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On the Cover:

RCP used for concrete pipeline and facilities for enhancing the quality of the natural environment with an innovative design for collecting and treating aircraft de-icing runoff. The facility is one of only a few of this kind in North America.

Editorial

Placing All Products in the Bid Document is Short-sighted, Dangerous, and Can Be Costly

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

Some champions of competitive materials are asking why their products are not used more often in pipelines and culverts. The organizations they represent joined forces to change language in legislation to increase the use of flexible pipe products, especially HDPE. Tampering with the language through the actions of lobbyists and legislators runs the risk of increasing the liability of design engineers and specifiers. Such myopia can result in funding the construction of sewers and culverts that are not resilient and far from being sustainable development (social, economic, and environmental). Taking the engineer out of the material selection process is dangerous and should not be supported.

The Victorian era of British history was the period from June 1837 until 1901. It was a period of great public works, including massive legacy sewer systems that are still very much in use today. The London sewers were not constructed with flexible pipe, especially thermoplastics. Engineers had the authority to design and specify the materials for pipelines and other structures that have proved to be resilient to acts of nature and man. Infrastructure was built for generations that would not be burdened with the shortcomings of a society that valued the low bid ethos.

Why can we not ensure that engineers in the USA have the ability to design and specify the materials best-suited for their projects? The regulated profession needs tools like MAP 21 to be able to create resilient highway infrastructure. Engineers do not need interference by thermoplastic pipe manufacturers, their sales force and lobbyists to limit their ability to choose pipe materials and products best suited for a particular application. The Moving Ahead For Progress in the 21st Century Act (MAP-21), clearly states that "States shall have the autonomy to determine culvert and storm sewer material types to be included in the construction of a project on a Federal-aid highway" (Section 1525). Responsibility lies with the engineer involved in State infrastructure design, specifications, value engineering, and construction to deliver a constructible project that meets the desired purpose, and protects the health, safety and welfare of the user.

Being light, longer, and low capital cost are reasons often cited for the specification of thermoplastics to save taxpayers money, and that "competition on price alone is good." When it comes to sewers and culverts that impact public maintenance budgets, health and safety – and yes resilience to natural and man-made catastrophes, more has to be considered like installation costs, the quality of the installation, and quality of material arriving onsite. Oxidation does not stop with concrete and metal pipe. Plastic oxidizes and weakens over time, while concrete strengthens. It can be argued that the rate of failure of thermoplastics is hastened with live and dead loads when the soil structure around a thermoplastic installation is not constructed to Standards and code. Those that believe that building to code will give ultimate performance are living in a fool's paradise. Code is the bare minimum that should be met to be safe. Much more has to be considered for a pipeline system that will last through the ages and perform as expected. Design engineers and specifiers need to make choices based on technology, product and materials knowledge, and experience – not a sense of entitlement by some producers of competitive products and their associations.

SOURCES

Builder & Engineer, Down in the sewer, builderandengineer.co.uk/feature/down-sewer
Water Utility Infrastructure Management, Commentary -- A Call for Fair Competition,uimonline.com/index/webapp-stories-action/id.1429/title.commentary----a-call-for-fair-competition
Concrete pipe manufacturers push for restrictive legislation in Michigan, ads-pipecanada.ca/pdf/en/tline500.pdf

Concrete Pipe Used in Critical Infrastructure System at Gerald R. Ford International Airport

By Roy E. Hawkins, R.L.A., Airport Planning Engineer
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The Gerald R. Ford International Airport (GFIA) has completed an environmental assessment for a $20 million Stormwater/De-icing Management Program[1] was required for the construction of a stormwater treatment system. The Airport's National Pollutant Discharge Elimination System (NPDES) permit required elimination of the Airport's contribution to existing nuisance biofilms and prevention of de-icing runoff from contributing to the development of biofilm conditions in receiving waters. Among the project requirements were re-routing stormwater from the Airport's north detention basin (NDB) to a new outfall at the Thornapple River, and reconfiguring the Airport's west apron stormwater system to consolidate runoff from all major existing and future aircraft de-icing areas. Reinforced concrete pipe (RCP) was specified by GFIA for the storm sewer draining de-icing runoff to an engineered natural treatment facility, and then to the new outfall. The project is scheduled for completion in the fall of 2015.

The storm sewer alignment required the storm crossing under a railway, a local road, an expressway, a golf course, a river, and utilization of miles of 12-inch to 108-inch diameter RCP. Numerous manholes and drop structures, overflow energy dissipation structures, concrete boxes, and many other cast-in-place concrete structures were also a part of construction. The concrete pipeline passed over the top of two box culverts used to channel streams encountered in the alignment of the sewer. Northern Concrete Pipe Inc.[2] supplied most of the wet and dry-cast precast concrete products.

Sixty-inch diameter RCP was installed from the new natural treatment system to the M-6 Expressway crossing where 48-inch diameter concrete pipe was bored and jacked. The standard 48-inch RCP then followed an alignment to a thermoplastic outfall pipeline and diffuser weighted by concrete collars under the river bed. The 108-inch diameter RCP was required for the alignment that collected runoff from the airfield, passing under a railway track alignment and local primary road crossing before discharging into the natural treatment system. Jacking pipe (108-inch) was required for the tunnel boring under the local road and railway. The smaller diameter RCP collects storm runoff from a major portion of the airfield.

The greatest quantity of RCP was 48-inch, 60-inch, 72-inch, and 108-inch diameter. With the exception of approx. 500 feet of 48-inch jack pipe (C-76-V), and 600 feet of 108-inch jack pipe (Class V), most of the pipe was either Class III or IV. The 108-inch tunnel bore pipe was installed with rings of plywood to cushion the pipe at each joint. All 108-inch Class III pipe had to be produced and shipped in 2014 even though half would not be installed until June 2015. The remaining portion of 108-inch pipe for the tunnel and jack operation was produced and delivered in 2015.

GFIA is owner and operator of the new stormwater treatment system. Grand Rapids-based Kamminga & Roedvoets was the excavation contractor . The project is an example of constructing critical infrastructure to service a major international airport. This stormwater treatment system enhances while enhancing the quality of the natural environment with an innovative design for collecting and treating propylene glycol, and managing storm water.

Miles of 12-inch to 108-inch diameter RCP used for stormwater management and propylene glycol collection and treatment system at Gerald Ford International Airport.

Standard 108-inch diameter reinforced concrete pipe used for pipeline construction by trench and jacked methods of installation.

Jacking pipe (108-inch) tunneled and jacked under the local railway to carry stormwater and de-icing runoff to the new treatment facility.

LINKS

1. grr.org/SWStudyPhotos.php
2. ncp-inc.com/index.shtml

Photos Credit: Roy D. Hawkins, R.L.A., Airport Planning Engineer, Gerald R. Ford International Airport and David Ecklund, Drone Photographer

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- **Keyword Search on American Concrete Pipe Association Website** (airport, storm, detention, retention, treatment, jacking, tunnel, joint) concrete-pipe.org
- **Concrete Pipe Design Manual** concrete-pipe.org/pages/design-manual.html
- **Concrete Pipe News** concrete-pipe.org/pages/cpnews.html

4-foot box sections that weighed 52,000 lbs. each were designed to MDOT's HL-93 Modified Design requirements.

The entire project was successfully completed in 12 days and 8 hours.

Small bridge constructed using the APC method with minimal impact to the community and region.

Every Minute Counts: Accelerated Bridge Construction in the Fast Lane

By Jim Washabaugh, Sales Manager
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The new precast concrete box culvert/bridge on Michigan's M-142 over Phillip Drain exemplifies Accelerated Precast Construction (APC)[1] to quickly replace culverts and small bridges in ways emulating ABC (Accelerated Bridge Construction).

The award-winning M-142 project in 2014 called for removal of the existing bridge, installation of a cofferdam with sheet piling, installation of a 48-foot long by 24-foot wide by 12-foot tall precast concrete box structure, all associated end treatment, and all associated road reconstruction. The project had a completion date of 14 days, regardless of the weather. Minimizing user delays and traffic disruption were a priority for MDOT, as M-142 is the major artery in the area. Another consideration was the Huron County Fair that was scheduled for July 27. The contractor guaranteed that the road would be open to the 1000s hoping to attend the annual fair.

Engineers at Fisher Contracting Co.[2] wanted every element of the bridge crossing to be manufactured as precast to complete the project within the strict timeline that the schedule allowed. The schedule did not accommodate any cast-in-place elements, and Fisher needed to eliminate uncertainty associated with curing time.

A complete precast crossing was approved by working with MDOT's bridge design division[3], as well as the regional project engineer. The 24-foot x 12-foot boxes were cast in 4 foot sections that weighed 52,000 lbs. each, designed to MDOT's HL-93 Modified Design requirements. The design is based on 1.2 times the current AASHTO LRFD Bridge Design specification loading with the exception that the design tandem portion of the HL-93 load definition is replaced by a single 60 KIP axle load before the application of the 1.2 factor. For the end treatments, 120 feet of 4 foot wide by 2 foot high footings were precast in four sections for the wingwalls and end box sections to rest on. Eighty-five feet of precast cut off walls were manufactured in four sections and placed at the outside ends of the precast apron slabs. The apron slabs were cast in two sections and were pinned and grouted to the cutoff wall footings. The 18-foot tall wingwalls had concrete earth anchors attached to the backside. Each wingwall was precast in two sections. The inner sections were bolted to the end box sections with a pair of 1-inch thick galvanized steel plates. The outer sections were bolted and plated to the adjoining inner wingwall segments. Due to the required height of the headwalls, on top of an already 14.5-foot tall (outside) box section, the headwalls had to be cast separately from the box sections. L-shaped, 6-foot tall precast headwalls were match-cast to the top deck of the end box sections and bolted to the top using 1-inch diameter stainless steel bolts, nuts and washers that were threaded into stainless steel anchors cast into the top slab of the end box sections. All precast was supplied by Northern Concrete Pipe Inc.[4]

The date for delivery of boxes to the site was set for July 14. The entire project was successfully completed in 12 days and 8 hours, well ahead of the required timeline. The construction contractors appreciate the great time savings that precast offers, because they can't afford to spend weeks forming, pouring and curing when precast is available. The case for APC, using precast concrete boxes for small bridges and culverts, is illustrated with the M-142 bridge over Phillip Drain.

Photos: Courtesy of Fisher Contracting

LINKS

1. concrete-pipe.org/magazine/2014fallcpnews.html (Editorial)
2. fishercompanies.net/?page_id=25
3. michigan.gov/mdot/
4. ncp-inc.com/index.shtml

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- **Keyword Search on American Concrete Pipe Association Website** (accelerated, box, culvert, bridge) concrete-pipe.org
- **Concrete Pipe Design Manual** concrete-pipe.org/pages/design-manual.html
- **Concrete Pipe News** concrete-pipe.org/pages/cpnews.html

CMP Culvert Inspections Strongly Suggest Rethinking of Aluminized Type 2 Service Life

Claims by the corrugated metal pipe (CMP) industry are that Aluminized Type 2 (Al Type 2) coated steel pipe will last 1.3 to 6.2 times longer than galvanized coated steel pipe. Such service life claims cannot be supported because evidence exists that Al Type 2 can fail within 3 decades. Report No. FHWA-RD-97-140, Durability Analysis of Aluminized Type 2 Corrugated Metal Pipe details culvert inspections from October 1994 to December 1996. The American Concrete Pipe Association (ACPA) performed an inspection of the culverts on the Natchez Trace Parkway on November 12, 2014.

Service Life Predictions (years) Inspections & Calculations Oct. 1994 to Dec. 1996					CMP Inspection November 12, 2014					
CULVERT MILE MARKER	USACE	AISI 1994	AISI Current*	FHWA FLH	PIPE TYPE	PIPE GAGE	DIA. (in.)	BEDLOAD	AGE YEARS	OBSERVATIONS
312.4 E	68	73	75+	92	Al Type 2	16	42	None	33	Standing water, minor corrosion.
312.4 W					Aluminum	14	42	None	33	Standing water, minor corrosion.
312.4 Single	58	61	75+	78	Al Type 2	16	18	None	33	Dry, good condition.
311.9 N	55	88	115	72	Galvalume	16	72	Minor	33	Corrosion across 40 inches of the invert. Minor perforations at invert.
311.9 S	130	136	136+	170	Al Type 2	16	72	Minor	33	Approx. 12 inches of corrosion across invert of pipe.
310.6 N	80	83	87+	106	Al Type 2	16	60	None	33	Minor corrosion and perforation across 18 inches along the invert.
310.6 S	44	94	100	57	Galv. Bituminous Coated	16	60	Minor	33	Approx. 36 inches rusting across invert with 24 inches completely gone for the first 10 feet of the inlet, which appears to be from abrasion and corrosion.
310.2	88	92	95+	116	Al Type 2	16	54	None	33	Coating gone in spots with some rust in invert and crown.
310.1	94	101	100+	126	Al Type 2	16	72	Moderate	33	Approximately 30 inches along width of invert corroded with 18 inches of invert fully perforated and deflected at the 1:00 o'clock position upstream.
310.0	86	91	90+	114	Al Type 2	16	72		33	Recently rehabilitated with 50-inch diameter liner.
309.5	123	128	128+	160	Al Type 2	16	30	None	33	Aluminum coating gone over entire barrel length. The barrier coating appears to be intact
309.4	84	90	90+	112	Al Type 2	16	42	Moderate	33	Approximately 18 inches of corrosion across the invert with 6 inches completely gone due to abrasion and corrosion.

*Modern Sewer Design, a publication of AISI, uses the current AISI chart and a multiplier of 1.3 for Al Type 2. Therefore, the plus sign (+) could conceivably be replaced with a multiplier of 1.3.

The November 12 inspections were observations of the inside of the culverts that generally experience earlier and greater wear than the soil side because of service conditions, oxygen exposure, and replenishment. The lowest water pH and resistivity shown in Table 1 are 7.0 and 2609 respectively. Most are higher than 7.0 and 5000. It is apparent that abrasion is a significant factor and should be considered in any metal pipe durability assessment. The abrasion levels (bedload) are consistent with previous reports except for culvert 310.6 N which was previously reported as minor and is shown as "none" in the ACPA inspection.

Conclusion

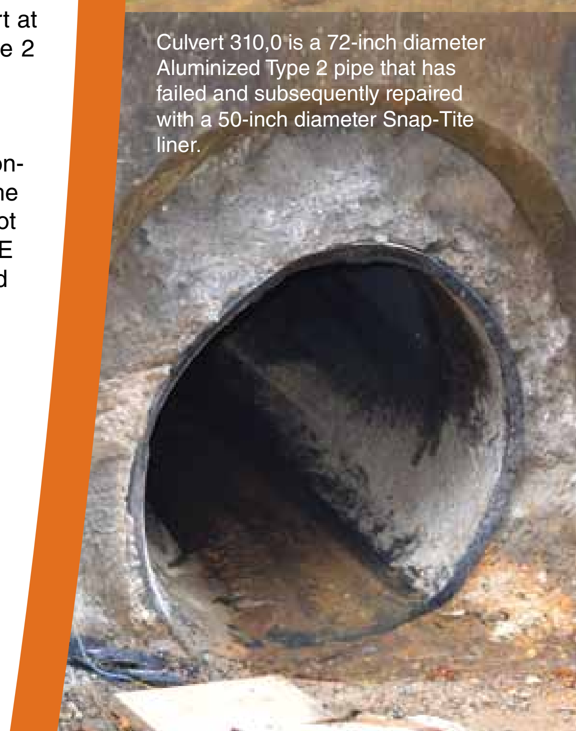
Culvert 310.0 collapsed and was lined with Snap-Tite in its 33rd year. Culverts 310.6 S, 310.1, and 309.4, which appear to be nearing the end of their service life, will soon need repair or replacement. The U.S. Army Corps. of Engineers (USACE) predictions in Table 1 are closest. If the 2.0 multiplier for Al Type 2 were removed, then the USACE predictions would be a lot closer to reality. The prediction for culvert 310.0 would be 43 years instead of 86 and it had to be rehabilitated at 33 years. Additionally, the USACE prediction of 44 years for the galvanized and bituminous coated culvert at 310.6 S is closer to reality and experiencing approximately the same service life as the Al Type 2 culvert 310.0 in similar environmental conditions.

Recommendation

The conclusion of Report FHWA-RD-97-140 says that Al Type 2 and galvanized under extreme conditions will perform in a relatively similar manner (last a long time or fail rapidly). Considering the condition of the pipe versus the service life predictions, the Al Type 2 pipe performance does not warrant a multiplier over galvanized pipe. ACPA recommends that the chart used by the USACE with the multipliers of 17.24 (pH ≤ 7.3) and 1.84 (pH ≤ 7.3), should be used by AISI and others - and that the multiplier for AL Type 2 be deleted.

The metal pipe industry changed the abrasion criteria for corrugated metal pipe. Moderate abrasion velocity used to be 5-8 fps and it is now 5-15 fps. Severe abrasion velocity used to be > 8 fps and it is now > 15 fps. NCHRP Report 50, Durability of Drainage Pipe, states; "Doubling the velocity of a stream carrying a bedload increases its abrasive power by approximately fourfold. Under the same conditions, its ability to transport rock fragments of a given size is multiplied as much as 32 times". ACPA recommends that the velocities for abrasion levels be changed to the more conservative values of 5-8 fps for Moderate abrasion and > 8 fps for Severe abrasion, and that the CMP industry develop a method (with greater detail) that incorporates abrasion in the service life prediction of CMP.

Approximately 30 inches along width of invert corroded with 18 inches of invert fully perforated and deflected at the 1:00 o'clock position upstream.



Culvert 310,0 is a 72-inch diameter Aluminized Type 2 pipe that has failed and subsequently repaired with a 50-inch diameter Snap-Tite liner.

Photos: ACPA Staff

Florida Community Opts for APC In Face of Advancing Hurricane Season

By David L. McClintock, P.E., Technical Resource Engineer
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A collapsed corrugated multi-plate steel arch culvert in Palm Bay Florida was rapidly replaced with an 11-foot x 7-foot x 148-foot long precast concrete box culvert before peak periods of the hurricane season arrived. In addition to the narrow window of opportunity in the face of the advancing hurricane season, Brevard County public works officials were fully aware of the impact that a road closure and detoured traffic would have on local businesses, residents and approximately 75,000 motorists who travel Palm Bay Road, daily. The advantages of accelerated precast construction with concrete boxes over a poured-in-place concrete structure included completion of the culvert replacement four weeks ahead of schedule that shaved $150,000 from the estimated project budget of $750,000. A Facebook site and YouTube channel video captures a time lapse documentary of the installation that demonstrates the accelerated precast construction method (APC) - facebook.com/palmbayroadculvertreplacement?fref=ts

Removal of 82-inch x 112-inch x 80-foot long multi-plate steel arch culvert.
Photo Source: facebook.com/palmbayroadculvertreplacement/photos

The project began with temporary concrete reinforcement of the failed culvert followed by removal of the arch culvert that was installed in 1981. The box culvert had seventeen 8-foot long sections and two 4.6-foot long end sections, along with cast-in-place endwall/wingwalls. Hanson Pipe and Precast[1] designed the culvert according to Florida Department of Transportation (FDOT) Index 291 and 292 and the FDOT 2014 Standard Specifications for Road and Bridge Construction modified with BoxCar software to facilitate the 7-foot rise dimension. To accommodate the site's aggressive environment, Hanson used Class IV concrete and a 3-inch concrete cover over the reinforcing steel in the 10-inch thick top, bottom, and sidewalls with 8-inch haunches.

Just-in-time delivery of precast concrete box sections.
Photo Source: facebook.com/palmbayroadculvertreplacement/photos

In addition to the advantages of the APC method[2], the new box culvert would increase and provide a service life as long as 100 years. Supplying the culverts under the tight construction schedule required Hanson to reduce its production lead time from the season's typical six to eight weeks to five weeks. Hanson worked closely with Brevard County to quickly design the sections and acquire approval of the replacement structure, order raw materials, and immediately begin manufacturing the boxes, maximizing production and shipping schedules. Once the box sections were on site, the County crew's familiarity with precast box installation brought additional efficiencies to the project.

APC improves total project delivery, material quality, material durability, protects the environment, and improves work zone safety for the traveling public and construction workers. Precast box culverts are used for small bridge replacement, culvert replacement, and detention and retention applications. Box culverts are buried bridge structures that reduce both cost and construction time. In addition, they enable simultaneous construction activity thereby reducing project delivery and costs. Reduced project delivery shortens traffic delays and community disruption. Specifying precast box culverts can reduce right-of-way acquisition needs, eliminate temporary alignments and minimize utility relocations. Shortened installation time reduces environmental impacts and eliminates the possibility of weather-related delays. Precast concrete box culverts can accelerate construction activity and shorten construction schedules. The speed of completion of the project has been attributed both to the County work crew and the coordinated efforts of the project's vendors, including Hanson Pipe & Precast.

Installation of 11-foot x 7-foot x 4.6-foot precast concrete box section.
Photo: Courtesy of Hanson Pipe & Precast

LINKS

1. hansonpipeandprecast.com/english/index.php
2. concrete-pipe.org/magazine/2014fallcpnews.html (Editorial)

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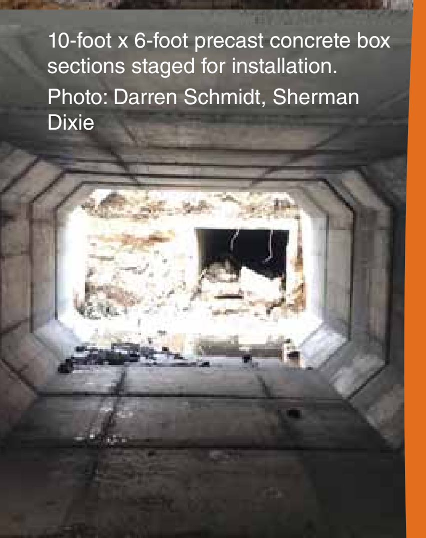
- **Concrete Pipe News** concrete-pipe.org/pages/cpnews.html

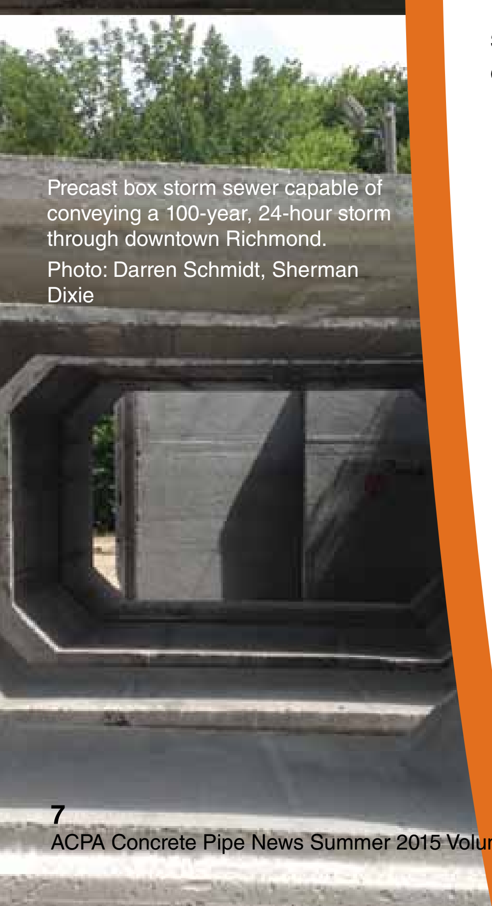
Gasketed precast reinforced concrete box sections supplied by Sherman Dixie.

Photo: Darren Schmidt, Sherman Dixie



10-foot x 6-foot precast concrete box sections staged for installation.

Photo: Darren Schmidt, Sherman Dixie



Precast box storm sewer capable of conveying a 100-year, 24-hour storm through downtown Richmond.

Photo: Darren Schmidt, Sherman Dixie

New Concrete Box Storm Sewer Reduces Flooding in CBD of Richmond KY

By Darren Schmidt, Technical Marketing Representative
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Precast concrete boxes were specified for the reconstruction of a storm sewer in the central business district (CBD) of Richmond, Kentucky. Lack of detention basins for developed areas of Richmond has increased runoff within the Water Street district of the CBD. The service life of materials used in the construction of the antiquated and undersized storm water system has been exceeded and materials used for the sewer have deteriorated. Parts of the sewer may have been constructed more than 100 years before the reconstruction. Prior to reconstruction, the grade and alignment of the sewer varied throughout the system that was comprised of steel tanker cars, wet stone masonry, corrugated steel pipes, concrete, and precast structures. Lack of smooth transitions between the storm sewer sections impaired the efficiency and the capacity of the system.

The new system, designed by Integrated Engineering[1] with head office in Lexington, KY, is approximately 2,900 feet long. Sherman Dixie[2] in Nashville, TN was contracted by the City of Richmond to supply 1,062 feet of 10-foot x 6-foot and 485 feet of 6-foot x 6-foot precast concrete box sections for the new storm sewer which traverses underneath several streets, and parking lots before discharging the headwaters of Dreaming Creek. Smith Contractors Inc.[3] of Lawrenceburg, KY was retained as the General Contractor of the project, which included the installation of the boxes and construction of the storm sewer. The total drainage area to the outfall is approximately 240 acres.

The box sections were installed using the open cut trench method with a track hoe for offloading and installing the boxes. The staging area for the reinforced concrete box sections was limited due to CBD site constraints. This situation created opportunity for just-in-time delivery of box sections. Many were offloaded and installed directly from Sherman Dixie's flatbed trucks.
The capacity of the new storm sewer is three times that of the previous and is capable of conveying a 100-year, 24-hour storm through downtown Richmond while eliminating the flooding issues that had troubled the downtown core. The project is part of an approximate $9 million grant from the Federal Emergency Management Agency (FEMA) Hazard Mitigation Grant Program. Construction of the storm sewer system started in July 2014 and was scheduled for completed in October 2015.

A video news report from local news station WKYT describes the effect of chronic flooding on the CBD of Richmond. Go to wkyt.com/home/headlines/Richmond-storm-drain-improvements-to-stop-flooding-problems-202012851.html.

LINKS

1. int-engineering.com
2. shermandixie.com
3. smithcontractorsinc.com

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Concrete Pipe Week - USA

The inaugural observance of Concrete Pipe Week takes place during the third full week in August. The celebration is designed to educate communities and their leaders on the importance of buried infrastructure and its concrete pipe and precast manufacturers.

Concrete Pipe Week serves to recognize the contributions of concrete pipe manufacturers who provide a quality product to public and private owners who design, build, plan, operate, and maintain the transportation, water supply, water treatment and solid waste disposal systems, and other structures and facilities essential to the U.S. economy and way of life.

Join with the ACPA and its members in the celebration of Concrete Pipe Week.

Save this link 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.