replacement under North Temple, while the boxes are used for construction of a culvert under the track bed of an existing heavy rail system that crosses North Temple. The replacement pipe was the same diameter as the original pipe to which it was connected. Other sections of the concrete pipeline that are less affected by the light rail line were left in place to continue setting performance records for concrete sewers and culverts.

Full Story:

LINKS

Info Links

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2. www.concrete-pipe.org/pages/why.html
3. www.ensignutah.com/
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Photos: Phil Gale, Geneva Pipe

Metro Vancouver Opts for Lined Concrete Pipe Sanitary Sewers

By Mark Omelaniec, President
The Langley Concrete Group
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Significant amounts of concrete pipe[1] were used to develop the main sanitary sewer system throughout the Lower Mainland of the Greater Vancouver beginning in 1914. Some of the larger interceptors, which service significant areas of the surrounding municipalities, were cast-in-place in the late 1960s and early 70s to move sewage to newly constructed treatment plants. Continued rapid growth over the past twenty-five years of the municipalities that make up Metro Vancouver has placed substantial demand on the existing sewer infrastructure. Because of its longevity, ease of installation and local availability, concrete pipe remains the backbone of Metro Vancouver's sanitary sewerage system.

The topography, climate, organics and volume of warm effluent in the sewers of the Lower Mainland combine to provide an environment that is conducive to the propagation of *Thiobacillus* – the bacterium that converts H_2S gas found in sewers to H_2S0_4 (sulphuric acid). Over the past 20 years, Vancouver area concrete pipe producers worked with Metro Vancouver staff to significantly reduce the risk of sulphuric acid (H_2S0_4) corrosion[2] of concrete pipe sanitary sewers by supplying concrete pipe with cast-in plastic liners.

In the mid 1990s, The Langley Concrete Group[3] elected to use T-Lock PVC liners[4] supplied by Ameron. One of the largest initial projects was tendered in 1999 for approximately 2.5km of 2400mm (96-inch) diameter lined pipe installed on piles along the Hwy 91 corridor from Hwy 10 to 64th Ave. This was the first significant improvement project to increase the capacity of the main South Surrey Interceptor[5], a major link in the sewers that convey sanitary sewage to the Annacis Island Secondary Treatment plant. In 2009, the Township of Langley rerouted its sewers to the Metro Vancouver system triggering an upgrade of municipal sewers that connect with the South Surrey Interceptor (SSI). In the same year, Metro Vancouver released the tender for twinning the SSI for over three kilometers with lined concrete pipe.

Additional equipment was required to produce ten 3050mm (120-inch) diameter pipes per day following ASTM C655-11, when The Langley Concrete Group was awarded the contract to supply pipe and manholes. Langley Concrete used American Concrete Pipe Association pipe design software and the direct design method to accommodate the installation parameters of the project.

To meet tough design requirements, a higher than normal concrete strength, higher tensile strength of the reinforcing steel, and strict attention to quality assurance was paid to the entire production process. The contractor used the bedding surface for an access road, saving the cost of a temporary road for supplying pipe and equipment. As the pipeline was constructed, the contractor used a device to shape the pipe bedding for each new pipe. The new line parallels the old sewer which will be left in place and maintained to accommodate sewage, if the new line requires maintenance. Over 500,000 people will benefit from the lined precast concrete South Surrey Interceptor, which is designed for more than 100 years of service.

Full Story:

LINKS

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1. www.concrete-pipe.org/pages/why.html
2. www.concrete-pipe.org/cp_info/CP-Info-Precast-Concrete-Pipe-Durability.pdf
3. www.langleyconcretegroup.com/
4. www.amerontlock.com/
5. www.facebook.com/pages/The-Langley-Concrete-Group-of-Companies/192422710787722
6. www.metrovancouver.org/Pages/default.aspx

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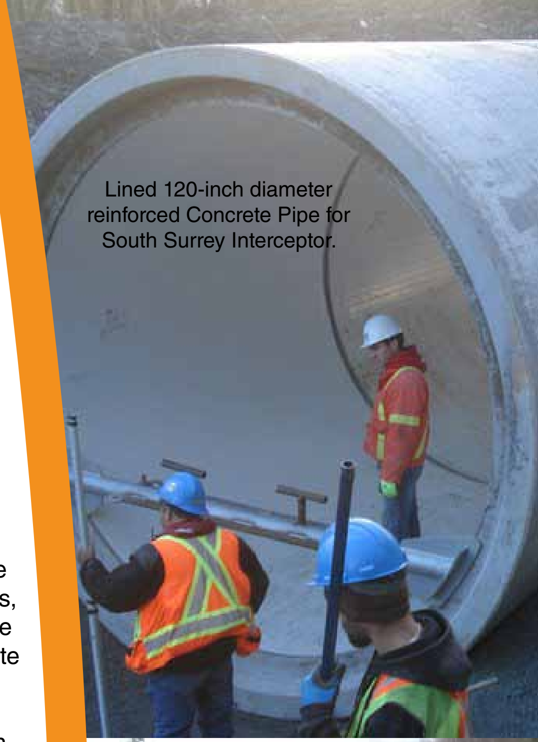
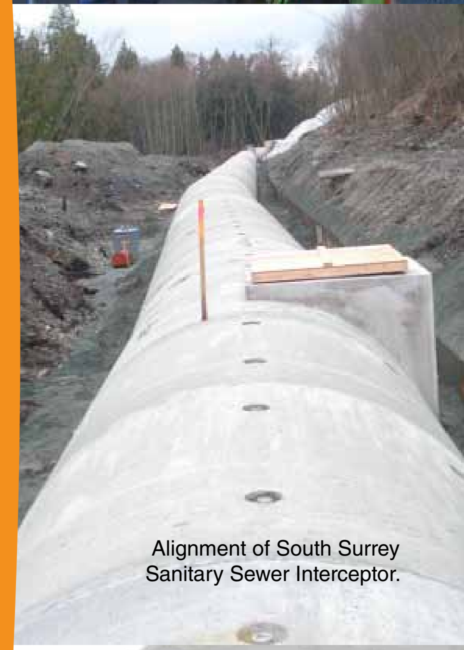
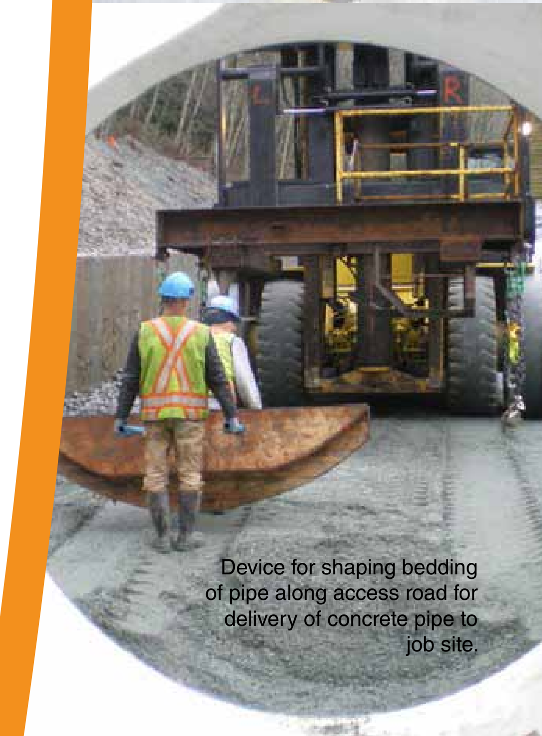
Photos: Mark Omelaniec, The Langley Concrete Group



Lined 120-inch diameter reinforced Concrete Pipe for South Surrey Interceptor.



Alignment of South Surrey Sanitary Sewer Interceptor.



Device for shaping bedding of pipe along access road for delivery of concrete pipe to job site.

Innovative Box Design Used for Flood Abatement

By Russell Tripp, P.E., Georgia Engineer
American Concrete Pipe Association
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Donna Newman, P.E., City Engineer
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The Chattahoochee River borders downtown Columbus GA on the west and south, and Weracoba Creek borders the east. Historically, surcharging of combined sewers and flooding of the downtown core by Weracoba Creek was hazardous.

Approximately 12 years ago, Donna Newman, P.E., City Engineer began planning long-term storm drainage solutions for downtown Columbus[1]. One element of the plan, developed jointly by the City and Jacobs Engineering[2] was the 6th Avenue Flood Abatement Project; a "combined" sanitary and stormwater system divided into two phases. Both phases would utilize precast concrete boxes (PCB) for sections of the flood abatement storm sewer system. Newman and Jacobs believed that PCB sewers would provide the best long-term solution based on hydraulic capacity and minimal disruption to historic downtown Columbus. Precast boxes were the preferred solution because the storm sewer could be constructed quickly with limited disruption to commerce, and use of the downtown facilities would be returned to residents more quickly.

Reynolds, Inc.[3], (installation contractor), awarded Foley Products Company[4] (Columbus) the contract to supply precast concrete boxes to Phase II beginning in March, 2011. This phase included 8,350 feet of PCB ranging in size from 8-foot x 6-foot to 14-foot x 12-foot. All sections required a troughed invert. In addition to the precast boxes, Foley supplied 6,064 feet of 15-inch to 72-inch diameter reinforced concrete pipe. The Foley design team, headed by Chris Davidson and Bob Palmer P.E., had to accommodate a design that was efficient and cost effective considering site limitations that affected the contractor's on-site equipment. The small construction work area determined the size of installation equipment, and product had to be scheduled for just-in-time delivery. "*Foley Products worked diligently to meet all of the material requirements for the Flood Abatement Project. The products delivered were of a superior quality and consistency. Foley's dedication to the project yielded a positive working relationship with the owner and engineer.*" (Andy Hedrick, Project Manager with Reynolds Inc - SE Utility Division)

Foley redesigned its boxes by reducing the wall thickness from 16 to 33 percent. The product modification decreased the average weight of each box by 25 percent. This innovative design removed more than 5,000 tons from standard designs. The weight reduction allowed the contractor to set a majority of the boxes with existing equipment already on site. A unique set of lifting pins were designed for unloading the 14-foot x 12-foot boxes, safely and efficiently.

An on-site progress meeting was held in July between Donna Newman, Joseph Thames and Andy Hedrick of Reynolds, Chris Davidson and Bob Palmer of Foley, and Russell Tripp with the American Concrete Pipe Association in attendance. It was agreed that timely delivery of a quality product had contributed to the overall success of the project. The last 1,300 feet of 14-foot x 12-foot PCB was installed in August. The project continues to be on schedule for completion by the end of 2012.

LINKS

Info Links
1. http://columbusga.com/
2. www.jacobs.com
3. www.laynechristensen.com/Brands/Reynolds-Inc.aspx
4. http://foleyproducts.com/

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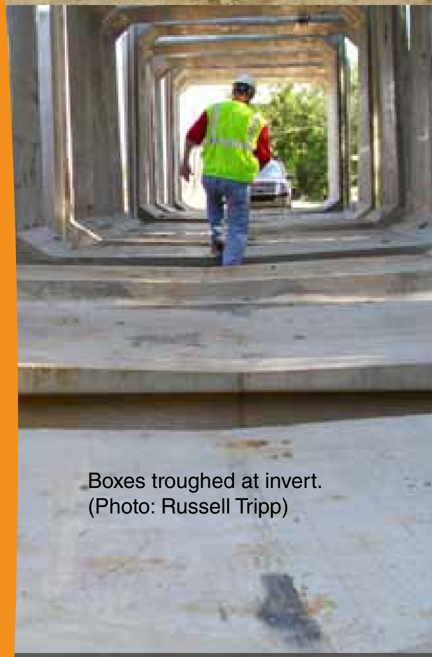
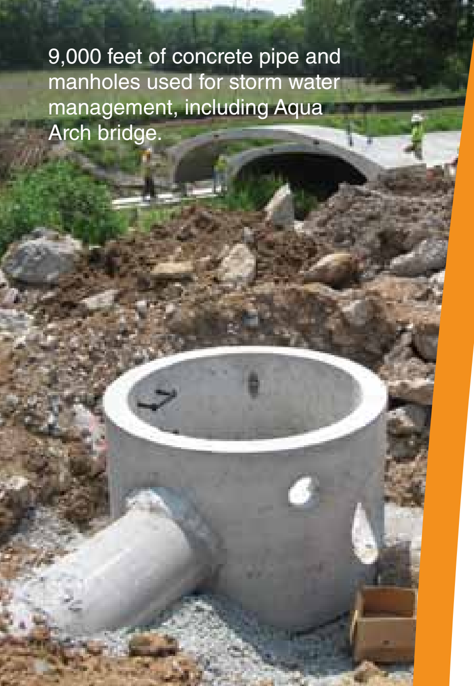
Transitioning to twin 12-foot x 8-foot box sewer from 14-foot x 12-foot box at poured-in-place concrete junction box. (Photo: Andy Hendrick, Reynolds, Inc.)



Boxes troughed at invert. (Photo: Russell Tripp)

Looking down the barrel of recently installed 14-foot x 12-foot PCB storm sewer. (Photo: Foley)



9,000 feet of concrete pipe and manholes used for storm water management, including Aqua Arch bridge.

Installation of three-sided Aqua Arch bridge.

Decorative precast wing and headwalls.

Aqua Arch and RCP are High Value Assets in Expanded Thoroughfare

By Michael Kusch
Director of Technical Marketing
Sherman Dixie Concrete Industries
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McEwen Drive is an important element of the City of Franklin[1], TN transportation network that connects the eastern area of City to I-65 and the community of Cool Springs. An expansion plan for McEwen was approved, and the initial construction phase commenced in 2005 with the construction of the McEwen Interchange on I-65. Phase III, began construction in February 2011. The expansion was necessary to alleviate growing congestion triggered by new mixed-use development, and concerns over traffic safety in the growth areas. By improving the capacity of McEwen, emergency vehicle response times should improve. The multi-phased construction project will conclude in 2012.

Construction of the four lane roadway with a center median required a crossing of the South Prong of Spencer Creek. The crossing had to integrate restoration works, and have minimal impact on the creek's ecosystem during construction. Sherman Dixie Concrete Industries[2] worked with Sullivan Engineering and Tennessee Department of Environment and Conservation (TDEC)[3] to design a three-sided bridge made of precast concrete arch sections that would be assembled on site. Sherman Dixie's Aqua Arch[4] was able to accommodate the technical and environmental concerns of TDEC and the City. At the same time, the precast system would deliver an economical structure within the City's goal of balanced construction costs and attractive appearance of capital works.

Sherman Dixie produced 166 feet of 32-foot span x 6.5-foot rise arch sections, and 297 feet of 28-foot span x 5-foot, 9-inch rise sections in its Cullman, AL facility. The installer, Brown Builders of Springfield, TN used a 350-ton crane to set the precast sections of the two structures on poured-in-place footings. In addition, the producer supplied four sets of precast wing walls and headwalls. Decorative stone form liners were used by Sherman Dixie in casting the wing and headwalls, which mechanically attached to the Aqua Arch end pieces. The producer invested in additional formwork for casting skews on the Aqua Arch sections. The precast bridges were constructed in two locations over a period of just 5 days in July, 2011.

Reinforced concrete pipe[5] was specified for the various phases of the McEwen Drive expansion. Sherman Dixie supplied nearly 9,000 feet of 18-inch to 42-inch diameter RCP from its Franklin, TN facility for cross drains, median drains and storm sewers. Precast concrete catch basins, junction boxes, headwalls, and manholes were manufactured and supplied by Sherman Dixie's Nashville facility. All precast products supplied were used to complete the concrete storm water management system associated with the roadway.

Project Manager was Jonathan Marston of the City of Franklin and Eric Gardner, P.E. of Franklin was Director of Engineering. The General Contractor was The Parkes Companies, Inc.[6] of Franklin represented by Joe Parkes Jr., Don Harris, Trey Evans, and Chris Bagley. The Civil Engineer of Record was Dickie Sullivan of Sullivan Engineering[7], Franklin and Smyrna, TN.

LINKS

Info Links

1. www.franklin-gov.com/
2. www.shermandixie.com/index.php
3. www.tn.gov/environment/
4. www.shermandixie.com/products/boxculverts/index.php
5. www.concrete-pipe.org/pages/why.html
6. www.parkescompanies.com/
7. www.sullivanengineering.com/

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Photos: Michael Kusch, Sherman Dixie Concrete Industries

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For the Engineering and Marketing attendees, the highlight of this year's school will be a half-day dedicated to a Demonstration on the Evaluation of Cracks in Concrete Pipe. Learn how to avoid "strike-outs" over cracks in concrete pipe by attending our RCP cracking demo. We will discuss proper measurement and reasonable evaluation techniques for cracks in RCP. Being able to properly share knowledge about the structural nature of cracks and how to differentiate cracks that require no repair from cracks that may require sealing or structural repair will greatly benefit you and your company in areas where stringent post installation inspections are being utilized.

Save this link www.concrete-pipe.org/pages/cpnews.html to your favorites list to increase your knowledge about drainage applications and innovative ways to use precast reinforced concrete pipe and boxes to build structures that will last.