

CONCRETE PIPE NEWS



The Magazine of the
American **Concrete Pipe** Association

Precast Box Storm Water Vault Meets Environmental and Structural Design Challenges



Aerial view of 65,000 cubic-foot vault system.



This issue:

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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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ACPA's annual training program is conducted by industry experts from November 7 to 9 in Las Vegas. The program covers a variety of topics related to the design, specifications and installation of concrete pipe. Each year the program attracts engineers, consultants, designers and specifiers of concrete pipe products. CEUs and professional development hours are offered. Space is limited and registration closes October 12, 2005. Visit www.concrete-pipe.org for details.

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A major rainfall on June 16, 2004, saturated soils from a previous storm, and a failing corrugated metal pipe (CMP) storm sewer led to the collapse of a parking lot near a major intersection on Cleveland Avenue in Sioux Falls, South Dakota. The storm sewer was replaced with 430 feet of 84-inch diameter Class 3 reinforced concrete pipe, along with two 84-inch diameter precast concrete apron sections.

Precast concrete box storm water vault system covering 1.4 acres installed in lieu of traditional storm water pond.



Cover Photos: Rinker Materials – Hydro Conduit Division

president's message

John J. Duffy



Farewell to Friends and Colleagues

The first assignment that I was given when I joined the staff of the American Concrete Pipe Association in 1974 was to edit *Concrete Pipe News*. It was a difficult job then, and to this day *CP News* demands a great deal of effort from staff and industry representatives who author and peer review its content.

I believe that the benefits of publishing *CP News* far outweigh the effort that is required to publish this outstanding publication. It affords the concrete pipe industry an opportunity to reach thousands of infrastructure designers, specifiers, contractors and elected representatives across the United States and Canada to showcase the many applications of precast concrete pipe, boxes and manholes.

Over the last 31 years, articles have covered every facet of precast concrete pipe. Some of the more memorable have been the article on a 17-foot diameter storm drain in Michigan, articles on the research initiative of the 1970s that led to standard installations and direct design, articles on jacking concrete pipe and an article on recharging ground water using concrete pipe with an opening cast in the wall.

This is my last message for publication in *Concrete Pipe News*, as I am retiring this summer. I am proud of the volumes of some 125 issues of *Concrete Pipe News* that have been published since 1974.

I will be returning to Virginia where most of my family live. There, I will be redirecting my efforts to lower my golf handicap. This should be easy as I am starting at a 30. The balance of my time will be spent enjoying all that Chesapeake Bay has to offer.

I extend my sincerest gratitude to all who have generously volunteered their time and energy to secure interesting photos and write great stories, and to staff for its dedication in delivering the magazine in a timely manner. ☺

Editor's Note

John has served longer than any other concrete pipe industry state or provincial association executive in North America, since joining the ACPA in 1974. Before then, John worked as a project engineer in the Arlington, Virginia, Public Works Department and as a member of the Montgomery County, Maryland, Engineering Department.

John's first term with ACPA was 1974 through 1993. He served as Deputy Director of Technical Services and Vice President of Marketing Services in the 1980s when the Association's marketing efforts were initiated. He also served as Executive Vice President of the Association.

He left the American Concrete Pipe Association in 1993 to work in biotechnology, and was primarily involved with bio-remediation of petroleum products.

In 1998, when the ACPA was searching for a staff President to oversee all operations of the Association, John returned and served for the best part of eight years. In total, John has served the concrete pipe industry and its members in the United States, Canada and other countries for over 26 years.

John is a 1968 civil engineering graduate of the Catholic University of America in Washington, D.C. ☺

and now you know...

Concrete Pipe Is the Only Pipe That Gets Stronger With Age

by Ken Kienow, P.E.
 President, Kienow Associates, Inc.
 Civil, Environmental, Forensic, Geotechnical and
 Pipeline Engineers
 Big Bear Lake, California
 909-866-8636

Concrete pipe is the only pipe that gets stronger as it ages. Increasing strength with age continues as long as any unhydrated cement is still present, provided the concrete remains moist, and the concrete temperature remains favorable. When the temperature of the concrete drops below freezing, hydration and strength gain virtually stops.¹ Once temperatures rise above freezing, however, that hydration can resume. Considering that sanitary sewer pipe is generally wet and never subject to freezing temperatures, curing continues indefinitely. The principal factors affecting strength are water-cement ratio and age, or the extent to which hydration has progressed.² The lower the water-cement ratio, the stronger the concrete.

The binding quality of portland cement paste is due to the chemical reaction between cement and water, called hydration³. Cement paste is composed of water and extremely fine cement particles. Factors that influence the rate of hydration include fineness of cement grinding, admixtures, if any, water and temperature.

On occasion, where high bed loads and steep slopes exist, hydraulic structures may be subjected to abrasion. Results indicate that abrasion resistance is closely related to the compressive strength of concrete. High strength concrete has more resistance to

abrasion than does lower strength concrete. Since compressive strength depends on water-cement ratio and curing, low water-cement ratio concrete pipe provides superior abrasion resistance.

Reinforced concrete pipe is designed to crack and then undergoes a chemical reaction called autogenous healing. Cracking under load indicates that the tensile stresses have been transferred to the reinforcing steel. A 0.01-inch wide crack does not indicate structural distress and is not harmful. Cracks that are much wider than 0.01-inch may be sealed to ensure protection of the reinforcing steel. An exception occurs with pipe manufactured with greater than one inch cover over the reinforcing steel. In these cases acceptable crack width should be increased.

Autogenous healing is common when the buried pipe is in the presence of moisture, either on the soil side or inside of the pipe itself. These cracks, when healed autogenously, are impermeable and stronger than the original concrete. One of the reasons is that the concrete pipe seals the crack with calcium carbonate crystals. These calcium carbonate crystals are formed when the carbon dioxide in the surrounding soil, air and water carbonates the free calcium oxide in the cement and the calcium hydroxide liberated by the hydration of the tricalcium silicate of the cement.



The first documented discovery of autogenous healing was by the French Academy of Science in 1836. Since then, there have been numerous examples where cracks in concrete have been repaired naturally by moisture reactivating the hydration process of the cement in the concrete.

In most environments, concrete pipe continues to cure at a slower rate than the rate set during production of the pipe. Tests on old pipe discovered during reconstruction

projects, or tested under circumstances decades later, repeatedly confirm that the strength of concrete pipe increases as time passes.

The American Society of Civil Engineers (ASCE) Pipeline Division's International Conference (What's on the Horizon, theme) on Pipeline Engineering and Construction was held from August 1 through 4, 2004, in San Diego, California. A concrete pipe evaluation paper was given by Kienow Associates, Inc. that detailed the compressive and D-Load strength of reinforced concrete pipe that had been recovered and tested for strength. Following are the data presented at the conference.

California

GETTING OLDER AND BETTER SINCE 1946

Spec. 0.01-inch Crack D-Load	Test 0.01-inch Crack D-Load	Required Ultimate D-Load	Test Ultimate D-Load
1800	4489	2700	No Test
1800	4399	2700	4794
1850	3575	2775	4426
2000	4588	3000	4875
2000	5722	3000	No Test
2500	8055	3750	No Test
2500	8375	3750	8934

Los Angeles County sanitary 27-inch unlined reinforced concrete pipe sewer installed 1946, tested 2002 ±.

The 27" pipe was recovered from a landslide that took out 700 feet of 27-inch RCP belonging to LA County Sanitation Districts.

Arizona

REINFORCED CONCRETE PIPE - 15 YEARS OLD
Concrete Compressive Strength More Than Doubled in 16 Years

Core I.D.	Spec. fc psi	Test fc psi	Alkalinity A	Az Life Factor
A Flowline	6000	14,730	0.319	0.66
B Flowline	6000	14,560	0.309	0.62
E Crown	6000	11,920	0.330	0.62
E Crown	6000	12,720	0.308	0.54

Phoenix Salt River Outfall 69-inch RCP near 40th Street installed 1965, tested 05/16/1980, 0.21 inch loss at crown of pipe.

The D-Load strength of the 27-inch tripled in 56 years in service.

The 69-inch unlined RCP was washed out by the Salt River Flood of 1980 near the east end of the Sky Harbor runway.

REINFORCED CONCRETE PIPE AFTER 16 YEARS

Core #	Spec. fc psi	Test fc psi	Steel Cover	Alkalinity A	Az (Inches) CaCO3
C Crown	6000	8620	2.75 inches clear	0.967	2.66
C Crown	6000	9080	2.50 inches clear	0.975	2.44

Core tests on 48-inch RCP at Southern Avenue interceptor (corner of Priest Road and Southern Avenue), Tempe, Arizona, installed in 1964 and tested 05/19/1980, minimum specification "A" of 0.80, limestone aggregates.

The Az or "Life Factor" is a direct measure of the corrosion resistance of the concrete that is protecting the steel from corrosion. The 48-inch Tempe RCP (produced with 100% limestone aggregates) has four times the corrosion resistance of the 69-inch RCP from 40th St. (produced with limestone sand and granitic rock). Tests were done in May, 1980. The 48-inch RCP from Southern Ave/Priest Road was cored when the top 3-foot x 4-foot section was cut out of the pipe to add a manhole or structure in 1980. The top was trucked to Hydro Conduit's plant at 43rd Ave and Buckeye Road in Phoenix and cored and tested by Engineers Testing Labs.

Viewing a videotape of the inside of the pipe gives little or no information regarding concrete cover over the steel, strength, corrosion resistance, or life expectancy of the pipe. Pipe inspectors must be aware of the attributes of the pipe material, and cores must be taken to understand fully what they are seeing on tape. Specifiers and pipeline designers must be aware of the performance and durability of reinforced concrete pipe to match service life of products and materials with the design life of projects. ☺

References:

- 1.) Steven H. Kosmatka and William C. Panarese, "Design and Control of Concrete Mixtures", Thirteenth Edition, Portland Cement Association, 1988, p. 4
- 2.) Ibid, p. 5
- 3.) Ibid, p. 3

Feature Story



Photos: Rinker Materials – Hydro Conduit Division

by Jeffery A. Hite, Rinker Materials - Hydro Conduit Division, Plant City, Florida
Mark Pirrello, P.E., Moffatt & Nichol, Tampa, Florida
813-220-4076

Engineers sometimes face a regulatory challenge when designing systems to treat storm water before it is released into water bodies. When this challenge is coupled with the system capacity requirements of a densely populated development, the use of storm water ponds for treatment is not always desirable, or feasible. The Westshore Yacht Club, located in historic South Tampa, presented such a challenge. Developed by WCI Communities Inc., the yacht club is a premier waterfront community offering residents the splendors of waterfront living without sacrificing the conveniences of city life. It consists of 500 residential units including town houses, single-family lots, and residential apartment towers. A 246-slip marina

and yacht club put the finishing touches on this impressive development. The regulatory permits for the development required that the first inch of storm water runoff be treated prior to discharge into Old Tampa Bay.

Precast concrete retention and/or detention systems are a viable alternative to storm water ponds. On this project, the engineer recommended a precast concrete system over cast-in-place system due largely to final grade limitations, water table concerns, and overall reduced construction costs. Other common benefits of using precast systems include immediate backfilling that results in faster installation, and a reduction in cost for traffic control and project management.

Frequently, precast concrete box systems are compared to cheaper vault systems constructed of plastic or metal pipes and chambers. Such a comparison almost always favors precast concrete for a variety of reasons. These include structural integrity with minimal or no cover, a greater service life, and reduced in-

“We proposed a precast system given the height limitation imposed on the structure which would have made it more difficult to construct other vault systems, including a cast-in-place system. In addition, the elevated water table would have required additional dewatering. It was anticipated that both issues would have resulted in a

Environmental and Structural Design Challenges

stallation footprints. Precast concrete box structures, as demonstrated on this project, provide a solution that is both environmentally responsible and structurally sound.

The project’s civil engineer, Heidt and Associates, Inc., proposed a vault system in lieu of traditional ponds because of the density of the residential units within the 35-acre phase one site. The vault required a storage volume of 65,600 cubic feet. Due to the proximity of the vault system to Old Tampa Bay and finished grade elevation, the total height of the vault could not exceed six feet. The proposed vault would lay directly under the marina parking lot; therefore HS20 live loads were called for in the design.

Heidt and Associates retained the services of Moffatt & Nichol to perform the structural aspects of the vault system. After evaluating several different vault systems, Moffatt & Nichol recommended a detention and vault system constructed of precast concrete boxes and three-sided boxes. Mark Pirrello, P.E., of Moffatt & Nichol noted,

significant increase in the total construction cost.”

The final design consisted of 3,864 feet of 10-foot x 4-foot precast concrete box sections and 256 feet of 10-foot x 4-foot precast concrete three-sided box sections with lids. The vault system was designed assuming no cover. In total, the system now occupies an area of approximately 1.4 acres. The Hydro Conduit Division of Rinker Materials’, Plant City Florida



3,864 feet of 10-foot x 4-foot precast concrete box sections and 256 feet of 10-foot x 4-foot precast concrete three sided box sections with lids.

Facility, produced all of the box sections. According to Tim Jones of Hydro Conduit, 202 of the 515 pieces were special, meaning that they required access holes in the top, equalization holes or pipe inlet holes in the sides, or a bulkhead in one end. The production and supply process went smoothly from the start. Chapman

Feature Story



Three-sided boxes designed to hold a special sand media filter.

Contracting Company of Tampa, Florida started construction of the storm water detention system in January, 2005. Chapman reached substantial completion of the system by May, 2005, and did not encounter any major obstacles during construction.

The three-sided boxes with lids were used

as the treatment vault through the use of a special sand media filter. The regulating agency, Southwest Florida Water Management District, requires that the engineer certify the vault's condition each year. According to Mr. Pirrello, "Inspection and certification for a vault this size will run \$5,000 per year, and every four years the sand media filter will need to be replaced at a cost of approximately \$15,000."

Precast concrete box sections and pipe used in retention/detention applications are becoming increasingly recognized as alternatives to storm water management ponds. The precast concrete vault system in place at The Westshore Yacht Club is designed to function for decades under a planned maintenance program. Engineers weighed the alternatives and specified a material and product that best met physical and regulatory challenges. Residents of the area are left with a healthy and safe environment. ☺

Rinker Materials has been a part of Florida's building and construction industry since 1926, when Marshall E. (Doc) Rinker, Sr. started the company. Rinker Materials is a major supplier of precast concrete pipe, boxes, Stormceptor®, construction materials, aggregates, and ready-mixed concrete throughout the United States. For more information on Rinker Materials-Hydro Conduit, visit www.rinkerhydroconduit.com.

<p>Project: Westshore Yacht Club Storm Water Detention System Tampa, Florida</p> <p>Owners: WCI Communities, Inc. Tampa, Florida</p> <p>Consulting Engineers: Heidt and Associates, Inc. (civil) Tampa, Florida</p> <p>Moffatt & Nichol (structural) Tampa, Florida Mark Pirrello, P.E</p>	<p>Contractor: Chapman Contracting Company Tampa, Florida</p> <p>Producer: Rinker Materials - Hydro Conduit Division Plant City, Florida Jeffery A. Hite</p> <p>Quantities: 3,864 feet of 10-foot x 4-foot precast box sections 256 feet of 10-foot x 4-foot precast three-sided box sections with lids. 202 of the 515 pieces were specials with access holes in the top, equalization holes or pipe inlet holes in the sides, or a bulkhead at one end.</p>
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Photos: Rinker Materials – Sherman-Dixie Concrete Industries, Inc.

Catastrophic Pipe Failures

Continue to Mark the End of Short Service Lives of CMP

by John Simpson
Sherman-Dixie Concrete Industries, Inc.
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Collapse of a twin line of 84-inch diameter corrugated metal storm sewer in Knoxville, Tennessee clearly demonstrates how major cities in the Southeast United States have underground infrastructure on the verge of failure, and the impact that failed infrastructure has on local businesses. Flooding, followed by the catastrophic failure of the line in June 2004, and a series of rainstorms including tropical depression Ivan on September 17, forced many local business owners to close and relocate due to the lengthy delays in reconstructing the sewer and associated roadwork. Collapse of the corrugated metal pipe (CMP) occurred at the intersection of Papermill Road and Kingston Pike.

Papermill Road, running parallel to Interstate 40, is a key arterial road providing access to numerous local retailers and restaurants. The road was shut down for approximately three months.

The CMP structure had lasted 25 years under the parking lot of the Papermill Plaza. At the time of the failure during a heavy rainfall event, the section of the parking lot in front of Knoxville Wholesale Furniture was completely inundated. In addition, several cars in the parking lot in the upstream restaurant of PF Changs were covered by the floodwaters. The storm sewer accommodated runoff from the mall, as well as storm water from heavily developed neighborhoods. Reconstruction was complicated because the collapse occurred on both private and public property. The owner of the mall, CBL Associates and the City of Knoxville had to come to agreement on the scope of the reconstruction project and costs, before the storm sewer could be replaced. There are at least three lawsuits pending and the replacement costs of the storm sewer alone were

\$2,000,000. Unaccounted additional costs include the costs to consumers, the motoring public, lost revenues to merchants and restaurateurs, and the pending lawsuits.

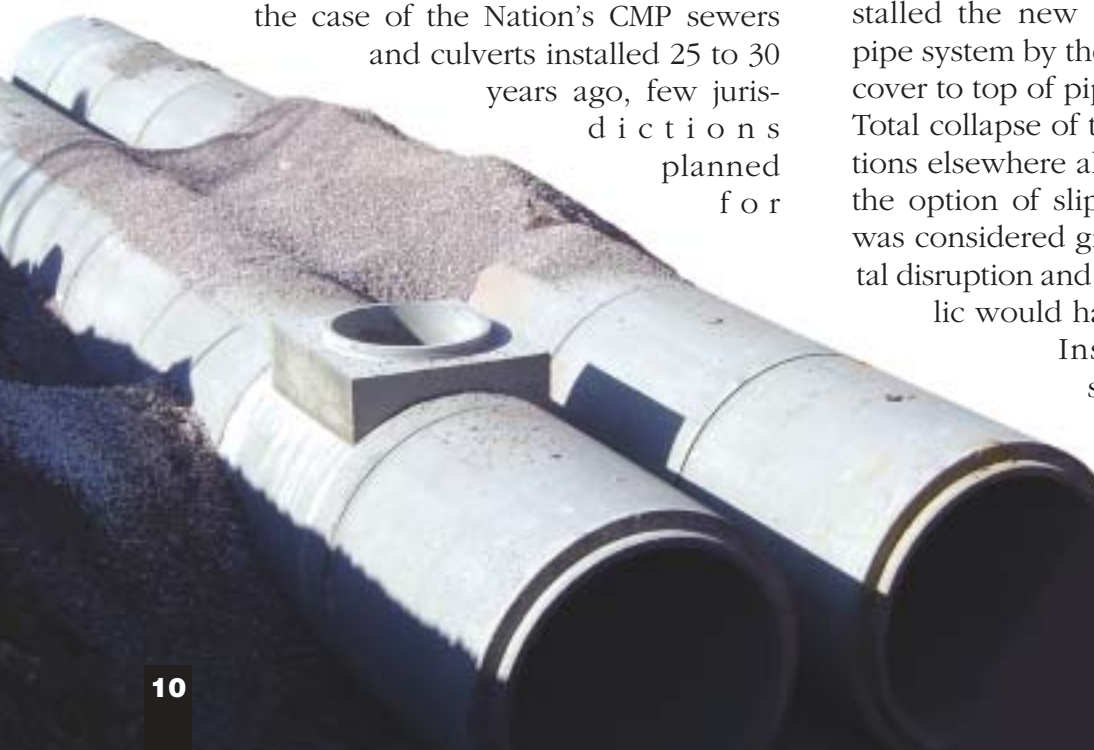
Collapse of the twin CSP sewer system was largely due to performance of pipe material, and matching service life of product with design life of projects. According to published information and current knowledge of various materials used in the production of pipe for storm water, sanitary sewers, and culverts, the service life of CMP manufactured in the 1970s may be expected to last between 25 and 30 years. In spite of protective coatings, metal pipe may oxidize and rust. Debris carried by a storm water event can abrade, dent, and thereby remove coating. Once portions of the coating have been removed, oxidation often begins, followed by pitting and rusting that generally leads to structural deterioration of the galvanized metal pipe invert. This typical environment of a storm sewer makes flexible CMP a poor choice for projects with a design life greater than 20 years. When pipe is considered for deep burials under major roadways, such as many arterial roads in Knoxville, the selection of pipe material and products during the design phase of the project is of utmost importance. Funding for new capital works tend to be more easily budgeted, while maintenance costs are often under-funded or overlooked. In

the case of the Nation's CMP sewers and culverts installed 25 to 30 years ago, few jurisdictions planned for

their replacements, or the costs of replacing the systems in the event of catastrophic failures. Many CMP sewers and culverts are now ready for replacement, despite the longer design life of the projects where they have been installed. When premature failure of long-term projects occurs, public agencies are often the ones left to repair the works, and the question is always posed, "From where does the money come to fix this type of failure?" For projects with long-term designs, replacement with concrete pipe makes good economic and safety sense.

Sherman-Dixie was selected to manufacture the 84-inch reinforced concrete pipe for the replacement section of the sewer. This product will give the owners the long-term durability, strength, and service life that they did not purchase 25 years ago. The City and CBL Associates understand the differences between flexible and rigid pipe, along with the risks and liabilities associated with flexible pipe that can turn out to be very costly. Hindsight suggests that projects incorporating life cycle cost analysis during the design phase, and selection of the appropriate product for the application, are less likely to fail prematurely and have to be replaced. The contractor installed the new reinforced concrete pipe system by the open cut method. Depth of cover to top of pipe ranged from 20 to 25 feet. Total collapse of the CMP and extreme deflections elsewhere along the pipeline, eliminated the option of slip lining the pipe. Slip lining was considered given the depth of cut and total disruption and associated costs that the public would have to endure.

Installation of the concrete sewer began in October and was completed by January 2005. Although Papermill Road



was closed for approximately three months, the failure disrupted businesses in the area for over half a year. This was too long for some to bear and they relocated. No good has come out of this nationally recurring infrastructure problem of unplanned flexible pipe failures or replacements after only a few decades of service. The attraction to save a few thousand dollars on a job of this magnitude 25 years ago by specifying



84-inch diameter RCP with depth of cover to top of pipe ranging from 20 to 25 feet.

ing a flexible pipe, has now turned into a costly situation for many.

Class IV reinforced concrete pipe was specified for the job because of the 20 to 25 feet of fill over the pipe. An alignment change within the system was accomplished by employing 84-inch diameter reinforced concrete pipe bends. Access into the system was provided by precasting saddle tee structure openings on top of the pipe. About 100,000 cubic yards of material were excavated to prepare for the installation of approximately 1,950 feet of twin 84-inch diameter concrete pipe sewer.

Reinforced concrete pipe is a strong and durable product. Unlike a flexible pipe where its strength is derived from the select granular

backfill placed by the contractor, most of the strength of the concrete pipe is in the product itself and arrives at the site on the truck. Its service life will extend far beyond 100 years, as concrete pipe gets stronger over time. Concrete pipe was specified for the replacement of the failed CMP storm sewer because of its inherent strength, durability, and long-term performance. Before the failure, the City of Knoxville changed its specifications requiring that all storm sewer systems located within public rights of way, and drainage easements that the City assumes from private and public sector development, be concrete pipe. This policy continues. ☺

Project: Papermill Plaza and Papermill Road Storm Sewer Replacement
Knoxville, Tennessee

Owners: The City of Knoxville
David Harrell
CBL Associates (Knoxville Mall)
Steve Arnsdorf

Contractor: City of Knoxville
Blalock Construction,
Sevierville, Tennessee
CBL Associates
Brabston Trucking, Knoxville,
Tennessee

Producer: Sherman-Dixie Concrete
Industries, Inc.
John Simpson, P.E.
Knoxville, Tennessee

Quantities: 1,950 feet of 84-inch diameter
Class IV RCP

Sherman-Dixie manufactures and markets precast concrete pipe and precast concrete storm and sanitary sewer structures for market areas in the southeast United 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.

Concrete Pipe

Something To Talk About!

2005 Fall Short Course School

Program Details:

This is a 2 – day training course conducted by industry experts. There will be two general sessions covering environment/sustainability and risk/liability. A variety of breakout sessions will be available through three tracks on the 2nd and 3rd day including topics such as concrete pipe basics, specifications, fill height tables, fiberglass reinforced polymer pipe, installation, oxidation and stress, video inspections, soil structure, jacking and micro tunneling, pipe repair, detention and retention, flotation, DASH software and buried pipe design. Here's the perfect opportunity to learn more about the design, specification and utilization of piping products and to network with peers and industry professionals.

Who Should Attend:

Engineers, consultants, designers, and specifiers of concrete pipe products for sanitary sewer, storm drain and culvert applications.

Continuing Education Credits:

Attendees can earn up to 1.6 CEUs or 13 Professional Development hours based on participation.

Registration and Costs:

Registration and complete agenda online:
www.concrete-pipe.org.

Space is limited; registration closes October 12, 2005.

Costs: \$825 per person for non-members of the ACPA; \$225 for guests when sponsored by an ACPA member company. Includes course materials, group functions, meals and refreshments. Does not include hotel or travel expenses.

"Over the last several years, my job duties have included the difficult issues related to alternative piping products. I believe that the ACPA Short Course was an excellent general overview of issues related to piping products for the design engineer. I found the courses related to durability of concrete pipe and concrete pipe hydraulics extremely useful. Classes discussing life cycle cost analysis and the true cost of culvert failures showed that a lowest cost may not always be the best way to go."

Ray Waters
Assistant - Quality Assurance Supervisor
Clark County Dept. of Public Works
Construction Management Div.



American
Concrete Pipe
Association

CORPORATE MEMBER OF ASCE

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Photos: John Kearns, MSD



Stainless steel helical ramp (drop structure).

Deep Tunnel Built With Reinforced Concrete Pipe Relieves Flooding

by Lex H. Lindholm
Independent Concrete
Pipe Company
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The first phase to the solution of a major flooding problem that had existed in the vicinity of South Grand Boulevard and Bates Street in the City of St. Louis, Missouri since the 1930s has been completed. Railways and roads in the area form depressions that block storm water from draining naturally to the Mississippi River. Sewers were inadequate to carry any storm surcharges and extensive flooding of basements and roadways would occur. Local records suggest that flooding had reached depths of eight feet in recent years, impacting businesses and residents. Publications by Metropolitan St. Louis Sewer District (MSD) note that in 1995 a flash flood turned the area's residential streets into a deep river, nine feet wide. The solution to the problem was a 6,400-foot long, 14.5-foot diameter tunnel that could accommodate a 132-inch diameter reinforced concrete pipeline to carry storm water to an outfall on

the Mississippi River. The final project to construct sewers to bring the stormwater to the tunnel will start

in the summer of 2005.

When the project was called for construction in 2002, only one contractor, Affholder, Inc., of Chesterfield, Missouri (a subsidiary of Insituform Technologies, Inc.), bid the project. The \$32 million bid was in excess of the MSD's estimate which led to a cooperative review of the project by the contractor and MSD engineers to determine an alternate approach to constructing the tunnel. The solution included an increase in size of the reinforced concrete pipe (RCP) that was originally specified from 108-inch diameter to 132-inch diameter pipe. The resizing of the pipe would result in a 40% increased in capacity of the pipeline. In addition, the pipe would be buried at a greater depth (increased from 60 feet to 108 feet) than previously considered to accommodate a single tunnel vertical profile and eliminate a costly tunnel bor-

ing machine (TBM) remobilization at a shaft originally designed for the project. Vertical tunnel shafts were constructed using 84-inch and 90-inch manhole risers, and the outfall to the river was constructed using 80 feet of twin 10-foot x 8-foot box sections. Apart from the increased tunnel bore, pipe size, and precast concrete box outfall, the revised project included relocation and redesign of drop shafts, pump station structure, and horizontal and vertical alignment. The revisions to the project did not reduce the bid price, but did reduce disruption to the daily affairs of the neighborhood during construction, increased the service life of the system, and required the contractor to assume all risk for any changed underground conditions.

Construction of the tunnel began in May 2002, and ended May 2004. Independent Concrete Pipe Company of St. Louis, Missouri supplied precast reinforced concrete pipe, boxes and manhole risers. The 14.5-foot diameter, 190-ton tunnel boring machine remained underground for approximately

one year, moving at a rate of 50 to 100 feet per shift. Workers descended to the tunnel inside a 32-foot diameter shaft and traveled by open train to the TBM. The rotating cutter head of the machine bored the rock at the front of the machine.

Buckets in the head of the machine collected bored rock, which was transported to a point behind the machine and carried to the surface.

Concrete pipe was lowered into the shaft, loaded onto a rail cart and transported to the installation site. All units of 132-inch diameter RCP used for the tunnel liner were shipped in 2003. The pipe weighed 41,000 lbs. each and had a lay length of 7.7 feet in the tunnel. The 90-inch and 84-inch diameter manhole risers were shipped in early 2004.

The Metropolitan Sewer District of St. Louis has a service area of 524 square miles including all 62 square miles of the City of St. Louis. The current population served by MSD is approximately 1.4 million. The Grand and Bates Relief Phase II (Tunnel) project was a major initiative to reduce flooding and sewer backups. The concrete pipe used in the tunnel is the principal structure that will extend its service life. Because of the deep bury requirements and proven performance of reinforced concrete pipe, there were no other options for the liner of the tunnel that could meet the expectations of the MSD and the contractor's project costs. ☺



Inspection of 132-inch diameter RCP used for tunneled storm sewer.

Project:	Grand and Bates Relief Phase II (Tunnel) St. Louis, Missouri
Owner:	Metropolitan St. Louis Sewer District John Kearns, Project Inspector
Consulting Engineers:	TSI Engineering, Inc. St. Louis, Missouri Peter Merten
Contractor:	David Masson & Associates St. Louis Missouri Marc Bucchetti Affholder, Inc. Chesterfield, Missouri Charlie Hodge
Producer:	Independent Concrete Pipe Co., Missouri Division St. Louis, Missouri
Quantities:	6,300 feet, 132-inch diameter Special D-Load Design Reinforced Concrete Pipe. 727 feet, 90-inch diameter precast concrete manhole risers. 416 feet, 84-inch diameter precast concrete manhole risers. 160 feet (twin 80-foot lines), 10-foot x 8-foot box sections.

The Independent Concrete Pipe Company (ICPC) has been manufacturing reinforced concrete pipe for storm and sanitary sewers across the United States since 1912. ICPC was founded by Howard Schurmann and began as a family-owned and operated business. It remains so today, one of the few concrete pipe producers in the United States that can make that claim. See www.hyspanbridge.com/icpc/htm.

Photos: Hanson Pipe & Products, Inc.

by Scott Hofer
Hanson Pipe & Products, Inc.
605-335-7807

Failed CMP storm sewer replaced with 84-inch diameter Class III RCP.



Large Diameter CMP Storm Sewer Replaced With RCP after Twenty-Year Service

A major rainfall on June 16, 2004, soils saturated from a previous storm, and a failing corrugated metal pipe (CMP) storm sewer led to the collapse of a parking lot near a major intersection on Cleveland Avenue in Sioux Falls, South Dakota. Failure of the 84-inch diameter CMP, buried 25 feet below the surface, caused a sinkhole 75 feet wide and 250 feet long. Backfill over the pipe had infiltrated the sewer during earlier flood events and washed away the soil foundation of the parking lot. When the remaining soil structure supporting the walls of the pipe became saturated, the load over the pipe became too great for the rusting walls and invert to bear and the collapse occurred. The failed CMP, along with an additional run of 200 feet beneath a heavily traveled roadway were replaced with reinforced concrete pipe.

The storm that triggered the collapse dropped 7.79 inches of rain on the south west area of the city over a two hour period. It was the worst flooding in Sioux Falls in ten years. Many homes and businesses were flooded, as storm sewers overflowed leaving storm water to accumulate in basements, streets and other low-lying areas.

Reconstruction of the collapsed portion of the sewer and 200-foot section under Cleveland Avenue that showed clear signs

of pending failure had to begin immediately, as water continued to flow through the channel of the crumbled parking lot. Hanson Pipe & Products, Inc. was contacted by the City of Sioux Falls Drainage Engineer early June 17 to place an order for 84-inch diameter reinforced concrete pipe. Hanson staff calculated the strength of the pipe required to replace the CMP. Immediately upon the City's acceptance of the calculation, 12 truckloads of concrete pipe were dispatched from Hanson's Apple Valley Minnesota plant to cover the first 200 feet of the project. The City held an emergency bid letting for the project and selected H&W Contracting of Sioux Falls for the installation. A total of 430 feet of 84-inch diameter Class III reinforced concrete pipe was supplied to the contractor, along with two 84-inch diameter precast concrete apron sections.

The total project cost was nearly \$500,000, a hefty price to pay to replace a 27-year-old pipeline. Concrete pipe, although more expensive initially than corrugated metal pipe, is a much better value in the long run. That's why the City of Sioux Falls prefers concrete pipe for its storm drain needs. The failure could have been catastrophic had the pipeline collapsed an hour later when employees were in the parking lot or if the pipeline under the city street had failed. ☺

Project:	Storm Sewer Replacement Sioux Falls, South Dakota
Owner:	Sioux Falls Public Works Lyle Johnson, Director of Public Works Jeff Dunn, Sioux Falls Drainage Engineer
Contractor:	H&W Contracting, Sioux Falls, Minnesota
Producer:	Hanson Pipe & Products, Inc. Apple Valley, Minnesota Scott Hofer, Sales Manager John LeGros, Western Region Engineer
Quantities:	430 feet of 84-inch Class III reinforced concrete pipe 84-inch diameter precast concrete apron sections.

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.

Announcing First Annual Project Achievement Award Program for DOT Departments

The ACPA has launched a new award program to recognize state DOT departments and leaders that have demonstrated creativity and innovation using precast concrete pipe or boxes. The award has been established to promote public awareness of the activities and contributions of state Departments of Transportation, the American Concrete Pipe Association and its members.

A state DOT official or ACPA member may enter as many qualified projects as they wish. Projects that have received awards from other organizations may be entered. All projects submitted for the award must have been completed and in use between January 1, 2001 and February 1, 2006.

Judges will evaluate and compare projects based on the following:

- Overall aesthetics and incorporation into surrounding infrastructure
- Public involvement and education
- Use of innovative materials
- Use of new technologies
- Complexity
- Cost effectiveness
- Environmental benefits

A plaque will be presented to the award winners during a special breakfast held by the ACPA in conjunction with the AASHTO Bridge and Structures Subcommittee meeting in June 2006. The winning project will be featured in an upcoming issue of Concrete Pipe News, and a press release issued to publicize the award program and the award-winning project. The due date for submissions is February 1, 2006. Contact Matt Childs at mchilds@concrete-pipe.org, or 972-506-7216 for details.

CONCRETE PIPE NEWS READER SURVEY CONTEST THE WINNER IS...

Thank you all who took the time to complete the Concrete Pipe News Reader Survey distributed in the Spring, 2005 issue. Your input into the content of the publication is very important to us, and it will help our writers to provide information that is useful and relevant. Changes to Concrete Pipe News occur in partnership with our readers.

Congratulations to the winner of the digital camera, **D. Steele of J-U-B Engineers, Inc.** located in Utah. ☺



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