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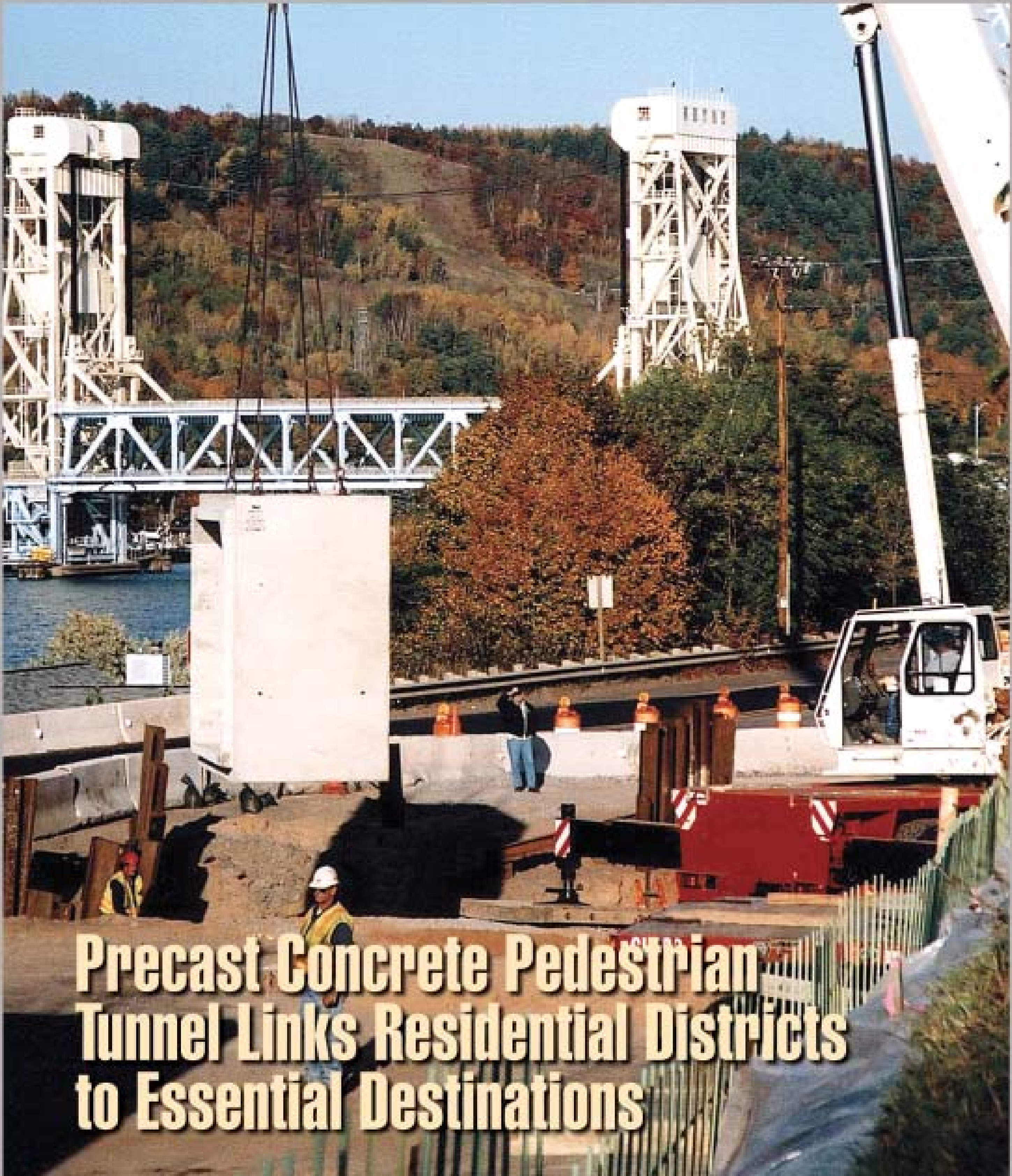
CONCRETE PIPE NEWS

The Magazine of the American Concrete Pipe Association



Precast Concrete Pedestrian Tunnel Links Residential Districts to Essential Destinations

This issue:

Volume 58, Number 1
Winter 2006

Concrete Pipe News is published four times each year by the American Concrete Pipe Association. It is designed to provide information on the use and installation of precast concrete pipe products for a wide variety of applications, including drainage and pollution control systems. Industry technology, research and trends are also important subjects of the publication. Readers include engineers, specifiers, public works officials, contractors, suppliers, vendors and members of the American Concrete Pipe Association.

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American **Concrete Pipe** Association

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This feature article is dedicated to the memory of Esther Kloet

Esther served 55 years with U.P. Concrete Pipe Co., first as a partner of her husband and the late founder, John P. Kloet, and then as family matriarch.

She proudly watched as her son and protégés of her husband became the management of U.P. Pipe. She provided nurturing and guidance for her family and company personnel. Her sense of business and personal ethics, that she unabashedly demanded, was shaped by her devotion to Christian ideals.

Precast concrete box section for pedestrian tunnel lowered into position.

Photo: John Kloet, Upper Peninsula (U.P.) Concrete Pipe Co.

editorial

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

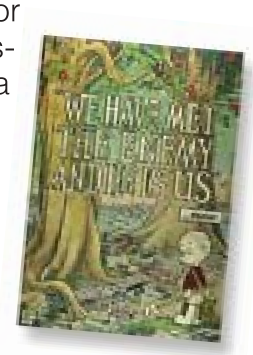
BEHOLD THE PROFESSIONAL ENGINEER

It has been said many times that the end results of engineering are the most visible of all the learned professions. Transportation networks comprised of roads, railways and airports safely transport millions of people daily within and between urban centers of the nation. Millions more live in safe and healthy communities because of massive networks of sewers and watermains. Considering the entire above ground infrastructure and buried lifelines designed by engineers that go unnoticed in our daily lives, it is ironic that engineering has become known as the invisible profession.

Professional engineers who design, specify or regulate buried pipelines for sanitary and storm sewers face hard choices when confronted with limited time and resources to complete projects. This is when professionalism shines its brightest where engineers stand on their principles and code of ethics to make the right choice. Occasionally, codes of ethics pass as rules of conduct intended for passive observance. But as The World Federation of Engineering notes, "A code of professional ethics is more than a minimum standard of conduct; rather, it is a set of principles which should guide professionals in their daily work."

The issue of who should take responsibility when things go wrong is becoming a central concern for the engineering profession. The trend toward criminal prosecutions and an increase in civil law claims threatens the ability of the profession to hold paramount the safety, health and welfare of the public. The American Concrete Pipe Association has long recognized the need for due diligence when it comes to specifying, designing and observing the installation of buried storm and sanitary sewer systems and culverts. It has documented many cases where an inappropriate pipe material was selected and installed for a particular application. Recent premature culvert failures in many states have underscored the need for professional engineers to reevaluate what they are being asked to do.

The ACPA is taking a message to specifiers, regulators and designers in a series of national ads. The ad, *Stand On Your Principles* is directed at professionals who may be working in the private sector, municipal offices or government agencies. It evokes their duty to not lower the bar on quality and performance of sanitary, storm sewers and culverts. *Be Rigid In Your Principles* broadens its audience to include anyone involved in specifying or using concrete pipe, as it speaks to the inherent properties of concrete pipe, which makes it an easy product to install with low risk and low liability. The third ad, "As A Matter of Principle," urges the reader to think long-term and not be short sighted when it comes to specifying products and materials for sanitary and storm sewer systems that are designed to last a lifetime.



The time is right for engineers to take a hard look at the real cause of the threats to our profession. As Pogo said, *"We Have Met the Enemy and He Is Us."*

and now you know...

5% Deflection Testing of HDPE Culvert and Sewer Systems is Quickly Becoming the Norm

High-density polyethylene (HDPE) pipe is a flexible pipe which relies upon stiffness, rather than strength, for its structural integrity. Under soil load, the pipe deflects, developing passive soil support at the sides of the pipe. The load carrying capacity of this flexible pipe is derived almost exclusively from the strength of the embedment soil. An installation using HDPE pipe should be considered as a soil-pipe system. Such a system derives its structural integrity from the soil envelope. A poorly constructed soil envelope can produce deflections that lead to premature system failure.

For decades, the concrete pipe industry has been offering research, evidence and cases that support the call by specifiers and regulators, and even the HDPE industry, for deflection testing of HDPE installations. Debate has intensified over recent years about when in situ deflection testing of HDPE systems should occur, and what the minimum allowable deflection before the installation is considered a liability or risk. It now appears that the debate is ending, as more specifications are making deflection testing mandatory and insisting that the test be performed no earlier than 30 days after completion of installation.

The closing of the gap between the recognition for deflection testing and recent developments where regulating bodies have zeroed in on the 5% limit, can be partially credited to significant advances in equipment used for in situ pipe inspections. Laser video imaging is an extremely accurate technology for determining not only the degree of deflection of HDPE pipe installations, but also the most probable causes of structural deficiencies caused by over deflection. The light ring of the apparatus is projected a set distance away from the camera so that the entire ring is in view by the trailing inspection camera. Deflection is measured by using a computer and software. Where deflection is evident, the image is captured and software is used to measure the deflection occurring at the point of the projected laser ring.

The inspector sets the required intervals for the deflection measurements to be taken. If higher deflections are observed between the set intervals, then additional measurements are taken at these locations. Deflection measurements are taken in the vertical and horizontal positions unless other deflection is noted by the video inspection. Some systems allow for continuous monitoring for deflection in which a preset deflection value such as 5% can be entered into the program.

The laser ring shows areas of significant HDPE pipe distortion such as crown flattening and vertical and horizontal deflection that may or may not be observed or captured by video inspection alone. The technology can also pick up vertical and horizontal joint offsets and cracking.

The American Association of State Highway and Transportation Officials (AASHTO) is a strong voice in providing clear policy for deflection testing of HDPE systems. AASHTO calls for replacement of the pipe if deflection exceeds 7.5% of the inside diameter. Some State Departments of Transportation and Provincial Ministries of Transportation (Canada) have already required deflection testing with specifications more restrictive than those included in the AASHTO provisions.

The 2005 AASHTO Bridge Committee - LRFD Bridge Construction Specifications: Section 30 has set these minimum requirements:

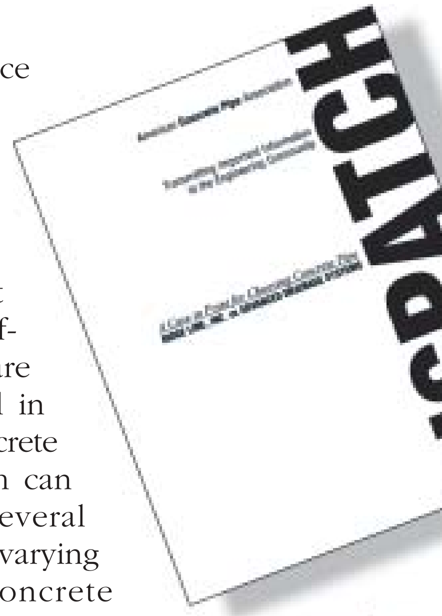
- For locations *where pipe deflection exceeds 5 percent* of the inside diameter, an evaluation shall be conducted by the Contractor and submitted to the Engineer for review and approval considering the severity of the deflection, structural integrity, environmental conditions, and the design service life of the pipe. Pipe *remediation or replacement* shall be required for locations where the evaluation finds that the deflection could be problematic.

- For locations where pipe deflection exceeds 7.5 percent of the inside diameter, remediation or replacement of the pipe is required. Pipes shall be checked for deflection using a mandrel or any other device approved by the Engineer or where direct measurements are made, a measurement shall be taken once every 10.0 ft. (3 m) for the length of the pipe.
- At least 10 percent of the total project footage on the project shall be randomly selected by the Engineer and inspected for deflection.
- Soil consolidation continues with time after installation of the pipe. While 30 days will not encompass the time frame for complete consolidation of the soil surrounding the pipe, it is intended to give sufficient time to observe some of the effects that this consolidation will have.

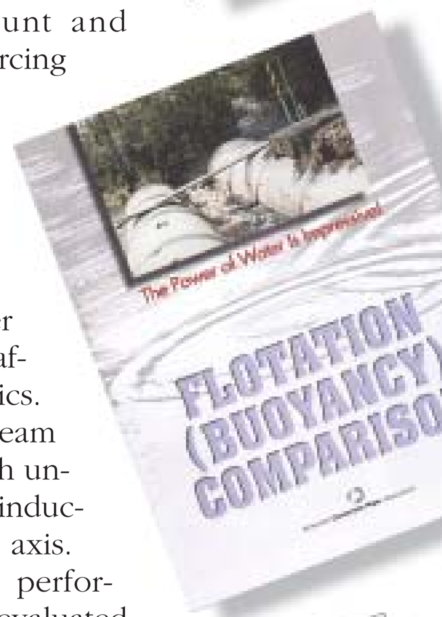
The American Concrete Pipe Association has published a “You Should Know” Bulletin #136 that details the specifications in several states and provinces. The bulletin is available for download at www.concrete-pipe.org.

Installed HDPE experiences creep and stress relaxation (deflection). Although polyethylene is an inert material when not under stress (load), it is susceptible to attack from some chemicals while under stress. Examples of these chemicals are strong oxidizing acids, oils, alcohols, and polar reagents such as detergents. Slight scratches or wear from handling and abrasion can be critical to thin-walled HDPE pipe.

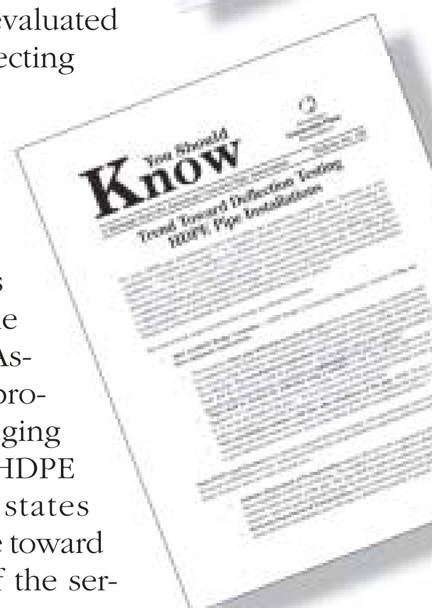
The inherent strength of concrete pipe increases with an increase in pipe diameter for the same strength classification. Conversely, pipe stiffness often decreases as pipe diameter increases with most polyethylene products.



The primary difference between concrete pipe and high-density polyethylene pipe is one of structural strength versus pipe stiffness. These terms are not interchangeable. The differences between them are significant and technical in nature. Furthermore, concrete pipe’s structural strength can be adjusted through several means, most notably by varying the wall thickness, concrete strength, or the amount and geometrics of the reinforcing steel.



As a rigid pipe, concrete pipe has high beam strength and can be pushed to proper grade. Only concrete pipe can bridge over uneven bedding without affecting the pipe hydraulics. Flexible pipe has a low beam stiffness and deflects with uneven bedding, thereby inducing strain along the pipe axis.



Claims of long-term performance of HDPE can be evaluated to a large degree by inspecting HDPE pipe systems installed several years ago on projects with long-term design lives. Now that allowable deflection of HDPE pipe is widely accepted as 5%, the American Concrete Pipe Association has initiated a program of laser video imaging and documentation of HDPE pipelines in selected states through 2006 to contribute toward a better understanding of the service life of HDPE pipe systems.

Feature Story

Precast Concrete Pedestrian Tunnel Links Residential Districts to Essential Destinations

By Mary Vermeer • Upper Peninsula (U.P.) Concrete Pipe Co. • 906-786-0934

Houghton, Michigan is one of America's most walkable cities. An impediment to residents who walk to Michigan Technological University (MTU), destinations in the downtown area, or the city's waterfront recreational attractions was the M-26 highway and increased traffic caused by development. Residents and visitors now benefit from a safer and more pleasant means of accessing these destinations because of a pedestrian and bicycle tunnel constructed with precast concrete box sections manufactured by Upper Peninsula Concrete Pipe Co. The project was dedicated in the spring of 2005.

The M-26 pedestrian tunnel connects the Houghton waterfront with the west and central Houghton residential districts. The tunnel is under M-26 and connects Houghton's waterfront park with residential areas on the other side of the increasingly busy highway. The 12 foot x 9 foot tunnel has a length of 160 feet. It was a collaborative effort between the Michigan Department of Transportation (MDOT), West Houghton Community Partnership, and the City of Houghton.

M-26 is a major artery in the northern portion of the Upper Peninsula of Michigan. It joins US-41 in Houghton to provide the only vehicle access onto the Keweenaw Peninsula via the Houghton lift bridge, recognizable to the thousands of engineers that have graduated from Michigan Technological University. Michigan Tech is recognized as a national and international leader in engineering, science, and business programs. For those seeking to enjoy the waterfront development with its park and beaches, it has been a dangerous and frustrating barrier to pedestrian access. The western side of the city has about 80 percent of the permanent population. When the West Houghton Neighborhood Association brought their access concerns to the City Manager, Scott MacInnes, he looked for ways to resolve the issue and consulted with Andy Sikkema, P.E., and Manager of MDOT's Ishpeming Transportation Service Center.

M-26 was built in 1980 and at that time there was little reason to be concerned with pedestrian access to the canal area. With the completion of the waterfront development project in

1994, the situation changed. According to Jeff Moyle, of Moyle Construction of Houghton (contractor for the pedestrian tunnel), the waterfront is Houghton's best asset. When MDOT began looking at improving M-26 at the western approach to the city with the addition of a lane, Sikkema worked with MacInnes and West Houghton residents to develop a solution to their access safety concerns. Sikkema proposed a precast concrete box culvert designed as a pedestrian and bicycle tunnel. This solution had been used successfully in other recreational projects, such as the creation of an under-the-road snowmobile tunnel in the eastern region of the Upper Peninsula.

"We are pleased we were able to include the tunnel as part of our major reconstruction of the area. It gave us the opportunity to do more than the usual roads and bridges, cars and trucks." said Sikkema. "It's been a good collaborative effort, everyone working together." According to MDOT engineer, Alan Anderson, P.E., "This is our first pedestrian tunnel project and we are very happy with the results."

Wilcox Professional Services of Cadillac, Michigan, undertook the design of the tunnel. Following a cost comparison, Wilcox concurred with Sikkema that precast provided a less expensive option compared to cast-in-place. Connie Houk, P.E. of Wilcox commented, "The biggest design issues were the retaining wall, the pedestrian ramp, and the stairs that were all used to lower the grade so that the tunnel could be accessed by all." Aesthetically, the terrain was enhanced using texture and color on the concrete walls and landscaping at the tunnel entrance.

Greg Kingstrom, P.E., of U.P. Engineers and Architects, conducted an additional structural analysis on the box culvert with the primary design parameters being the traffic loading condition, the depth of soil cover and soil conditions. Special analysis was required because the dimensions of the box sections were not a standard size recognized by ASTM C1433. Also, specially designed traffic barriers were to be attached to the end box sections. The slope of the tunnel and the super-elevated road surface above resulted in varying depth of soil cover along the length of the tunnel requiring multiple design analyses. Additionally, the skew of the culvert with respect to the road centerline caused an increased span length that had to be accommodated in the design. The analysis was completed using a precast concrete design program and checked using methods detailed in ACI 318-02.

According to Sikkema, the biggest problem in constructing this project was traffic flow. Use of 27 precast concrete box segments allowed construction without total road closures. Roadwork was managed by part-width construction. Temporary sheeting and a temporary mechanically stabilized earth wall were required to make construction possible. A silty-clay mix sand, underlain by conglomerate bedrock, was indicated by soil borings conducted at the tunnel site.

Pedestrian tunnel constructed with 27 precast concrete box sections.

This conglomerate was very compact, allowing for a relatively high bearing pressure foundation design for the base of the tunnel. Work began in summer of 2003 when the westbound lane was closed and traffic diverted to share the eastbound lanes. U.P. Concrete Pipe Co. delivered the first half of the segments in late September, 2003. Following the completion of the westbound lane, the same construction technique was applied to the eastbound traffic.

All parties mentioned the collaboration needed to meet the short schedule of the project, and the use of precast concrete box sections helped make it possible. According to Kingstrom, there were times when the precast design and the production of tunnel sections nearly coincided.

For nearly 25 years, U.P. Concrete Pipe has been producing precast concrete box sections for culverts for stream beds and storm water. Innovative uses of box sections for pedestrian and bicycle tunnels are exciting applications of traditional products, leading to new markets. In addition to accommodating short construction schedules, precast concrete products require a small construction footprint compared

City of Houghton provided lighting, security cameras and gates for the tunnel.

to cast-in-place projects. Since less on-site space is required for material storage, a more aesthetically pleasing view during construction is possible, as well as reduced environmental impact. Asked whether he could foresee this kind of project in other locations, Moyle replied that he has seen quite a few spots where this would work because "in this terrain (Houghton) it makes so much more sense than a pedestrian overpass."

The city provided lighting, security cameras and gates for the tunnel, which is open from dawn until dusk with 24 hour monitoring by the security camera. Richard Thomas of the Houghton Chamber of Commerce complimented the state for "being willing to work hard" with the residents who were the force behind the project. MacInnes says, "Houghton has been recognized as one of the Nation's most walkable cities and this tunnel will provide even more opportunities for pedestrians in our community."

The $350,000 tunnel was funded by a Federal Enhancement Grant. It was a component of a larger $4.3 million highway reconstruction project. MacInnes gives MDOT credit for spearheading the solution.

Project:	M-26 Pedestrian Tunnel Houghton, Michigan
Owner:	The City of Houghton, Michigan Scott MacInnes, City Manager
Consulting Engineers:	Wilcox Professional Services Cadillac, Michigan Connie Houk, P.E. U.P. Engineer and Architect Houghton, Michigan Greg Kingstrom, P.E.
Contractor:	Moyle Construction Houghton, Michigan Mr. Tom Roberts, Site Representative
Quantities:	160 linear feet of 12 foot x 9 foot precast concrete box sections Joints: internal – butyl trowelable (Easy-Stick by Press Seal Gasket) external – 11inch wide Cadilloc External Pipe Joint (Cadilloc, Inc.)
Producer:	Upper Peninsula Concrete Pipe Company Escanaba, Michigan

Upper Peninsula Concrete Pipe Company (UPCPC) is a manufacturer of concrete pipe, manholes, box culverts, Con/Span® bridges, and related precast products for primarily the underground utility and road building industry in the Upper Peninsula of Michigan. It has been serving the region for over 55 years. UPCPC is also a distributor of construction related materials including, but not limited to water main pipe and fittings, hydrants and valves, geotextile fabrics, construction castings and other products for the underground industry. See www.upconcretepipe.net.

Storm Water Controlled
A Showcase Development Emerges

By Michael Kusch, Director of Technical Marketing,
Sherman-Dixie Concrete Industries, Inc.
615-386-4407

Precast concrete box sections were used to assemble a deep burial box storm sewer designed to accommodate a 100-year storm event and service a major gateway development for the City of Murfreesboro, Tennessee. The 350-acre Murfreesboro Gateway project is a mixed-use development in the Nashville area that is located 1.6 miles from Interstate 24. It is accessed by the new Manson Pike/Medical Center Parkway interchange, which also provides access to Middle Tennessee State University, the home of the Concrete Industry Management (CIM) program that trains future leaders of the concrete industry. The Murfreesboro Gateway master plan includes development of over one million square feet of premier office space, a hospital, conference center and hotel, multi-family residential housing, and limited retail space.

The risk of flooding of the gateway project, partly located in the West Fork Stones River flood plain and new interchange, called for the design of a stormwater management system that would accommodate regional storm events and 100-year storms. The system itself would have to meet the long-term design life of the mixed-use development, and make efficient use of any developable land. The solution to the challenge was a precast concrete box storm sewer. In addition to the box sewer, the lands would be drained by 1,184 feet of 60-inch diameter reinforced concrete pipe. The new stormwater management system would handle much of the drainage from the city-owned property and highway interchange.

Photos: Sherman Dixie Concrete Industries, Inc.

Concrete pipe and precast concrete box sections used for storm water management.

The alignment of the storm sewer ran through variable ground conditions ranging from limestone bedrock to soil deposits located in low-lying areas and sinkholes. Some blasting was required to prepare the trench that occasionally reached a depth of 25 feet. Sherman-Dixie Concrete Industries produced the precast concrete box sections and reinforced concrete pipe used on the project. The structure began with a specially designed safety end treatment installed approximately 2,500 feet upstream from a 9-foot diameter tunnel under the CSX Railroad. In all, Sherman-Dixie supplied 24 feet of 8-foot x 4-foot precast concrete box sections, 900 feet of 8-foot x 7-foot precast concrete box sections, 1,560 feet of 10-foot x 8-foot precast concrete box sections, and 12 feet of 10-foot x 10-foot precast concrete box sections, along with the 60-inch diameter concrete pipe.

Safety protocol was enhanced on the job site and the time required for constructing the structure was reduced, because the project specified precast concrete boxes. Many of the precast box sections were delivered just in time to the site for a crane to offload each section and lower it into position, as required by the installation crew. Since limited onsite storage of box sections was required, as well as the movement of products from a storage area to the trench, the handling of precast concrete products was minimized and the time that people spent within the trench and around the excavation was also kept to a minimum. The entire 2,500-foot length of trench was excavated, precast boxes installed and trench backfilled in only 45 working days. This was an amazing tribute to proper planning, coordinating and communication.

60-inch diameter orifice formed at joint of two precast box sections.

Sherman-Dixie staff made a significant contribution to the success of the project in four ways. First, the products performed as specified and resulted in an easy and safe assembly. All pipe penetration of box sections, including the 9-foot diameter orifice for the railway tunnel were cast at the plant in a controlled environment for easy field connections, eliminating the need for field staff to measure and cut the holes in the field. In addition, all three box transitions were designed and built in single 6-foot pieces. Secondly, Mike Kusch, Director of Technical Marketing, used the BOX-CAR design software available through the American Concrete Pipe Association to design a thin-wall box section for the 8-foot x 7 foot, 10-foot x 8 foot and 10-foot x 10 foot sizes. These designs were presented to Wiser Company (the civil engineering firm). This reduction in concrete provided a competitive edge over conventional poured-in-place installations. The reduced weight of the boxes contributed to savings in transportation costs. Third, supply of the precast boxes was quoted with the crane time. Sherman-Dixie coordinated the delivery of the boxes with the use of the crane for off-loading and placement. A full time representative was onsite to receive deliveries and coordinate the offloading with the installation crew. The contractor was able to concentrate on the installation of the boxes while Sherman-Dixie accommodated the need for the crane. Sherman-Dixie's engineer worked with

Transition from 10-foot x 8-foot precast concrete boxes to 8-foot x 7-foot precast concrete boxes.

Wiser Company and the City of Murfreesboro to design the entire structure. Detailed drawings and laying schedules furnished by Al Hogan, P.E., of Sherman-Dixie were valuable time and coordination tools.

Before construction commenced on the box storm sewer, several pre-installation meetings were held between staff of Sherman-Dixie, CBM, Wiser, and the City. These meetings were key to communicating the expectations of each party. They covered such considerations as overhead and underground utilities, supply delivery routes, foundations and bedding, the lifting device, crane, trackhoe and tools to be used in the trench while installing the sections. At the end of the project, Keith Sears, Senior Project Manager with CBM commented, "I believe this project serves as an example of success due to the professionalism, high standards and hard work exhibited by all parties involved." Construction started June 23, 2003 and finished May 3, 2004. During this period, the box storm sewer and 60-inch diameter reinforced concrete pipe tie ins were installed within six months – nine months ahead of a schedule that the contractor had estimated for a poured-in-place alternate.

Immediate backfill after boxes set.

Project: Manson Pike/Thompson Lane Area Drainage Improvements
Murfreesboro, Tennessee

Owner: The City of Murfreesboro
Ken Hays, P.E., City Engineer
Tom Clark, City Inspector

Consulting Engineer: Wiser Company, LLC
Murfreesboro, Tennessee
Darren Gore, P.E. (Now with Murfreesboro Sewer District.)

Contractor: CBM Enterprises, Inc.
La Vergne, Tennessee
Keith Sears, Senior Project Manager
Craig Cash, Superintendent
Troy Langford, General Superintendent

Subcontractor: Morgan Contracting, Inc.
(Tunnel under railway)
Baker, Florida

Quantities: 12 feet of 10-foot x 10-foot precast concrete box sections
1,560 feet of 10-foot x 8-foot precast concrete box sections
900 feet of 8-foot x 7-foot precast concrete box sections
24 feet of 8-foot x 4-foot precast concrete box sections
1,184 feet of 60-inch Reinforced Concrete Pipe
Three special transition boxes
Eight specials for maintenance access
Two specials for 60-inch diameter Reinforced Concrete Pipe connections
One bend

Producer: Sherman-Dixie Concrete Industries.
Franklin, Tennessee Facility

Sherman-Dixie manufactures and markets precast concrete pipe and precast concrete storm and sanitary sewer structures for market areas in the southeast Unites States. The company has plants located in Hermitage, Chattanooga, Franklin and Knoxville Tennessee, as well as Louisville, Elizabethtown, and Lexington Kentucky, Cullman Alabama, and Dayton Ohio. Its corporate office is located in Nashville, Tennessee. See www.shermandixie.com for details about products and services.

Delivery of the TOTAL Package

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

While manufacturing techniques and testing methods of concrete pipe have evolved slowly over the past century, the production process has changed greatly, partially due to automation. There are many documented installations where concrete pipe is still performing long after the 100-year milestone, even though pipe production in the early decades of the 20th century was a labor intensive process with little quality control. The performance of today's concrete pipe sewers is far superior. Concrete pipe is stronger, with compressive strengths much greater than the specified 4,000 or 5,000 psi. Production facilities now benefit from reduced waste due to more automation and tighter controls in the production process. Based on historical performance, modern standards, quality control, education programs, and automation of the entire production process, concrete pipe will become even more reliable than ever before.

Automation in precast concrete pipe production traditionally focused on the production plants and rarely on all elements of the production process from communications and record keeping to the quality of raw material. Many existing machines, however, have become more efficient with the addition of automated features and computer-controlled guidance. Most new machines arrive on site from the manufacturer fully automated and programmed to integrate with sophisticated supervisory control and data acquisition systems. Automation has spread to the entire production process. A cage machine that automatically adjusts to different sizes, manufactures wire cages for reinforcing. Robots place the cages onto a steel pallet and position the outer form over the cage and pallet. Upon completion of pipe production, automated equipment can place and strip the entire assembly in chambers where they are cured before removal the next day. After curing, many plants have automated procedures for pipe removal, hydrostatic testing, and pipe marking, before storing the pipe for shipping.

Dry cast and packerhead are the manufacturing techniques for producing precast concrete pipe that are most frequently associated with today's advanced production plants. Forms are removed from the pipe (produced with no slump concrete), as soon as the pipe is produced. They are then available for re-use any number of times during the day.

The dry cast process has several variations but all use low frequency-high amplitude vibration to distribute and densely compact the dry mix in the form. Dry cast pipe machines may be either one, two or three station models and these variations can generally cover a size range from 12 inch to 156 inch (300 mm - 4000 mm) in diameter in lay lengths of 8 feet, 12 feet, and 16 feet (2.5 m, 3.5 m, and 5 m). These machines are unique because they can make a wide variety of shapes and types of concrete products such as round pipe, elliptical pipe, arch pipe, pre-bed, boxes, and lined pipe.

The packerhead process uses a device rotating at high speed that forms the interior surface of the pipe. It is drawn up through the exterior form as mix is fed from above the form. The head has rollers or deflectors mounted on the top, which compact the mix. When compaction is complete, the form and pipe are moved to a curing area where the exterior form is removed. Packerhead machines can make round pipe from 6 inches to 84 inches (150 mm - 2100 mm) in diameter and in lengths from 1 foot to 12 feet (0.3 m - 3.5 m).

The transformation of the production process that is rapidly taking place throughout the precast concrete industry focuses on raising the quality, performance and precision of the complete range of products used in a drainage system. In addition to pipe, boxes and manholes, the production plants focus on monolithic pre-benched manhole bases, traditional manhole bases, reinforced and non-reinforced adjustment rings, cones, and catch basins. With precision and consistency of quality in all components of a drainage system, many pipe producers offer *the package deal* to their customers.

Robotic facilities that have emerged from this quiet transformation have their differences. Some pipe production plants are able to run pipe of various sizes at the same time. Others need a system shut down for a speedy change over to a new size. All have the ability to operate 24/7 with the only restraints being market demand and material supply. Producers are able to phase their investment as funds become available for expansion. Facilities are set up with long-term designs with modular plants in mind. As equipment is added, production costs are reduced to the bare minimum where only a handful of highly trained technicians and technologists tend the needs of the robots, and test products for compliance with industry standards and project specifications. Engineers, technologists and technicians of the equipment suppliers (stationed anywhere in the world) are able to monitor production operations in real time by dedicated DSL lines, satellite and cameras to streamline operations and troubleshoot. Since new facilities are highly organized with clean environments (a requirement of sensitive electronic equipment), the workplace has become much safer and healthier for employees.

Educating people about automation of the production process that results in high performance products, improved quality, and a safe environment is a goal of the American Concrete Pipe Association. The ACPA hosts well over 250 industry professionals each year at the Production Short Course School held in late February in conjunction with the MCPX Show. Attendees of the production school take courses in production, safety, quality, leadership and management. ACPA also holds a Concrete Pipe University (CPU) that covers quality control procedures and optimization of pipe production. Topics include materials, mix designs, finishing and product testing.

ACPA assists members in improving quality through its Q-Cast Plant Certification Program that assures conformance to industry standards through an annual unannounced audit by a third party firm specializing in materials engineering.

ACPA has the world's best manufacturers of equipment to supply an entire production line. Other associate members service producers with specialized components of the production process. Producer members of the ACPA encourage tours of their facilities to showcase machines, products, operations, management, safety and control systems. Equipment manufacturers have showrooms and often display specialized equipment at major shows such as MCPX and Bauma. If you wish to request a plant tour, visit the ACPA Web site at www.concrete-pipe.org and complete the "Request a Seminar" form located in the "What's New" section.

Recent progress in the quality and performance of reinforced concrete pipe is largely due to advanced equipment technology and product development by the world's leading pipe equipment manufacturers and pipe component suppliers. The will of concrete pipe producers to remain competitive and supply the market with high performance pipe has resulted with the ability to delivery a total precast concrete storm or sanitary sewer structure.

Photo credit: Kelly Lloyd, Hanson Pipe & Products, Inc.

By Kelley Lloyd
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Precast Concrete Boxes and Pipe Solve Flooding Problem on University Campus

Chartered in 1856, Auburn University (AU) is home to 21,550 students, 1,100 faculty, and more than 50 major academic buildings. The University employs 5,259 people of which 4,323 are full-time. It is estimated that 3,700 full-time employees work in the core area of the campus. For decades, chronic flooding in a part of the University's beautiful 1,900-acre facility disrupted campus life and business. Buildings in low-lying areas were affected, as well as parking lots where there were occasional pavement collapses due to problems attributed to underlying corrugated metal storm sewers.

Campus officials realized that the corrugated metal storm sewers needed replacement and that the system needed upgrading. This included rerouting of old storm drains, and the addition of new lines feeding into the basin. Dubbed *The Jordan-Hare Basin Storm Sewer* project, the new system had to be in place before the construction of new buildings in the basin, repair of existing buildings in the areas prone to flooding, or construction along the alignment of a new storm sewer.

The Jordan-Hare Basin Storm Sewer was designed to service more than the problematic areas of AU's campus. A neighborhood north of campus between Magnolia and Glenn Avenues changed over time from small houses on tree-covered lots to apartment complexes with paved parking lots. Vegetated areas that once slowed storm water runoff disappeared. Consequently, the volume of runoff from the neighborhood began to surcharge the existing storm sewer system of the campus during heavy rain events.

A concrete storm sewer tunnel beneath the campus was considered and determined to be too costly. Paul B. Krebs and Associates, Inc. (architects and engineers), came up with the solution to build a precast concrete box storm water detention system that included a concrete pipe outfall. Sediment removal and maintenance were considered in the design, resulting in several large precast sediment removal boxes as well as a ventilation system to provide a safe environment during periodic clean out. The detention system would support portions of a problematic parking lot and the concrete pipe storm sewer would pass through Jordan-Hare Stadium by tunnel and open cut construction. Scheduling and coordination were key components on the project because the detention basins were located in the congested area of the campus. Sherman Concrete Pipe Co. (now Hanson Pipe & Products, Inc.) was contracted to supply the box sections and pipe from their facility in Birmingham, Alabama.

Storm water detention system constructed with precast concrete boxes.

Jordan-Hare Stadium was constructed in 1939 seating 7,500 and called Auburn Stadium. In 1949, the seating capacity was increased to 21,500 and the stadium was renamed Cliff Hare Stadium, in honor of Clifford Leroy Hare, a member of Auburn's first football team, president of the old Southern Conference and longtime Chairman of Auburn's Faculty Athletic Committee. The stadium went through a series of additions, and in 1973 was renamed Jordan-Hare Stadium honoring Auburn's all-time winning football coach Ralph "Shug" Jordan. The stadium went through additional redesigns to its current capacity of 85,612.

The project was constructed in two phases. Phase I started in early 2004 with construction of two underground detention systems comprised of cells of precast concrete box sections to intercept storm water from Magnolia Avenue. The detention system would release the storm water gradually into concrete pipe that extends to the drainage basin at Biggio Drive. One detention system consisted of 1,134 feet of 10-foot x 10-foot precast concrete box sections designed to hold 111,132 cubic feet of storm water. The other storage cell was 1,988 feet of 10-foot x 8-foot precast concrete box sections with a volume of 155,064 cubic feet. The cell footprint measured approximately 250 feet by 60 feet. Both were approximately 10 feet deep, with the top of the boxes at least five feet below the surface. Precast box sections were chosen over a poured in place structure because the installation would have less impact on vehicular and pedestrian traffic, and the cost of the product was competitive. The low bidder on this $8 million phase was Rast Construction, Inc. of Birmingham, Alabama.

Phase II was the construction of the concrete pipeline that commenced in late 2004. Construction included replacing deteriorating drainage pipes in some sections, rerouting some lines, adding others and extending the underground system along Biggio Drive to Samford Avenue. Construction of a new 48-inch concrete pipeline presented its own challenges, as this was the portion with an alignment through the football stadium. A tunneling process was used on both ends of Jordan-Hare Stadium but the pipe was laid open cut along the sideline of the football field. Scheduling was crucial on this phase to assure that the project would be completed by the beginning of football season. Russo Corp. of Birmingham, Alabama was the contractor on this $2 million phase.

Auburn University now has a storm water management system that will age as well as the university has over its 150-year history. It is important for major facilities to be built with products and materials that will last. The huge costs of construction and liability associated with buried infrastructure are reasons enough to think hard about making the right choice.

Project:	The Jordan-Hare Basin Storm Sewer Auburn, Alabama
Owners:	Auburn University/City of Auburn Auburn, Alabama
Architect/ Engineer:	Paul B. Krebs and Associates, Inc. Birmingham, Alabama Nina Williams
Contractor:	Rast Construction, Inc. (Detention Tanks) Birmingham, Alabama. Dan Rast Brad Stevens Bryant Vincent
Contractor:	Russo Corp. (Concrete Pipe) Birmingham, Alabama. Keith Brown Tommy Smith
Producer:	Hanson Pipe & Products, Inc. Birmingham, Alabama Kelley Lloyd, Sales Manager/Engineer
Quantities:	1,134 feet of 10-foot x 10-foot precast concrete box sections. 1,988 feet of 10-foot x 8-foot precast concrete box sections. 482 feet of 8-foot x 6-foot precast concrete box sections 1,100 feet of 48-inch Class 3 reinforced concrete pipe.

Hanson Pipe & Products, Inc. is a diversified manufacturer of concrete pipe and a variety of supporting products including manholes, drainage structures, box culverts, bridge components, retaining walls and concrete block. Its plant locations throughout North America enable the company to serve the most rapidly growing parts of the U.S. and Canada. Hanson is an international building materials company. It is one of the world's largest producers of construction aggregates, and concrete gravity and pressure pipe, precast concrete, and is the leading manufacturer of facing bricks in Europe. See www.hansonconcreteproducts.com for details.

Strength Through Learning at Fall Short Course School

The 8th Fall Short Course School (FSCS) attracted 340 attendees including 81 guests – the best attendance yet. The school is an informative three-day educational and networking event presented annually. Presenters included association members, state and region concrete pipe association executives and highly qualified industry experts. Three tracks of concurrent sessions were offered including sales and marketing, basic engineering, and advanced engineering.

The impact of the Fall Short Course School will continue to influence attendees for some time, as all session PowerPoint presentations will be mailed to attendees for their own use as reminders of the knowledge shared throughout the school. Many listened to special guest speaker, Pat Galloway, P.E., and former President of the ASCE who spoke about the ramifications of specifying pipe materials that fail to perform as specified. She left delegates with much to think about.

Within a few months, details of the 9th Fall Short Course School will be announced, allowing time for Association members and their guests to plan ahead.

The location of the event will change. Las Vegas has been a great venue to get the Fall Short Course School rolling as an annual industry-wide event, but it is time to change to make it easier for more guests to take advantage of this unique learning experience.

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