Concrete Pipe News

FALL 2014
Volume 66 No. 4

American Concrete Pipe Association
www.concrete-pipe.org

Fall 2014
Volume 66 No. 4

Concrete Pipe News is published four times each year by the American Concrete Pipe Association. It is available in hard copy and digital format posted on the ACPA website. *Concrete Pipe News* content is linked to archived technical information, research and product development, educational products and applications of precast concrete pipe and boxes. Content is linked to archived word and graphic files on the ACPA and other industry-wide websites. Readers include engineers, specifiers, contractors, suppliers, government officials, and members of the American Concrete Pipe Association.

Published by:
American Concrete Pipe Association
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On the Cover:

Mine shaft lined with T-Lock-lined reinforced concrete pipe.
Photo: Russell Tripp, P.E.

Editorial

It Can Be As Easy As ABC and APC

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

The Federal Highway Administration (FHWA) recently published the 3rd Edition of *Every Day Counts (EDC)*[1], an initiative which is designed to identify and deploy innovation aimed at shortening project delivery, enhancing the safety of roadways, and protecting the environment. The initiative focuses on identifying efficient ways to design and build transportation projects within restrained economic times. After rolling out the initiative, FHWA partnered with American Association of State Highway and Transportation Officials (AASHTO) and held a series of regional summits to introduce the initiative to state and local governments, contractors, consultants and others who make day-to-day project decisions.

Accelerated Bridge Construction (ABC)[2], one of EDC's initiatives, improves total project delivery, improves material quality; improves material durability; protects the environment; and improves work zone safety for the traveling public and construction workers. Precast reinforced box culverts are a perfect fit for ABC. Precast reinforced concrete boxes are used for bridge replacement, culvert replacement, detention and retention applications. Precast box culverts are underground bridge structures that reduce both cost and construction time. Precast concrete box culverts enable simultaneous construction activity, which removes bridge construction from the critical path. This reduces project delivery, which in turn reduces costs to local communities in several ways. Reduced project delivery shortens traffic delays and community disruption. Utilizing precast box culverts reduces right of way acquisition, eliminates temporary alignments and minimizes utility relocations. Shortened installation time reduces environmental impacts and eliminates the possibility of weather-related delays. Precast concrete box culverts accelerate construction; exactly what the FHWA promotes in its ABC initiative.

ACPA members are the key enabler in our industry's promotion of precast box culverts as the next initiative of Every Day Counts. Not only is it important to educate our members about Accelerated Precast Construction (APC), it is equally important to increase the awareness of customers about APC. Regional Training Workshops and Concrete Week activities provide effective mechanisms to raise awareness and educate. ACPA members can better promote APC as the next EDC initiative through ACPA's education opportunities that include webinars, Pipe School, and regional workshops. The better we understand our industry's innovative products, the more effective our Accelerated Precast Construction message becomes.

EDC builds on innovative practices that reduce construction time and costs, especially with precast concrete box culverts that meet the expectations of our customers. It seems like yesterday that the largest precast box was 12 foot x 12 foot, which wasn't big enough for our customer's accelerated construction schedules. Producers responded with innovative design and manufacturing techniques that produced precast boxes with spans exceeding 20 feet. In addition, producers developed a multi-cell box culvert design, which reduced construction time by as much as 50%. These innovative practices need to be promoted to local Departments of Transportation, empowering them to specify precast concrete boxes for culverts and other drainage structures.

FHWA's Every Day Counts builds upon the same initiatives as our industry, and provides a window of opportunity to promote our industry's products. Precast concrete boxes were innovative long before FHWA started promoting ABC. Accelerated Precast Construction with reinforced concrete box culverts, saves money, time and lives. It is opportune for our industry to act quickly and proclaim APC as the next innovative initiative of the concrete pipe industry, and the next component of Every Day Counts.

LINKS

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2. http://tinyurl.com/lljwha2

Rubber Gasketed and Lined RCP Used in a Large Diameter Tunnel for LA County Sanitation District Sewer

By Russell Tripp, P.E., Director, California Precast Concrete Pipe Association
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A 142-inch diameter tunnel to accommodate a 90-inch diameter PVC-lined reinforced concrete pipe sanitary sewer in the upstream portion of the Joint Outfall "C" Unit 1 Relief Trunk Sewer[1] in Los Angeles County, California was required because the existing 72-inch diameter JO "C" Unit 1 Trunk Sewer had become hydraulically overloaded.

The tunneling project is the second and final phase of construction of the entire relief sewer. The first phase was completed in 2010. Phase II consists of the construction of approximately 7,600 feet of 90-inch diameter PVC-lined, double O-Ring rubber gasketed reinforced concrete pipe (RGRCP) sewer. The project includes construction of appurtenant structures, and the relocation of a ten-inch jet fuel line and seven oil and gasoline lines that interfere with construction of the trunk sewer and structures. Approximately 5,400 feet of RGRCP was installed in one direction, while 2,200 feet will be installed in the opposite direction from the tunneling pit.

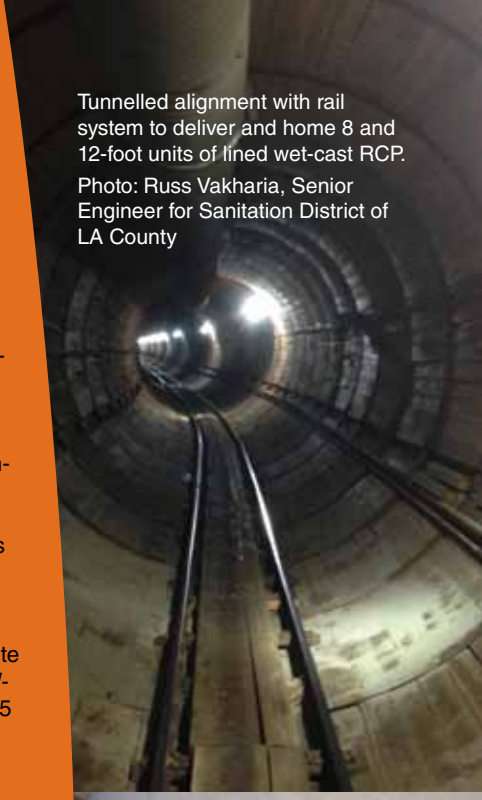
Thompson Pipe Group[2] in Rialto, California supplied the pipe for the project. Thompson Pipe Group has manufacturing locations in California, Texas, and Louisiana. Thompson Pipe Group produces reinforced concrete pipe and structures, reinforced polymer concrete pipe and structures, Meyer polymer concrete pipe, and FLOW-TITE® FRP pipe. Thompson Pipe Group wet cast eight- and 12-foot long RGRCP joints to accommodate the 35 to 40 foot depths, and horizontal and vertical curves inside the tunnel. All pipe joints were a specially-designed class 3,500 D with double-gasketed joints. The pipe with this joint design will be hydrostatically tested as the pieces are installed.

Since the entire sewer is designed as a siphon and the bottom section is completely submerged, only sections above the low flow level that would be exposed to sewer gases were lined 270 degrees along the circumference with PVC T-Lock liner to prevent corrosion. A precast channel insert placed within a rectangular cast in place junction structure will be used for the live connections between the new run of 90-inch diameter relief sewer and the existing 72-inch diameter sanitary sewer.

Constructing a tunnel and installing the RGRCP sewer inside was necessary due to the depth of the sewer, several oil lines directly above the sewer alignment, multiple railroad crossings, and oil storage tanks in adjacent oil refineries along the sewer alignment. There was limited work area for open trench construction due to container truck traffic from Port of Los Angeles and Long Beach and only a narrow corridor due to the parallel existing 72-inch sewer and a 66-inch storm drain. The Sanitation Districts of Los Angeles County[3], owner and designer of the pipeline, prefers lined concrete sewers for diameters greater than 42 inches based on the success experienced with this material in large diameter sanitary sewer systems. A rigid alternative (vitrified clay pipe), is typically specified for diameters less than 42 inches. Rosann Paracuelles, P.E., Senior Engineer with the Sewer Design Section, County Sanitation Districts of Los Angeles County was Project Engineer.

According to Jeremy Juarez, project manager for the General Contractor, W.A. Rasic Construction[4] hired contractor Golden State Boring & Pipe Jacking, Inc.[5] of Chino, California. W.A. Rasic had to address the challenges of limited space near the pit for pipe storage, live oil and jet fuel lines that had to be relocated, inclement weather, difficult soil conditions, rail crossings of the alignment, and the anticipated utilities, and services in the same alignment as the tunnel. The tunnel itself had two vertical curves and three horizontal curves to avoid oil storage tanks and the edges of a closed landfill. The vertical bends were required to accommodate the up-leg and down-leg portions of the siphon. The contractor used a rail system to excavate spoil from the tunnel face and will install pipe within the tunnel with a special rail machine to push the pipe joints together. Some of the soil was contaminated, thus classifying the tunnel as "gassy" and requiring that all tunneling equipment be "permissible."

The Joint Outfall "C" Unit 1 Relief Trunk Sewer has a 100-year design life. The concrete pipe supplied to the sanitary trunk sewer has a service life that is expected to exceed the 100-year design based on engineered strength of the sewer and the partially-lined RGRCP joints.



Tunnelled alignment with rail system to deliver and home 8 and 12-foot units of lined wet-cast RCP.
Photo: Russ Vakharia, Senior Engineer for Sanitation District of LA County

Installation by pushing RCP into a mine shaft with man-entry vehicle for construction of the sanitary sewer.
Photo: Russell Tripp, P.E.

90-inch diameter PVC-lined rubber gasketed reinforced concrete pipe delivered for installation.
Photo: Russell Tripp, P.E.

LINKS

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4. www.warasic.com
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- **Keyword Search on American Concrete Pipe Association Website**
  (lined, PVC, T-Lock, sanitary, interceptor, flexible, rigid, sewer, tunnel, service life, design life)
  www.concrete-pipe.org
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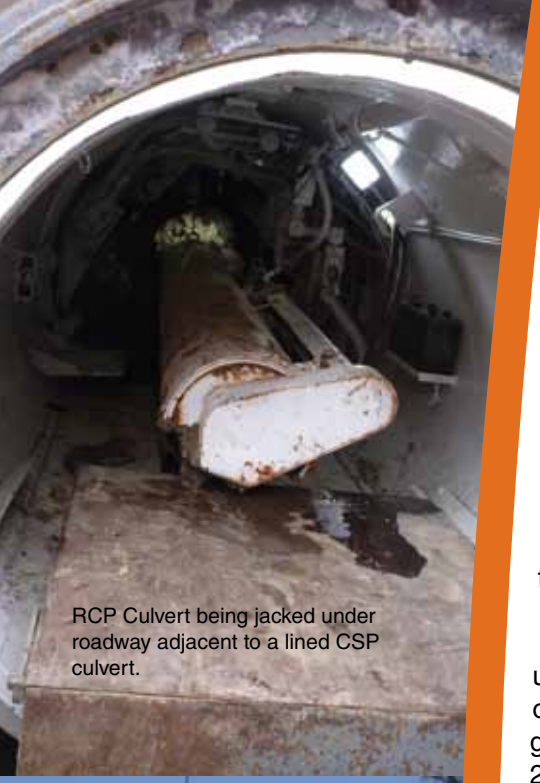
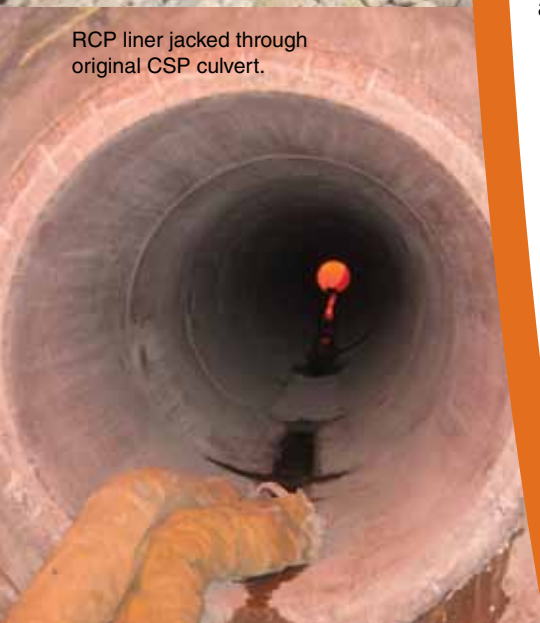


RCP Culvert being jacked under roadway adjacent to a lined CSP culvert.

Lined CSP culvert and second RCP culvert.



RCP liner jacked through original CSP culvert.

Conversation Shift – From Sustainable to Both Sustainable and Resilient Pipeline Systems

By Derek Light, P.Eng., Technical Sales and Marketing
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Conversations about critical infrastructure suggest that not only should materials and products be sustainable, they must also be resilient to both natural and man-made catastrophic events in the context of changing climate and weather patterns, carelessness, vandalism and deliberate attacks on a system. Reasons that impact the specification of concrete pipe are wide and varied, but the constant remains that concrete pipelines used for critical buried infrastructure perform for a long service life with little unplanned maintenance and low professional and corporate risk to designers, specifiers, and contractors.

To illustrate the notions of sustainable development and resiliency in the context of urban infrastructure is the culvert that channels Truro Creek under Portage Avenue, one of the busiest arterial roads in Winnipeg, Manitoba. Originally constructed with corrugated steel pipe (CSP), the 2.6m diameter culvert runs 50m under Portage Avenue. In 2010, as a result of heavy corrosion at the invert and joints, rehabilitation was required. A 2.1m diameter HDPE liner was grouted into the culvert before the spring melt in 2011 to extend the service life of the culvert.

The rehabilitation option, however, created a concern with the hydraulic profile since the resulting velocities would exceed the requirements of the Department of Fisheries and Oceans (DFO). To reduce culvert velocities and meet DFO requirements for fish passage, an additional 1200mm concrete pipe culvert was added late in 2011, adjacent to the existing culvert using a guided boring machine (trenchless) installation.

The Truro Creek passage remained in service until October 29, 2013 when a child built a “campfire” which burned the HDPE liner of the 2.1m diameter line. The fire generated toxic smoke prompting evacuation of nearby residences. Engineers concluded that without a liner, corrosion of the steel would deteriorate the structural integrity of the culvert and immediate rehabilitation was needed.

Engineers specified 1800mm diameter reinforced concrete pipe to line the Truro Creek culvert, based on the product’s longevity, strength, inert materials, and economics, while ensuring the option would still meet DFO requirements. The culvert was installed in the fall of 2013 to last for the next 70 -100 years.

Because of the need for lining, grouting, construction of a new secondary culvert and finally relining with jacked concrete pipe, it could be argued that the original culvert design was far from being sustainable within the three pillars of sustainable development. It could also be argued that implications of resiliency are more important than the sustainability of materials and products for pipeline systems.

The Truro Creek culvert speaks volumes to the issue of building buried infrastructure that is resilient, using materials and products that will meet the design life of a pipeline or culvert system. The conversation has shifted from that of sustainable development only, to development that is both sustainable and resilient.

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2. What do we mean by ‘resilience’?
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The Bigger the Diameter, the Greater the Confidence in RCP Sanitary Sewers

By Brent Klaiber, P.E. and Brandon Christiansen, P.E.
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The Des Moines Metropolitan Wastewater Reclamation Authority (WRA)[1] includes a conveyance system of about 125 miles of sanitary sewer with pipe sizes up to 144 inches in diameter. When pipelines reach the 144-inch size, pipe material options become limited and reinforced concrete pipe (RCP) is preferred. Many public works authorities are specifying modern RCP[2] with mix designs and liners for sanitary sewer applications that will perform as expected for the design life of the pipeline. Owners of lined RCP sanitary sewers benefit from the inherent strength and resiliency of reinforced concrete and the added resistance to the effects of sewer gases.

WRA outfall projects, Phase 17 Segments 3 & 4 and Phase 17 Segments 5 & 6 required approximately 11,947 feet of 144-inch diameter T-LOCK-lined RCP, including 205 feet of 144-inch diameter jacking pipe. Due to the size, timing, and phasing of these two projects, there were two concrete pipe producers supplying products. Cretex Concrete Products[3] supplied 75% of the projects with products manufactured at their Des Moines facility while Royal Concrete Products supplied the rest. Cretex utilized a 5000 psi self-consolidating concrete mix design along with O-ring gaskets. The pipe was designed and installed to meet an elevated level of performance with an allowable leakage rate of 100 gallons per inch of diameter per mile per day, which is half the typical allowable leakage rate.

Standards used to produce the Class 4 pipe included ASTM C76, ASTM C361, ASTM C361 and ASTM 443. There were several special quality control checks carried out at the Cretex pipe plant and on site. These included: visual inspection of all pipe units, documentation, and certification to meet ASTM requirements (Cretex implemented its own inspection criteria to ensure a quality product); hydrostatic testing of the 144-inch pipe at the plant to prove joint design and performance (the pipe joints were tested with straight and offset alignments); three-edge bearing testing a piece of the 144-inch pipe to prove method of design; visual inspection of all pieces by the owner's representative at the plant prior to shipping, and inspection again after the product arrived on site before being installed; and, Cretex was required to have personnel on-site during installation for quality control of the product, and to answer any questions from the contractor or owner's representatives. Ameron[4] trained several installation personnel on proper welding techniques for joining the T-Lock liners after the concrete pipe had been properly jointed.

All people associated with the installation had to go through proper installation training classes given by Cretex technical representatives. In addition, there were multiple plant tours for engineering firms and members of the WRA during the manufacturing of the 144-inch pipe.

The projects were designed by Veenstra & Kimm, Inc.[5] from West Des Moines, and S.M. Hentges and Sons[6] from Jordan, MN was the installation contractor. Segments 3 & 4 took 18 months to complete, while Segments 5 & 6 took 12 months.

LINKS

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Learn More About Buried infrastructure

- **Keyword Search on American Concrete Pipe Association Website** (lined, PVC, T-Lock, sanitary, interceptor, flexible, rigid, sewer) www.concrete-pipe.org
- **Concrete Pipe Design Manual** www.concrete-pipe.org/pages/design-manual.html
- **Concrete Pipe News** www.concrete-pipe.org/pages/cpnews.html

144-inch RCP was three-edge bearing tested to prove method of design.
Photo: Dave Anderson, Cretex

The contractor modified an old army truck to haul each piece to the site.

Projects included approximately 11,947 feet of 144-inch diameter T-LOCK-lined RCP, including 205 feet of 144-inch diameter jacking pipe.

Photos: Gary Zajac, SM Hentges and Sons

Lined RCP Specified for Critical Sanitary Sewer Interceptor

By Robert D. (Bob) Blasingame, Project Engineering Manager
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Lined reinforced concrete pipe (RCP)[1] is specified in major urban centres throughout North America on pipelines containing aggressive sewer gases. The Elm Fork Relief Interceptor[2], Segment EF-2 Phase 1 in Irving Texas is a concrete sanitary sewer that required unique transition pieces. Thompson Pipe Group[3], comprised of nine companies utilized three of its facilities including Thompson Pipe Group in Alvarado,Texas was involved in the design and manufacturing. Thompson Pipe Group has manufacturing locations in Texas, California, and Louisiana. Thompson Pipe Group produces reinforced concrete pipe and structures, reinforced polymer concrete pipe and structures, Meyer polymer concrete pipe, and FLOWTITE® FRP pipe. The Trinity River Authority of Texas Elm Fork Relief Interceptor transports sewage to the Central Regional Wastewater Treatment Plant, while providing supplemental capacity for overloaded existing pipelines and capacity for future development.

Nearly three miles of PVC-lined, 108-inch diameter RCP was supplied by the Thompson Pipe Group. Because of flotation issues and the need for installing the pipeline with varying depths of overburden, the project specifications required the concrete pipe to be designed for five different strengths to accommodate the various loads; 1350-D, 1400-D, 1500-D, 1700-D and 1900-D class pipe. Standard strengths is one of the major advantages of specifying concrete pipe for pipelines, because owners can purchase product for specific sections of projects to ensure that pipelines are designed efficiently. This form of detailed specification can save considerable costs for both the contractor and owner.

Thompson Pipe Group manufactured a unique polymer concrete transition piece to connect an existing 110 inch diameter fiberglass pipe to the new 108 inch RCP. Thompson Pipe Group manufactured four more transition pieces to connect round 108 inch diameter pipe to a rectangular (132 x 72-inch) precast concrete box structure, along with small quantities of 96, 72 and 54-inch diameter RCP required for short runs at junction boxes. The concrete pipe was designed with O-Ring rubber compound gaskets and the T-Lock PVC liner.

Concrete pipe was produced according to the requirements of ASTM C76[4], *Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe* and ASTM C655[5], *Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe*. The liners are also designed, manufactured and tested to ASTM Standards for plastic sheet, PVC, compounds, physical properties, sampling and testing.

The majority of the concrete pipe was installed by Oscar Renda Contracting, Inc.[6] using the open cut method. Because of the size and weight of the 108-inch diameter pipe, permits were required for the delivery route and time of day. The pipe supplier coordinated delivery of the pipe units with the availability of equipment for offloading.

Designed by Black & Veatch[7], the Elm Fork Relief Interceptor mitigates sanitary sewage overflows that have adverse impacts on human health, the environment, and economic development. The 108-inch replacement interceptor will serve the cities of Addison, Carrollton, Coppell, Dallas, Farmers Branch, and Irving by providing adequate capacity until 2040. The general contractor was S.J. Louis Construction of Texas Ltd.[8]

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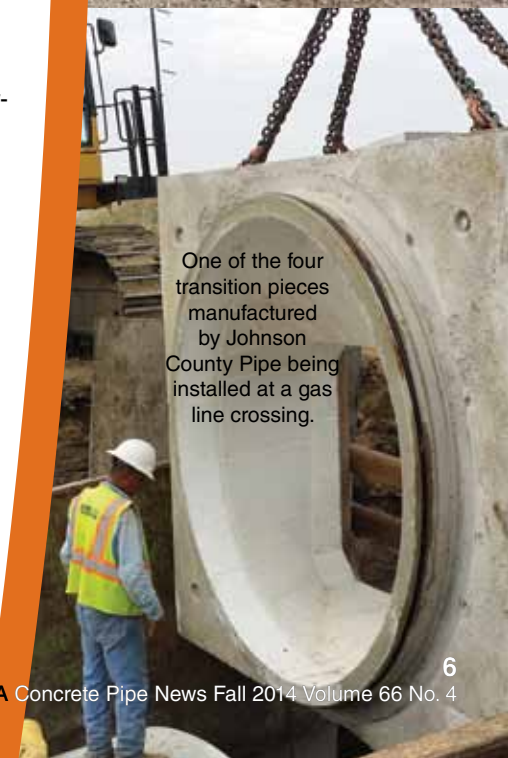
Photos: Robert D. (Bob) Blasingame

108-inch diameter RCP produced with PVC T-Lock liner.

Size and weight of the 108-inch diameter pipe required special permits to transport.



One of the four transition pieces manufactured by Johnson County Pipe being installed at a gas line crossing.

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Installation of four 210-foot runs of 10-foot x 8-foot box sections for construction of quad-cell culvert.
Photo: Scott Jordon, P.E., ACPA

Savings in time and cost with a design-build contract favoured the precast option over the cast-in-place alternative.

Quad Box Culvert A Critical Structure on Jimmy DeLoach Connectors

By Jason Hewatt, Project Consultant
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Precast concrete boxes produced by Foley Products[1] were used to construct a quad-cell culvert near Port Wentworth, Georgia on the Jimmy DeLoach Parkway[2] that connects Interstate 95 with the Port of Savannah. It is estimated that the $72.8 million, 3.1-mile connector will carry 8,000 trucks to and from the port each day, saving time and money. The limited-access, four-lane highway exemplifies America's shift to building infrastructure that is resilient to significant weather events. New precast concrete structures are critical elements in the overall design of the connector.

The precast culvert is comprised of four, 210-foot runs of 10-foot x 8-foot box sections with a parapet and wing walls at both ends. Since the project was design-build, it allowed Foley Products to re-design the box culvert using the American Concrete Pipe Association's BOXCAR[3] software providing an innovative and cost effective design solution. The original plans detailed a double cell bottomless culvert with a 28-foot span and 8-foot rise over a distance of 260 feet.

Georgia Department of Transportation[4] had recently allowed precast box culverts to be acceptable during pre-bid. Before the new rule, the contractor had to value engineer the design change after the bid. The contractor provided a savings of over $600k by making the change to a quad-cell box culvert.

BOXCAR software (Box Culvert Analysis and Reinforcing Design) can help reduce design time and project costs by calculating reinforcing steel areas for user-specified box geometry, material properties, and loading data. Due to the thinner walls, Foley shipped two (6-foot) sections per truck instead of one, and that design change reduced the freight costs by half.

The contractor, Archer Western[5], was able to install the precast sections with its own crews, instead of hiring a subcontractor to install a cast-in-place structure. Savings in shipping costs made the design-build option competitive with the cast-in-place option and helped keep the project ahead of schedule.

Jason Hewatt at Foley Products was the Project Consultant, while Bob Palmer, P.E., with Foley was the engineer who designed the thin-walled box sections. The precast concrete culvert was not installed until November 2013. The project continues with a completion date in 2016.

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Learn More About Buried Infrastructure

- **Keyword Search on American Concrete Pipe Association Website** (box, culvert, BOXCAR, hydraulic, brochures) www.concrete-pipe.org
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The American Concrete Pipe Association is joining the World of Concrete and introducing an all **NEW** 4-hour *Concrete Pipe and Box Culvert Design and Installation Course* for designers, engineers, installers and inspectors.

If you work with concrete pipe or precast boxes you will learn about concrete pipe design basics, box culvert design using ET Culvert, proper pipe and box culvert installation, and post installation inspection.

More more details, please visit www.concrete-pipe.org/pages/woc.html.

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