Concrete Pipe News

FALL 2009
Volume 61 No. 4

American **Concrete Pipe** Association

www.concrete-pipe.org

Fall 2009
Volume 61 No. 4

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

Media Task Group

Phillip Gale, Chair
Geneva Pipe Company

Bill Hobson
N C Products

Scott Lander
Hamilton Kent

Mike Leathers
Hanson Pipe & Precast

Peg Meyer
Hanson Pipe & Precast

Rick Phillips
Rinker Materials - Concrete Pipe Division CEMEX

Robert Powers
Inland Pipe Limited

Contract Editorial Staff

A. Grant Lee
AGL Marketing Limited

Karen Hunter
Director of Marketing

Published by:

American Concrete Pipe Association
1303 West Walnut Hill Lane, Suite 305
Irving, Texas 75038-3008
Phone: (972) 506-7216
Fax: (972) 506-7682
E-mail: info@concrete-pipe.org
www.concrete-pipe.org

On the Cover: Cowboys Stadium, Arlington, TX
Photo Credit:
Aerial Photography, Inc./
Manhattan Construction Co.

American **Concrete Pipe** Association

Editorial

Installation: Do It Right – Make It Last

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

Precast concrete pipe[1,2] outperforms plastic or metal conduits for stormwater and sanitary sewer applications. Concrete's rigidity and mass allow for easy and secure placement in the trench, without disrupting line or grade. Plus, precast concrete pipe joints[3] are easily assembled, which helps minimize the time needed for installation. Precast concrete pipe is the best option when installation time matters, or when the soil poses challenges to installation.

Since concrete pipe is a rigid product that is often over 85% dependent on the pipe strength and approximately 15% dependent on the strength derived from the soil envelope, installation[4] is easy. The installation of plastic or metal pipes can take longer than precast concrete pipe, because the structural and hydraulic integrity of flexible pipes is dependant on how well the surrounding soil is prepared at installation.

In an article in Storm Water Magazine in 2006[5], Dr. Pat Galloway advised that ASTM and AASHTO specifications place significant responsibility on the engineer at installation to ensure service performance. ASTM D2321-04[6] assigns responsibility to the engineer when installing thermoplastic pipe. Galloway states that, "engineers also must recognize that HDPE pipe requires an engineered installation in which the engineer must be involved in the construction activities. The engineer must take responsibility to ensure that post-installation deflection testing has been performed and documented. Before making a final recommendation to the client, the engineer has a responsibility to analyze life cycle costs, the risks associated with the chosen pipe product and any further risks that are identified during the selection of the pipe material."

The need for post-installation inspection is quickly becoming a priority throughout the country. Over 21 states are now reviewing their specifications on post-installation inspection. Some, like Florida[7] have completed their review and published their specification. Others are still in the review process.

Buried infrastructure has quickly become one of America's greatest environmental, social and economic assets. When designing culverts and sewers, do it right the first time and make it last!

References

1. http://www.concrete-pipe.org/why.htm
2. http://www.concrete-pipe.org/pdfs1/DD_25n.pdf
3. http://www.concrete-pipe.org/pdf/2009%2007%20epipe%20e-07-124%20concrete%20pipe%20joints.pdf
4. http://www.concrete-pipe.org/brochures/pdfs/standard_install.pdf
5. http://www.concrete-pipe.org/articles/2006%20Fall%20R%20&%20B%20Stormwater%20supp%20by%20Galloway%20pipesreprint.pdf
6. http://www.astm.org/DATABASE.CART/HISTORICAL/D2321-04.htm
7. http://www.concrete-pipe.org/pdf/Florida-spec.pdf

Link to the Full Story

Concrete Pipe and Boxes Entrenched in Cowboys Stadium
http://concrete-pipe.org/pdf/Concrete-Pipe-and-Boxes-Cowboys-Stadium.pdf
Contact: Kyle Dickerson, Hanson Pipe & Precast (Grand Prairie, TX), Phone: 214-707-9370
Kyle.Dickerson@hanson.biz

Precast Concrete Boxes Integrated Into Storm Tunnel
http://concrete-pipe.org/pdf/Concrete-Boxes-Storm-Tunnel.pdf
Contact: Syed O. Rizvi, Phone:780-410-3681
Syed.Rizvi@lafarge-na.com

The Saga of the AASHTO Box Culvert Standard Specification
http://concrete-pipe.org/pdf/AASHTO-Box-Culvert-Specification.pdf
Contact: Josh Beakley, Phone: 972-506-7216
jbeakley@concrete-pipe.org

Concrete Pipe Joints Have Rigorous Design and Testing Standards

ASTM and AASHTO have established standards[1,2] for the joints of concrete products. The versatility of precast concrete joints allows the designer to match project requirements with the appropriate joint and/or seal.

Besides the inherent strength of concrete pipe[3], a concrete pipe joint can be designed to provide soil-tightness or water-tightness, along with the ability to accommodate lateral or longitudinal movement by using several joint options including mortar, flexible joint sealants, rubber gaskets and external sealing bands.

Four different field test methods employ vacuum, air or water to verify concrete pipe joint design. ASTM C 924 - 02(2009)[4] *Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method* covers testing of 4 to 24-inch diameter concrete pipe sewer lines using the low-pressure air test method to demonstrate the integrity of the joint. ASTM C 1103 - 03(2009)[5] *Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines* provides procedures for acceptance testing of joints by air or water tests of installed concrete pipe joints. ASTM C 969 - 02(2009)[6] *Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines* covers procedures for testing installed concrete pipe sewer lines using water infiltration or exfiltration acceptance limits to demonstrate the integrity of the joints. ASTM C 1214 - 02(2009)[7] *Standard Test Methods for Concrete Pipe Sewer Lines by Negative Air Pressure (Vacuum) Test Method* covers procedures for testing 4 to 36-inch diameter concrete pipe sewer lines using the vacuum test method.

The use of a rubber gasket alone does not ensure that different joint types are equal. Designers can utilize ASTM standards to specify performance, but additional guidance may be required for alternate materials[8]. Concrete pipe joints are governed in national standards by detailed designs with very close or tight tolerances and high pressure tests.

Owners of buried concrete pipelines benefit from the integrity of joints for precast concrete drainage systems. The design of a rigid system enhances line and grade of the conduit, and offers assurance against deflection and buckling of the structure.

References

1. http://www.concrete-pipe.org/pdf/2009%2007%20epipe%20e-07-124%20concrete%20pipe%20joints.pdf
2. http://www.concrete-pipe.org/designmanual.htm
3. http://www.concrete-pipe.org/why.htm
4. http://www.astm.org/Standards/C924.htm
5. http://www.astm.org/Standards/C1103.htm
6. http://www.astm.org/Standards/C969.htm
7. http://www.astm.org/Standards/C1214.htm
8. http://www.concrete-pipe.org/ysk_pdfs/ysk120.pdf

210-foot box culvert under Baird Farm Road.
Photo Credit: Aerial Photography, Inc./
Manhattan Construction Co.

Cowboys Stadium – approx. 8 miles of 12 to 66-inch dia. RCP.
Photo Credit: Aerial Photography, Inc./
Manhattan Construction Co.

Two 10-foot x 8-foot cells of the triple cell box culvert.
Photo Credit: Mario Sinacola & Sons Excavating, Inc.

Concrete Pipe and Boxes Entrenched in Cowboys Stadium

By Kyle Dickerson
Hanson Pipe & Precast (Grand Prairie, TX)
214-707-9370

Miles of reinforced concrete pipe[1] and precast concrete boxes were used for the storm sewer system of the 3 million square-foot Cowboys Stadium[2], the largest domed stadium in the world. Hanson Pipe & Precast[3] provided nearly 2,000 feet of precast concrete boxes, and more than 43,500 feet (approximately 8 miles) of 12-inch to 66-inch diameter reinforced concrete pipe, supplied from Hanson's Cedar Hill and Grand Prairie plants. In addition to the pipe, boxes, and 17 sanitary sewer manholes, Hanson supplied 37 duct bank manholes, 102 catch basins, 14 junction boxes and precast drainage inlets.

One unique element of the stormwater management system was construction of a 210-foot three cell 10-foot x 8-foot box culvert under Baird Farm Road at a lower elevation than an associated box storm sewer. Aligned with the crossing is a 6-foot x 6-foot reinforced concrete box storm sewer that discharges at the same location as the outfall of the three-cell box culvert. The length of the box storm sewer is approximately 352 feet.

Concrete pipe was used for the storm sewers because the City of Arlington[4] specifies reinforced concrete pipe under its streets. Mario Sinacola & Sons Excavating, Inc.[5] installed the concrete pipe and boxes. Graham Associates, Inc.[6], civil engineering and surveying, worked with the contractor and pipe producer to design the stormwater management system. Production and quality testing of the concrete pipe and boxes were undertaken according to ASTM standards[7].

LINKS

http://concrete-pipe.org/pdf/Concrete-Pipe-and-Boxes-Cowboys-Stadium.pdf (full story)

Info Links

1. http://www.concrete-pipe.org/why.htm?cp_Session=ca6fb270aeca8177b4b63f163901c2d8
2. http://stadium.dallascowboys.com
3. http://www.hansonpipeandprecast.com
4. http://www.ci.arlington.tx.us
5. http://www.mariosinacola.com
6. http://www.grahamcivil.com
7. http://www.concrete-pipe.org/pdf/DM_Chp_5.pdf

Learn More About Buried infrastructure

- Keyword search: stormwater, standards, detention, retention.
  www.concrete-pipe.org
- Underground Storm Water Storage Systems – The Cost Effective, Efficient Way
  http://www.concrete-pipe.org/brochures/pdfs/underground_storm_water.pdf
- Design software
  http://www.concrete-pipe.org/software.htm
- Hydraulic Efficiency
  http://www.concrete-pipe.org/brochures/pdfs/hydraulics.pdf
- Concrete Pipe Design Manual
  http://www.concrete-pipe.org/designmanual.htm
- A Case in Point for Choosing Concrete Pipe – Ridge Line, Inc. vs. Advanced Drainage Systems
  http://www.concrete-pipe.org/dispatch/v1_n3.pdf
- Sustainable Concrete Pipe
  http://www.concrete-pipe.org/pdf/2009%2007%20epipe%20e-004%20Sustainable%20concrete%20pipe.pdf

Precast Concrete Boxes Integrated Into Storm Tunnel

By Syed O. Rizvi
Lafarge Canada Inc (Pipe Division).
780-410-3681

The City of Edmonton[1], Alberta constructed the Belgravia storm water outfall tunnel[2] in 2008 to relieve flooding in several neighborhoods. In addition, the tunnel offers an adequate outlet for an LRT underpass below Belgravia Road and restores capacity to an existing outfall to accommodate future development.

The outlet to the North Saskatchewan River is an 80-meter long precast concrete box sewer that is connected to the 3-meter diameter tunnel at a 5-meter long cast-in-place structure. The 3000mm x 2440mm x 2000mm boxes were supplied by Lafarge Canada Inc. (Pipe Division)[3] for speedy installation between November 25 and 29.

The box sections were designed to support a 4.0m earth cover (clay soil type) with light traffic loads. Eighty meters of boxes (40 units) were manufactured according to ASTM C1433 – 08[4] *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers*. BOXCAR[5], a computer program for structural design of reinforced concrete box culverts, was used to analyze and design the sections. Lafarge produced the sections within two weeks in its modern Edmonton facility[10]. Production started on September 22 and ended on October 6, in plenty of time for shipment to the job site at the call of the contractor.

Lowering of 3000mm x 2440mm x 2000mm box section into trench.

Positioning box section on line and grade for connection to outfall sewer.

Homing box section into position.

Photo credit:
Neil Kucharski, P.Eng.,
Senior Municipal Engineer,
Urban Systems.

LINKS

http://concrete-pipe.org/pdf/Concrete-Boxes-Storm-Tunnel.pdf (full story)

Info Links

1. http://www.edmonton.ca
2. http://www.acee-ceaa.gc.ca/052/details-eng.cfm?pid=22608
3. http://www.lafargeconcretepipe.com/edmonton_plant.htm
4. http://www.astm.org/Standards/C1433.htm
5. http://www.concrete-pipe.org/boxcar.htm
6. http://www.lafargeconcretepipe.com/edmonton_plant.htm

Learn More About Buried infrastructure

- Keyword search: stormwater, standards, detention, retention, sewer, box.
  www.concrete-pipe.org
- Underground Storm Water Storage Systems – The Cost Effective, Efficient Way
  http://www.concrete-pipe.org/brochures/pdfs/underground_storm_water.pdf
- Design software
  http://www.concrete-pipe.org/software.htm
- Hydraulic Efficiency
  http://www.concrete-pipe.org/brochures/pdfs/hydraulics.pdf
- Concrete Pipe Design Manual
  http://www.concrete-pipe.org/designmanual.htm
- Concrete Pipe and Box Culvert Installation
  http://www.concrete-pipe.org/ysk_pdfs/installation_guide.pdf
- Precast Boxes and RCP Used for Non Potable Water system at Oldest Public University
  http://www.concrete-pipe.org/pdf/2009%20CP%20News%20Spring.pdf
- Precast Concrete Box culvert Used to Pre-empt Urban Flood Damage
  http://www.concrete-pipe.org/news/pastissues/2001/CP%20NEWS%20WINTER%202001.pdf
- Gasketed Reinforced Concrete Boxes Utilized For Raw Water Conduit
  http://www.concrete-pipe.org/news/CP-News-Fall-2008.pdf
- Boxes Set in Record Time For Construction of Prestigious Hockey Field
  http://www.concrete-pipe.org/news/2008%20%20CP%20News%20Winter%20printable.pdf


Photo Credit: Hancock Concrete

The Saga of the AASHTO Box Culvert Standard Specification

By Josh Beakley, P.E.
Director of Technical Services
American Concrete Pipe Association
972-506-7216
jbeakley@concrete-pipe.org

The American Association of State Highway and Transportation Officials[1] (AASHTO) Material Standards for precast box culverts are AASHTO M 259[2] for deep installations, and AASHTO M 273[3] for shallow installations. These specifications are AASHTO-adopted versions of ASTM C789[4] and C850[5] that occurred before the AASHTO Standard Specifications for Highway Bridges[6] had a design section for box culverts.

Realizing that C789 and C850 were not completely in accordance with the AASHTO design criteria, ASTM decided to develop a precast box culvert standard in accordance with the AASHTO Standard Specifications for Highway Bridges. ASTM C1433 - 08[7] *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers* was developed in 1999. With adoption of ASTM C1433, C789 and C850 were both withdrawn from ASTM in 2000.

When C789 and C850 were withdrawn, the concrete pipe industry approached the AASHTO Subcommittee on Materials for adoption of ASTM C1433 into the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing. At that time, the LRFD Bridge Design Specifications (a new AASHTO Bridge Design Manual AASHTO LRFD-US-3[8]) was introduced as the new design method for all to follow. ASTM C1433 was never adopted into the AASHTO Materials Standard, even though it is the only national precast box culvert standard that follows the AASHTO Standard Specifications for Highway Bridges.

By October 2010, any culvert project receiving federal funding will need to be designed per AASHTO LRFD-US-3. To keep pace with the latest AASHTO design requirements, ASTM developed ASTM C1577 - 08[9] *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD*. If you are designing a precast box culvert to meet the requirements of the AASHTO Standard Specifications for Highway Bridges, HB-17, use ASTM C1433. If you are designing a precast box culvert that meets the requirements of the AASHTO LRFD Bridge Design Criteria (AASHTO LRFD-US-3) Specifications, use ASTM C1577.

Photo Credit: Hancock Concrete

LINKS

http://concrete-pipe.org/pdf/AASHTO-Box-Culvert-Specification.pdf (full story)

Info Links
1. http://www.transportation.org
2. http://aec.ihs.com/document/abstract/BHJIFBAAAAAAAAAA
3. http://aec.ihs.com/document/abstract/GQXFIBAAAAAAAAAA
4. http://www.astm.org/DATABASE.CART/WITHDRAWN/C789.htm
5. http://www.astm.org/DATABASE.CART/WITHDRAWN/C850.htm
6. http://www.techstreet.com/cgi-bin/detail?product_id=923675
7. http://www.astm.org/Standards/C1433.htm
8. http://www.techstreet.com/cgi-bin/detail?product_id=1154745
9. http://www.astm.org/Standards/C1577.htm

Learn More About Buried infrastructure
- Keyword search: standards, LRFD
  www.concrete-pipe.org
- Review of Box Culvert Design Per Standard AASHTO and LFRD Standard
  http://www.concrete-pipe.org/pdf/Box-Cliff-Notes.pdf
- Design Data 1 – Highway Live Loads On Concrete Pipe
  http://www.concrete-pipe.org/pdfs1/DD_1.pdf
- Award-Winning Road Widening Using Precast Boxes and SSC A First for WSDOT
  http://www.concrete-pipe.org/pdf/2009%2007%20WSDOT%20Precast%20boxes%20and%20self-consolidating%20concrete.pdf
- Shear Strength Design Provisions Based on the AASHTO LRFD Specification Applied to Concrete Pipe and Compared with Industry Practice
  http://www.concrete-pipe.org/news/pastissues/2000/CP%20NEWS%20SUMMER%202000.pdf

Photo Credit: Peters Construction Company

Trench Width

The Need for Care and Knowledge

By ACPA Staff

972-506-7216

When trench width is determined, pipe/soil interaction[1] is not the only consideration. Safety of workers, care in the workplace, and the science surrounding the trench wall are equally important. Commonly accepted convention says that, "if the trench wall stands it should be sufficient to support the buried culvert." However, there is no evidence that such a rule is actually correct.

The strength of the soil envelope surrounding a buried culvert is a composite value representative of the structural backfill and the materials at the sides of the structural backfill (in-situ soil). The final value is dependent upon the soil properties of the placed soil, the properties of the in-situ soil, and the distance between the culvert wall and trench wall (property of the trench width).

Section 1926.652(g)(2)[2], of the Occupational Health and Safety Association (OSHA) manual sets rules for trenches. However, the OSHA rules may conflict with common convention and ASTM D2321[3], *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*.

ASTM D2321 is "intended to ensure a stable underground environment for thermoplastic pipe under a wide range of service conditions." Thermoplastic pipe requires well compacted quality embedment material around it to support the applied loads. To ensure this, D2321 does not allow movable supports below the top of the pipe zone, "unless approved methods are used to maintain the integrity of the embedment material."

Out of concern for the safety of construction workers in the trench, OSHA has requirements for supporting trench walls during construction. Trench wall supports must extend to within 2 feet of the bottom of the trench, which is often well below the top of the pipe zone. Trench wall support can either be permanently left in place, or removable, so that the support advances as construction of the pipeline advances. Placement of backfill occurs while the trench support is in place, and thus when the temporary support is removed, or if the permanent support degrades over time, a void is left in its place, and may result in a lower soil strength surrounding the pipe than originally designated, thus leaving the poor soil support that ASTM D2321 seeks to avoid.

In response to this dilemma, one major manufacturer of HDPE pipe suggests a trench width equal to three times the pipe diameter when using a trench box. This would result in a trench 9-foot wide trench for a 36-inch diameter pipe and a 12-foot wide trench for a 48-inch diameter pipe.

Failure to clearly specify the correct installation and trenching procedures could result in either a violation of OSHA regulations or an infringement of ASTM standard installation procedures.

Depending on the loading conditions that must be supported by the culvert, and the culvert material itself, a wide variety of soil supporting strengths may be assumed in the calculation of the soil-structure envelope. A rule of thumb with no comparative scale is insufficient as a determining factor in either design or construction. Hence, additional costs often result from either an installation with a trench that is too narrow for a poor in-situ soil, thereby resulting in rehabilitation and additional life cycle costs of the culvert, or a trench requirement that is unnecessarily wide for a strong in-situ soil, thereby resulting in an excessive initial cost of the installation. Either way, the health and safety of the people working in the trench are affected by rules and standards that may not be based on science.

LINKS

References

1. http://www.concrete-pipe.org/articles/2006%20Fall%20R%20&%20B%20Stormwater%20supp%20by%20Galloway%20pipesreprint.pdf
2. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10776
3. http://www.astm.org/Standards/D2321.htm

American **Concrete Pipe** Association
1303 West Walnut Hill Lane, Suite 305
Irving, TX 75038-3008

www.concrete-pipe.org

2010 Pipe School

Joining Forces

Winning in the Trenches

February 17th - 19th
Sheraton Downtown Hotel
Phoenix, Arizona

Please visit http://www.concrete-pipe.org under "Education".

Save this link **http://www.concrete-pipe.org/cpnews.htm** to your favorites list to increase your knowledge about drainage applications and innovative ways to use precast reinforced concrete pipe and boxes to build structures that will last.