Editorial

It’s not a sinkhole…it’s a failed culvert or pipeline system

When there is a report of a catastrophic pavement failure, the odds are high that it will be reported as a sinkhole, when in fact the pavement failed because of a collapsed culvert or pipeline system. Many culvert and pipeline failures occur during, and immediately following massive rainfall resulting from a major weather event. It is easy to craft thoughtless headlines that mislabel the failure when the point of the story is to grab the attention and not report what has really happened.

The past decade has seen an increase in frequency of reported pavement failures. This is partially due to the end of service life of CMP culverts that were installed following construction of the Nation’s Interstate Highway System.

Culverts and pipelines are a system that depends upon an interaction between the surrounding soil and bedding/backfill material, jointing design and gaskets, and the design of the products used in an installation to accommodate loads and hydraulics. The recent failure of a parking lot at an IHOP restaurant in Meridian, Miss., and failed CMP storm sewer that contributed to pavement collapse and damaged police patrol car in Sheridan Colorado are two of many such stories archived on the ACPA Facebook site.

Careless reporting of pavement failures as sinkholes leads to a distraction from the real problem of specifying materials that cannot accommodate extreme weather conditions, or meet the design life of roadways.

Perhaps it is time to educate those who are reporting on the nation’s critical infrastructure.

Have something to say to Matt Childs about this editorial? The blog is published under Latest News at concretepipe.org. Get involved and leave a comment.
Why the City of Marshfield Chose to Replace a Concrete Storm Sewer with RCP

Bryan Jones, Marketing Coordinator, County Materials Corporation

In spring 2015, the City of Marshfield, Wisconsin began an extensive street reconstruction program in its downtown core. Underground utilities were inspected to assess their condition and need for replacement prior to design of the project. This included assessing 3,100 feet of precast concrete storm sewer. The 85-year-old concrete pipeline bearing the manufacturer’s stamp “WausauW29” was determined to have been manufactured by Wausau Concrete Co. in 1929. That plant is now owned and operated by County Materials Corporation after acquisition in 1986. In spite of its structurally sound and functioning condition, it was decided to remove and replace the existing 1929 storm system with new reinforced concrete pipe (RCP) manufactured by County Materials.

Old pipe proves its mettle

“It was a tough call to replace the pipe,” reports Tim Cassidy PE, Assistant City Engineer for the City of Marshfield. “The condition of the pipe itself was excellent. We ran our camera through it; looking at it internally there were no structural defects. In older pipe, the joints are a bit different (than modern pipe) but they weren’t cracked or falling apart. The concrete showed no sign of deterioration due to salts or deicing chemicals. The pipe definitely withstood the test of time.”

In fact, the old concrete pipe sections were in such good shape that plans have been made to re-use them in other projects. Some of the pieces were sold to local property owners for use as culverts. The City has considered reusing some of the remaining pipe sections for other municipal projects.

A decision based on sound design principles

The City of Marshfield’s decision to replace the old pipe was based largely on the need to accommodate design changes to the new storm sewer system and other concerns not related to the condition of the concrete pipe. Some of these considerations included:

- Improvements in roadbed depth. The design team was concerned that the original
85-year-old concrete pipe was manufactured by Wausau Concrete Co. in 1929.

Pipe had been installed at a shallower depth than is usual for modern construction. Marshfield’s clay soils have the potential to cause heaving when pipe is not buried deeply enough. Even though this problem had not come up on Maple Street in the past, there was concern that the thickness of the new, crushed rock subgrade would be reduced where the old, shallow pipe passed under the roadway. Increasing the depth of cover over the storm sewer system assured the full thickness of subgrade under all areas of the new pavement.

- Reinforcement concerns. While the 1929 pipe did contain steel reinforcement, it was not as heavy as that used in today’s concrete pipe. This, combined with the shallow depth of the old pipe and the reduced rock base cross-section, created concerns about the pipe being damaged during construction, if left in place.

- Improved pipe size. The original storm sewer system ranged in size from 42-inch to 24-inch diameter. The City chose to redesign the system with larger, elliptical precast concrete pipe measuring 38 inches X 60 inches. The larger hydraulic capacity provides more effective storm water drainage and helps prevent flooding issues during heavy runoff events. The reduced height of the elliptical pipe provides increased cover over the pipe.

- Planning for maximum longevity. The U.S. Army Corps of Engineers suggests a design life of 70-100 years for precast concrete pipe. At 85 years in service, the old pipe was nearing this limit. Many concrete pipelines and culverts have remained sound for far longer than 100 years. While these 85 year old pipes would very likely have lasted for at least another 50 years, the City of Marshfield decided to err on the side of caution by replacing them.

**Choosing Concrete**

Despite the availability of other options, the City of Marshfield never considered anything other than precast concrete pipe for the replacement storm sewer system. Long-term value was a priority, and reinforced concrete’s superior durability and structural integrity made it the ideal product. The excellent condition of the existing pipe only served to illustrate the economic advantage of concrete when service life is taken into account.
• Concrete is the most durable pipe material. The U.S. Army Corps of Engineers suggests the designer should not expect a material service life greater than 50 years for any plastic pipe and a maximum 50 year service life for aluminum pipe as well as corrugated metal with the use of coatings. One can expect concrete pipe to last 1.5 to 2 times longer than alternate materials such as HDPE, PVC, and polypropylene. Precast concrete pipe is non-flammable, will not rust, tear, buckle, or deflect.

Soon after the old storm drain was removed, County Materials delivered 3,070 feet of new RCP. The delivery included 716 feet of 38-inch X 60-inch horizontal elliptical pipe and 1,290 feet of RCP ranging in size from 18 inches to 36 inches diameter for the new storm sewer mainline under Maple Street, and 1,064 feet of 12-inch and 15-inch diameter RCP for the inlet leads.

“We prefer precast,” says Cassidy. “With other pipe options, we could not have installed as much road base. We know that the concrete will hold up and that’s our preferred material for storm sewers.”

The $2.9 million project, awarded to Earth, Inc. of Arpin, WI, included pavement, streetscaping and utility improvements to six blocks of Maple Street and adjacent streets between 6th St. and Veteran’s Parkway.

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| Who         | City of Marshfield, WI  
County Materials Corporation, Marathon, WI  
Earth, Inc., Arpin, WI  
U.S. Army Corps of Engineers |
| What        | An existing 1929 concrete pipe storm system was replaced with RCP. The 85-year-old pipe was reused. |
| Where       | City of Marshfield |
| When        | Spring, 2015 |
| Why         | An extensive street reconstruction program replacing 3,100 feet of precast concrete storm sewer to accommodate design changes to the new storm sewer system and other concerns not related to the condition of the concrete pipe. These concerns included improvements in roadbed depth, reinforcement concerns, improved pipe size, and planning for maximum longevity. |
| How         | Soon after the old storm drain was removed, County Materials delivered 3,070 feet of new RCP to replace the old. The delivery included 716 feet of 38-inch X 60-inch horizontal elliptical pipe and 1,290 feet of RCP ranging in size from 18-inch to 36-inch diameter for the new storm sewer mainline under Maple Street, and 1,064 feet of 12-inch and 15-inch diameter RCP for the inlet leads. |

Bryan Jones; bryan.jones@countymaterials.com
Oldcastle Precast, Telford, Pennsylvania supplied 11-foot X 11-foot precast concrete box sections with a V-shaped channel for the $12.5 million Laurel St. CSO (Combined Sewer Outfall) improvement project that replaced the existing one hundred year-old, 16-foot diameter brick combined sewer outfall in Philadelphia. The project is part of a U.S. EPA Order to reduce the number of CSO discharges to the Delaware River. The new state-of-the-art outflow with twice the capacity will reduce the risk of chronic flooding in Fish-town and Northern Liberties. As part of its original development plan and $164 million expansion of the SugarHouse Casino, SugarHouse agreed to upgrade the Laurel Street Combined Sewer Outfall.

Using prefabricated concrete boxes was a first for the City of Philadelphia. The Philadelphia Water Department specifiers in the past thought cast-in-place (CIP) concrete box structures provided an advantage over precast systems. Oldcastle Precast was able to prove to the owner, the engineer, and the Philadelphia Water Department that a precast concrete box system would be a feasible option for performance and accelerate a very aggressive construction schedule. It was imperative to restore the operation of the Laurel Street CSO as soon as possible.

Quick Notes

| Who          | City of Philadelphia  
|              | Philadelphia Water Department  
|              | JPC Contracting  
|              | Urban Engineers  
|              | Oldcastle Precast |
| What         | 11-foot X 11-foot precast concrete box sections with a V-shaped channel specified for the $12.5 million Laurel St. CSO (Combined Sewer Outfall) improvement project |
| Where        | Philadelphia, Pennsylvania |
| When         | 2015 |
| Why          | The new state-of-the-art outflow with twice the capacity will reduce the risk of chronic flooding in Fishtown and Northern Liberties. |
| How          | It was essential for Oldcastle Precast to provide precast concrete boxes that met the Philadelphia Water Department’s stringent design criteria for underground structures. There were load considerations to be worked into the box design because the structure would be located beneath the main parking lot of the casino, a small building called the SugarHouse Poker Room and an access road that would connect the main parking lots to additional parking areas. |

Oldcastle Precast supplied 1,307 feet of V-shaped box sections for the CSO outfall. The outfall was arranged as a triple 436-foot run of boxes.

The special precast box structure presented many challenges to the engineering department of Oldcastle Precast’s Pa. facility. It was essential for Oldcastle Precast to provide precast concrete boxes that met the Philadelphia Water Department’s stringent design criteria for underground structures. There were load considerations to be worked into the box design because the structure would be located beneath the main parking lot of the casino, a small building called the SugarHouse Poker Room and an access road that would connect the main parking lots to additional parking areas.
parking lots to additional parking areas. The connector road would be the main access road for buses and delivery truck traffic to and from the casino. Oldcastle Precast’s design of the precast box outfall with V-shaped channel was reviewed and approved by Urban Engineers of Philadelphia. Manufacturing of the box sections took approximately four months with time to spare for the project to be completed on schedule.

JPC Contracting of Blackwood, N.J. received the formal agreement for the first phase of site work and in turn contracted with Oldcastle Precast to provide the precast concrete box sections. Urban Engineers (Urban) was the civil and water-front structural designer.
Post Installation Basics

ACPA Staff

Post Installation Inspection

It’s in the owner’s best interest to know that all pipe in their system has been properly installed without damaging the structure of the system or shortening the anticipated design life of the pipeline. Post installation inspection provides that proof of proper installation and structural integrity to the owner prior to project close-out or final acceptance.

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.25 mm (0.01 inches), settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP, other) shall be checked for rips, tears, joint separations, soil migration through the joint, deflection, cracks, localized buckling, bulges, settlement and alignment.

Inspectors are required to determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel. Many municipalities require Pipeline Assessment and Certification Program (PACP)-certified inspectors and condition assessment codes to be used for pipeline condition assessments. Even the software used for data collection and reporting must be PACP-certified in many municipalities. As post installation inspection data is generated and presented to owners, engineers, and inspection professionals, the need to properly and quickly evaluate the issues in the inspection documents becomes critical. The decision maker must be trained to differentiate between items that are cosmetic, and conditions that require remediation.

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| Who         | American Concrete Pipe Association  
|             | National Association of Sewer Service Companies (NASSCO)  
|             | Pipeline Assessment & Certification Program (NASSCO) |
| What        | The ACPA published Post Installation Inspection Basics; a document that highlights some of the basic pipe performance and equipment requirements that should be specified on all pipe installations. |
| Why         | Post installation inspection provides that proof of proper installation and structural integrity to the owner prior to project close-out or final acceptance. |
| How         | Inspectors are required to determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel. |
The SMART Use of ABC and APC

Angela E. Torres - Cost Engineer, Stacy and Witbeck, Inc./ Herzog
Luis Santana, E.I.T., Sales Manager of California Forterra Pipe and Precast

The Sonoma-Marin Area Rail Transit (SMART) is a new rail transit system in the North Bay Area of California. The goal of this commuter passenger rail service line is to reduce congestion and ease travel along Highway 101, extending from the California Redwoods in Marin County to Sonoma County’s Wine Country. The initial operating segment from Airport Boulevard in Santa Rosa to San Rafael is scheduled to be completed by the end of 2016.

The project was designed as precast ABC (Accelerated Bridge Construction) to expedite the construction process and reduce any rail closures during the replacement of 60-100 year old rail lines from Santa Rosa to San Rafael.

It is well documented that the American concrete pipe industry is a major force behind the notion of accelerated precast construction (APC) - very similar to design and construction using ABC for bridges. The SMART system incorporates several precast concrete pipe and box culvert systems to accommodate drainage requirements along the rail bed alignment.

Major scope of the project includes rehabilitation of the existing rail infrastructure involving removal of existing rail, ties, and ballast. New ballast was added, and the rails and ties have been upgraded. Major scope also included repair of four existing bridge structures in place. Twelve cross-track jurisdictional culverts have been replaced and eight new cross track culverts installed.

The culverts range in size from 18 to 48 inches in diameter. Routine maintenance and repair activities on the culverts will generally occur in the dry season, and may include the removal of vegetation, soil, or other debris that affects their proper functioning. Excavation for removal and replacement of culverts typically occurred within the railroad right-of-way.

The project was awarded in 2011. Forterra Pipe & Precast (Hanson) has supplied precast concrete products since 2012. The design-builder, Stacy and Witbeck, Inc./ Herzog (a Joint Venture), subcontracted Forterra to supply 12-inch to 72-inch diameter reinforced concrete pipe and precast box sections of various sizes for the construction of box culverts and headwalls. All products supplied for structures under the rails met Cooper E-80 loading and American Railway Engineering and Maintenance-of-Way Association (AREMA) specifications.
Quick Notes

| Who          | Sonoma-Marin Area Rail Transit  
Stacy and Witbeck, Inc./ Herzog, a Joint Venture  
STV  
Forterra Pipe & Precast |
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<tr>
<td>What</td>
<td>A passenger rail service along an approximately 43 miles of existing rail corridor extending from Sonoma County to Marin County, California.</td>
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<tr>
<td>Where</td>
<td>Sonoma and Marin Counties, California</td>
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<td>When</td>
<td>Completion in 2016</td>
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<tr>
<td>Why</td>
<td>Growing congestion, travel times and delays on Highway 101 during peak travel periods, and capacity of the transportation system has not kept pace with the growth of travel demand in Sonoma and Marin Counties.</td>
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<tr>
<td>How</td>
<td>ABC and APC construction methods using precast concrete products including reinforced concrete pipe and precast box sections of various sizes for the construction of box culverts and headwalls.</td>
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Installing culverts and precast headwalls north of Civic Center Drive.  
Photo: Stacy and Witbeck, Inc./ Herzog, a Joint Venture

Angela E. Torres; atorres@herzog.com  
Luis Santana, E.I.T; Luis.Santana@forterrabp.com

Click to leave a comment!
Flooding of a section of Magnolia Drive in Mount Sterling, Kentucky restricted residents from commuting to work or driving children to school. Authorities identified the cause as a double-barrel 36-inch diameter corrugated metal pipe (CMP) culvert that had been installed when the subdivision was built in the 1980s. In addition to the physical deterioration of both pipes, the culvert was undersized and caused much of the flooding.

The undersized and failing CMP was replaced by 50 feet of 8-foot X 3-foot reinforced concrete box sections. The City of Mount Sterling contracted The Walker Company to remove the corrugated metal pipes and install the new reinforced concrete box culvert (RCBC). The pipes were replaced and the box culvert was installed over a two day period by installing half of the culvert one day and the remaining half on the second. This construction method allowed a passage lane to remain open throughout construction. Wing walls and safety fencing were installed to complete the box culvert.

One of the features of the RCBC on Magnolia Drive was its shallow bury. It has only two inches of cover. Precast boxes can be easily positioned in shallow or deep installations. They can be configured for upstream water levels and downstream flow velocities and can accommodate traffic immediately after placing and backfilling. Due to their ability to tolerate heavy wheel loads with little or no overfill, box culverts are often specified because they don’t require compacted overfill in place before loading is applied.
Comparative Flammability Demonstration

A demonstration of the comparative flammibility of polypropylene pipe (PP), reinforced concrete pipe (RCP), and high density polyethylene pipe (HDPE). Dry hay is ignited in three 18 in. by 18 in. pipes and allowed to burn.

Meridan, Mississippi IHOP Parking Lot Cave-In History

The crumpled pipe had replaced a much smaller one that had been there since the 1940s or 50s. The one that’s now crushed was installed 14 years ago after some major flooding.

Installation Demonstration of Rigid & Flexible Pipe

An installation demonstration of rigid concrete pipes and flexible plastic pipes from the American Concrete Pipe Association.

Supporting Members of This Issue

Authors and suppliers of concrete pipe and precast concrete boxes

[Logos of COUNTY, FORTERRA, Oldcastle Precast, and California Precast Concrete PIPE ASSOCIATION]