The Digital Pipe Digest

ACTB CCPA
Canadian Concrete Pipe Association
Association canadienne des fabricants de tuyaux de béton
Editor: A. Grant Lee, MCIP, RPP, FCInst.M October 2004

Alberta Chapter now on CCPA/ACTB Web site

The CCPA/ACTB Web site has undergone some minor updates. Contact information about member companies has changed on the Tremca, Brunet and Inland (Calgary) gateway pages.

The most apparent change is the move to a new logo inspired by the establishment of an Alberta Chapter of the Canadian Concrete Pipe Association. The new Chapter now has its own page and contact information. Anyone wishing to contact Jim Poole of the CCPAA Chapter may wish to try out the contact email or telephone number on the Alberta page.

Alberta Chapter logo

www.ccpa.com

Concrete Basics by the Portland Cement Association

www.cement.org/basics

In its simplest form, concrete is a mixture of paste and aggregates. The paste, composed of portland cement and water, coats the surface of the fine and coarse aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete.

Within this process lies the key to a remarkable trait of concrete: it's plastic and malleable when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks and superhighways, houses and dams.

Proportioning

The key to achieving a strong, durable concrete rests in the careful proportioning and mixing of the ingredients. A concrete mixture that does not have enough paste to fill all the voids between the aggregates will be difficult to place and will produce rough, honeycombed surfaces and porous concrete. A mixture with an excess of cement paste will be easy to place and will produce a smooth surface; however, the resulting concrete is likely to shrink more and be uneconomical.

A properly designed concrete mixture will possess the desired workability for the fresh concrete and the required durability and strength for the hardened concrete. Typically, a mix is about 10 to 15 percent cement, 60 to 75 percent aggregate and 15 to 20 percent water. Entrained air in many concrete mixes may also take up another 5 to 8 percent.

Portland cement's chemistry comes to life in the presence of water. Cement and water form a paste that coats each particle of stone and sand. Through a chemical reaction called hydration, the cement paste hardens and gains strength. The character of the concrete is determined by quality of the paste. The strength of the paste, in turn, depends on the ratio of water to cement. The water-cement ratio is the weight of the mixing water divided by the weight of the cement. High-quality concrete is produced by lowering the water-cement ratio as much as possible without sacrificing the workability of fresh concrete. Generally, using less water produces a higher quality concrete provided the concrete is properly placed, consolidated, and cured.

Although most drinking water is suitable for use in concrete, aggregates are chosen carefully. Aggregates comprise 60 to 75 percent of the total volume of concrete. The type and size of the aggregate mixture depends on the thickness and purpose of the final concrete product. Almost any natural water that is drinkable and has no pronounced taste or odor may be used as mixing water for concrete. However, some waters that are not fit for drinking may be suitable for concrete.

Excessive impurities in mixing water not only may affect setting time and concrete strength, but also may cause efflorescence, staining, corrosion of reinforcement, volume instability, and reduced durability. Specifications usually set limits on chlorides, sulfates, alkalis, and solids in mixing water unless tests can be performed to determine the effect the impurity has on various properties. Relatively thin building sections call for small coarse aggregate, though aggregates up to six inches (150 mm) in diameter have been used in large dams. A continuous gradation of particle sizes is desirable for efficient use of the paste. In addition, aggregates should be clean and free from any matter that might affect the quality of the concrete

Hydration Begins

Soon after the aggregates, water, and the cement are combined, the mixture starts to harden. All portland cements are hydraulic cements that set and harden through a chemical reaction with water. During this reaction, called hydration, a node forms on the surface of each cement particle. The node grows and expands until it links up with nodes from other cement particles or adheres to adjacent aggregates.

The building up process results in progressive stiffening, hardening, and strength development. Once the concrete is thoroughly mixed and workable it should be placed in forms before the mixture becomes too stiff.

During placement, the concrete is consolidated to compact it within the forms and to eliminate potential flaws, such as honeycombs and air pockets. For slabs, concrete is left to stand until the surface moisture film disappears. After the film disappears from the surface, a wood or metal handfloat is used to smooth off the concrete. Floating produces a relatively even, but slightly rough, texture that has good slip resistance and is frequently used as a final finish for exterior slabs. If a smooth, hard, dense surface is required, floating is followed by steel troweling.

Curing begins after the exposed surfaces of the concrete have hardened

sufficiently to resist marring. Curing ensures the continued hydration of the cement and the strength gain of the concrete. Concrete surfaces are cured by sprinkling with water fog, or by using moisture-retaining fabrics such as burlap or cotton mats. Other curing methods prevent evaporation of the water by sealing the surface with plastic or special sprays (curing compounds).

To protect the concrete, special techniques are used for curing concrete during extremely cold or hot weather. The longer the concrete is kept moist, the stronger and more durable it will become. The rate of hardening depends upon the composition and fineness of the cement, the mix proportions, and the moisture and temperature conditions. Most of the hydration and strength gain take place within the first month of concrete's life cycle, but hydration continues at a slower rate for many years. Concrete continues to get stronger as it gets older.

The Forms of Concrete

Concrete is produced in four basic forms, each with unique applications and properties. **Ready mixed concrete**, by far the most common form, accounts for nearly three-fourths of all concrete. It's batched at local plants for delivery in the familiar trucks with revolving drums. **Precast concrete** products are cast in a factory setting. These products benefit from tight quality control achievable at a production plant. Precast products range from concrete bricks and paving stones to bridge girders, structural components, and panels for cladding. Precast concrete pipe is a major product for buried infrastructure **Concrete masonry**, another type of manufactured concrete, may be best known for its conventional 8 x 8 x 16-inch block.

Today's masonry units can be molded into a wealth of shapes, configurations, colors, and textures to serve an infinite spectrum of building applications and architectural needs. **Cement-based materials** represent products that defy the label of "concrete," yet share many of its qualities. Conventional materials in this category include mortar, grout, and terrazzo. Soil-cement and roller-compacted concrete-"cousins" of concrete-are used for pavements and dams. Other products in this category include flowable fill and cement-treated bases. A new generation of advanced products incorporates fibers and special aggregate to create roofing tiles, shake shingles, lap siding, and countertops. And an emerging market is the use of cement to treat and stabilize waste.

There is still time to register for the "Raise Your Concrete Potential" – ACPA's Fall 2004 Short Course School

The Fall Short course School is an informative 2-day educational event presented annually by the American Concrete Pipe Association. Industry experts bring their personal knowledge and practical experience to each session covering concrete pipe standard installations, homeland security, box culverts, manholes, true cost of ownership, service lives of various pipes, and other pipe-related topics.

This training is designed to assist technical, sales, and marketing engineers in learning more about the design, specifications and utilization of piping products for sanitary sewers, culverts, and storm drain applications.

Registration and a complete agenda are online at www.concrete-pipe.org. **Space is limited: early registration closes October 7, 2004.** Each attendee is responsible for hotel and travel accommodations. **Before October 7, registration for sponsored guests is $US175. After October 7, the cost is $US230.**

ACPA about to release fourth "Concrete Pipe Advantage" video

The fourth video, "Built for the Future," developed by the American Concrete Pipe Association and Portland Cement Association steering committee has been completed, reviewed by the task group, and is in final editing. Once finalized, a copy of the video with marketing brochures will be distributed to members. Copies would also be available through the ACPA's Resource Center. This video focuses on the issue of sustainability, as outlined in the ACPA's strategic plan.

ACPA changes gear with new advertising campaign

Watch for the American Concrete Pipe Association's new advertising campaign launched in August. Three ad concepts were developed based on the strategic plan and target audience. The new ads have two versions with the message being that the engineer will "rest easy" by specifying concrete pipe because of its benefits.

The first ad to appear in Canadian media is in the latest issue of Environmental Science & Engineering magazine.

ACPA members (many in Canada) are welcome and encouraged to use the ads in their advertising program to strengthen and show a unified voice throughout the concrete pipe industry.

Contact Karen Hunter, if you are interested in using the print ads. The photo from one ad version was used in the ACPA exhibit booth at various trade shows in September. Staff received a lot of positive feedback from ACPA members and conference attendees.

Concrete pipe and box applications and industry developments in print

Concrete pipe in North America has a long history of dependability and performance. The quality of product and performance standards have taken a giant leap forward over the past quarter century, making concrete a preferred material for many traditional sanitary and storm sewer applications. Precast reinforced concrete pipe and boxes are finding niche markets where never before envisioned such as ventilation tubing (Earth Rangers Centre and Niagara Falls Butterfly Conservatory), buried utility galeries, groynes for current control and fish habitat in harbours, animal and pedestrian crossings of rail lines and highways, stormwater storage and retention chambers, small bridge structures, jacking and tunneling applications, and marine outfalls. New applications are limited only by the imagination of infrastructure designers.

The concrete pipe industry and its associations regularly publish applications of interest in many trade and professional publications throughout Canada and the United States. Many published articles become archived on various Web sites for access via the Internet. Following is a compendium and summary of some of the articles published over the past nine months.

Concrete Pipe News

Calgary Uses Specially-Designed Precast Concrete Boxes for Stormwater Duct

Construction of the *Rundle Underground Storage Duct* in Calgary, Alberta consisted of a two-cell precast concrete box system (each box unit measuring 2400 mm wide x 3000 mm high), 550 meters long with cover up to 5.65 meters. The boxes were designed using BoxCar to support an American 5299 fifty-ton crane used to place the two parallel lines of box units.

Lesson Learned About Making the Right Choice in Culvert Material

Residents of the River's Edge Street Subdivision in Jupiter Florida banded together to replace a failing high density polyethylene (HDPE) pipe installation with a reinforced concrete box culvert. Residents had taken a contractor's advice to install HDPE pipe instead of concrete because of a lower initial cost of the culvert material.

A Study Into The Economic Costs of Culvert Failures

Actual replacement cost and the cost of roadway user delays due to road closures and detours are often not considered in the Life Cycle Cost Analysis (LCCA). Since the Nation's highway infrastructure is in need of billions of dollars to simply maintain current assets, it is very important to include these costs in any LCCA. Supported by a literature review and survey, a study team developed a new equation for LCCA that includes total cost of installation.

RCP drains provide immediate health, safety, and economic benefits, by Robin Woodbury, Premarc Corporation, Durand, MI.
(RCP system designed to intercept existing combined flows from a 60-inch and 72-inch line that previously discharged directly into a retention treatment facility without benefit of pre-treatment.)

RCP Receives Rave Reviews, by Ron Almquist, North Dakota Concrete Products, Bismark ND.
(A 1.17 - mile segment of South Broadway [a major traffic artery in Minot, North Dakota] was reconstructed using RCP for storm sewers.)

Choice of Major Culvert Material Based On Proven Performance, by Ryan Finley, Lafarge Canada, Inc., Calgary AB.
(Use of precast concrete box units under the TransCanada Highway was based on the proven performance of concrete and the expected service life of precast reinforced concrete box culverts.)

Precast concrete pipe and box sections installed close to home, by Dale Pruden, Hanson Pipe & Products, Grand Prarie, TX
(1,500 feet of Class III RCP of various diameters and approximately 1,000 feet of precast reinforced concrete box sections installed within view of ACPA headquarters.)

Institute of Religion campus built on rock-Solid Infrastructure by Phil Gale, Geneva Pipe Company, Orem, UT.
(Specification for a stormwater detention system [originally specified as a 72-inch diameter concrete pipe] was changed to four rows of box sections (13-feet x 6-feet x 8-feet) approximately 120 feet in length.)

Concrete Pipe Journal

Engineers Design Unique Stormwater Duct Under Urban Section of TransCanada Highway

Construction of the *Rundle Underground Storage Duct* in Calgary, Alberta consisted of a two-cell precast concrete box system (each box unit measuring 2400 mm wide x 3000 mm high), 550 meters long with cover up to 5.65 meters. The boxes were designed using BoxCar to support an American 5299 fifty-ton crane used to place the two parallel lines of box units.

MTO Replaces Failing Culvert on Highway 403

Closure of Highway 403 westbound on April 26 (west of the Princeton interchange), was necessary to replace a failing corrugated steel pipe (CSP) culvert with reinforced concrete pipe. The CSP culvert was the second to fail at this location in less than one year. The replacement took place in a 12-hour period during the night.

Concrete pipe debuts under Highway 401 medians, by Mark Eaton, Con Cast Pipe, Guelph, ON. (New special provisions in the Ministry of Transportation contracts for major highways address the quality standards for the acceptance of drainage product specifications. Highway 401 between Regional Road 97 and Homer Watson Boulevard in the

Regional Municipality of Waterloo was the first contract that specified reinforced concrete pipe for median drainage.)

Environmental Science & Engineering Magazine

Engineers Design Unique Stormwater Duct Under Urban Section of TransCanada Highway

Construction of the *Rundle Underground Storage Duct* in Calgary, Alberta consisted of a two-cell precast concrete box system (each box unit measuring 2400 mm wide x 3000 mm high), 550 meters long with cover up to 5.65 meters. The boxes were designed using BoxCar to support an American 5299 fifty-ton crane used to place the two parallel lines of box units.

Recycled concrete pipe services fuel depot, by Hanson Pipe & Products Canada Inc., Cambridge, ON. (Four pieces of 450 mm RCP removed, cleaned and re-installed to accommodate an oil/sediment separator at fuel site.)

Research suggests conservative design of concrete box culverts by Paul Smeltzer, P.Eng., and Evan Bentz, Ph.D. (Article discusses University of Toronto research expected to have a significant impact on the cost of buried infrastructure and the use of resources for producing precast concrete boxes. The research will have a profound impact on design methodology and principles used in industry and academia for concrete structures).

Daily Commercial News and Construction Record, March 12, 2004 "Concrete" Special

A model for product quality programs, by Paul Smeltzer, OCPA.
(The Plant Prequalification Program for precast Concrete Drainage Products is discussed. The product quality testing program now includes not only circular pipe, but also elliptical pipe, maintenance holes, catch basins, valve chambers, box units, three-sided boxes and headwalls.)

Concrete pipe association wants to see more money invested in underground infrastructure, by Mark Sabine, OCPA.
(A point is made about the continued under funding of infrastructure by governments, and a call for proper consideration of design life of projects.)

Study provides information on concrete box culverts, by Paul Smeltzer, OCPA.
University of Toronto research on box culverts reported that develops an understanding of the shear resisting mechanisms for box structures. The crack development, reinforcement strains, and specimen deformation were compared to the results of extensive nonlinear finite element analysis using the computer modeling techniques developed at the University of Toronto. Discussion presented in the report called, "Shear Behaviour of Concrete Box Culverts: A Preliminary Study" by R.A. Yee, E.C. Bentz, and M.P. Collins, identifies areas of weakness and lack of clarity in the current codes governing box culvert design.

The Ontario Technologist

Drain gain – advances in sewer pipe design improve flow and safety

The benching in the base of the structure that maintains the flow properties and performance, including full flow and surcharged conditions is one of the critical components of modern-day maintenance hole structures. Concrete pipe producers in Ontario are raising the performance level of benching, and calling for new standards to accommodate advancements in technology and field conditions for contractors and maintenance crews.

Engineering News Record

Gibraltar's municipal complex built for the ages with concrete pipe

A short article published about the use of concrete pipe in a wetland area south of Detroit. Pipe floatation was a design consideration in the specification of concrete pipe.

Roads and Bridges Magazine

Concrete pipe – a product for present and future generations

An article that generally outlines the argument for the use of concrete drainage products in today's economy.

Pipe Floatation Design Data Sheet released by ACPA

The American Concrete Pipe Association's technical committee has released its latest revised Design Data sheet – Design Data 22, *Flotation of Circular Concrete Pipe*. Design Data 22 discusses the calculation of the possible flotation of circular concrete pipe and lighter flexible pipe products.

The Design Data are a series of publications available from the ACPA to serve as design aids for engineers and specifiers of concrete pipe. The Design Data cover topics in live loads, dead loads, bedding factors,


Design Data 22

Flotation of Circular Concrete Pipe

hydraulics, installation and miscellaneous topics. The Design Data are available from the ACPA web site at www.concrete-pipe.org.

Earth Rangers documentary to air on national television

In demonstration of concrete's role in the sustainable development movement, the concrete industry is supporting a documentary to air on national television this fall about the building of the Earth Rangers Centre in Woodbridge, Ontario.

"A SUSTAINABLE FUTURE: Creating the Legacy - The Story of the Earth Rangers Centre" was produced by award-winning CLARE Media (*Scanning the Movies*) in association with Canadian Learning Television (CLT), and will showcase the sustainable features of the facility.

Using footage gathered by the Cement Association of Canada from the construction stage of the building as well as interviews with environmental champions from Earth Rangers and beyond, the documentary examines Canadian efforts to meet sustainable building goals, and highlights concrete's role in this initiative.

Concrete sustainable features of the Centre include nine 20 m concrete 'earth tubes' used to heat, cool and ventilate the building; 21 km of tubing embedded in concrete slabs that take advantage of the thermal mass of concrete for energy efficiency; concrete pavers that return water to the water table; and solar collectors used to heat 20% of the domestic water for the building. Built to LEED standard, the facility stands as a model of sustainable design.

The concrete earth tubes are demonstrated and explained in the documentary by Paul Smeltzer, Executive Director of OCPA and Richard Lay of Enermodal Engineering Ltd.

The earth tubes were specified for the building by Enermodal Engineering Ltd. to reduce energy requirements associated with heating and cooling the facility and were donated to the Earth Rangers by the Ontario Concrete Pipe Association. The 900 mm diameter by 20 metre length pipe will provide for heat transfer in an area covering 1200 square metres of surface area. The earth's temperature 2 m below the ground is relatively constant at 10-12 degrees Celsius year round; air moving through the concrete earth tubes will be pre-heated or pre-cooled depending upon the season.

Fresh air will be delivered via the earth tubes to all areas of the building by "displacement ventilation." Air is supplied at floor level, which rises naturally and is exhausted through ceiling vents. Displacement

ventilation provides superior indoor air quality and occupant comfort while requiring less fan power for air circulation, contributing to the energy efficiency of the building.

Also featured are interviews with representatives of key sustainability influencers, including the Canada Green Building Council, the Vancouver 2010 Olympic Committee, EnerQuality R-2000 and others.

The mandate of Earth Rangers "to inspire within children a lasting passion to improve the environment" is demonstrated in the film through interviews with children and students, who visit the Centre and participate in Earth Rangers educational programs.

The Earth Rangers, including founder Robert Schad of the Schad Foundation, examines the role of youth in determining the questionable future of our planet, and industry professionals discuss industry's contribution to the education of future generations on sustainable issues.

The Ontario Concrete Pipe Association is joined in their support of Earth Rangers by the Cement Association of Canada (CAC), who have made a five-year funding commitment to Earth Rangers in addition to ongoing promotional support. The Centre, built almost entirely of concrete, is a model

demonstration of the environmental and sustainable benefits of concrete as a building material.

Earth Rangers Centre

The documentary will be aired on **Friday, October 15, 2004 at 7 p.m. on Canadian Learning Television (CLT).** Other broadcasters and air dates will follow, including Access, Alberta Educational Network. To purchase a copy of the documentary for industry non-broadcast purposes, please contact Chevanne Simpson at the Cement Association of Canada at csimpson@cement.ca.

North American Cargo Securement Standard

Since 1994, Canada and the United states have been actively collaborating on the development and implementation of a new North American Cargo Securement Standard. Consultations with Canadian industry took place in 1999.

The new regulations became mandatory in the United States as of January 1, 2004, and Canada is in the process of finalizing the proposed national standard that the province of Ontario intends to adopt. The new national standard will harmonize the Canadian rules with those that have been implemented in the United States. It is expected that the new standard will be implemented in Canada as of January 1, 2005.

The Ministry of Transportation Ontario is encouraging industry to review the approved standards in preparation for driver training.

Training materials related to the north American Cargo Securement Standard are available at www.ab.org/ccmta.html.

Concrete Pipe Industry Billboard

2004

ACPA Fall Marketing Short Course School
Las Vegas, Nevada
November TBA

International NO-DIG 2004
Hamburg, Germany
November 15 to 17

Construct Canada
Toronto, Ontario
December 1 to 3

Canadian Public Works Expo
Mississauga, Ontario
December 1 to 2

2005

TRB 84th Annual Meeting
Washington, DC
January 11 to 15

World of Concrete 2005
Las Vegas, Nevada
January 18 to 21

ACPA Production Short Course School/MCPX
Indianapolis, Indiana
February 9 to 11

NUCA 2005
Orlando, Florida
February 8 to 12

CCPA/OCPA Annual General Meetings
Niagara-on-the-Lake, Ontario
February 18, 19

Ontario Good Roads Association Conference
Toronto, Ontario
February 20 to 23

97th Annual Meeting of the ACPA
Las Vegas, Nevada
March 13 to 16

CONEXPO-CON/AGG
Las Vegas, Nevada
March 15 to 19

Water Environment Association of Ontario
Huntsville, Ontario
April 17 to 19

Ontario Water Works Association Conference and Trade Show
Ottawa, Ontario
May 8 to 11

Ontario Environmental Tradeshow
Toronto, Ontario
May 11 to 12

Canadian Society for Civil Engineering Annual Conference
Toronto, Ontario
June 2 to 4

Federation of Canadian Municipalities 66th AGM and Municipal Expo
St. John's, Newfoundland
June 3 to 6

AWWA Conference & Exposition
San Francisco, California
June 12 to 16

AWWA Conference & Exposition
San Francisco, California
June 12 to 16

STORMCON
Orlando, Florida
July 18 to 21

ASCE Pipelines 2004 Conference
Houston, Texas
August 21 to 24

ACPA Committee Week & CPU 301
TBA

APWA Congress & Exposition
Minneapolis, Minnesota
September 11 to 14

Transportation Association of Canada (TAC) Annual Conference
TBA

WEFTEC 2005
TBA

BAUMA
Munich, Germany
2007 (every 3 years)

The Digital Pipe Digest is published by the Canadian Concrete Pipe Association through AGL Marketing Limited. The Digest is being distributed via Internet technology and the World Wide Web. Information is believed to be correct at time of publication. The CCPA shall not be liable for any error or omission. It is published and distributed monthly, and is intended to provide general information, with contacts.

ACTB

Canadian Concrete Pipe Association
association canadienne des fabricants de tuyaux de béton

205 Miller Drive ■ Halton Hills (Georgetown) ■ Ontario ■ Canada ■ L7G 6G4
Telephone: 905-877-5369 ■ Facsimile: 905-702-0819 ■ E-mail: info@ccpa.com ■ www.ccpa.com