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In This Issue...

Lined Reinforced Concrete Pipe (RCP) Addresses Challenging Site Conditions

Nick Bray, P.Eng.
Operations Manager, Sewer & Water
Louis Bray Construction

Marc Maisonneuve, EIT
Civil Engineer in Training
Jacobs Engineering Group

Precast Producer: ***CON CAST PIPE***

Located in the West End of the National Capital Region (Ottawa), the North Kanata Trunk Sewer Phase 2 project consisted of the installation of a new trunk sewer. This project required the new sanitary trunk sewer to cross various jurisdictions including NCC Greenbelt, intersecting several major arterial roadways as well as a major railway line. The overall length of the trunk sewer was over 2 km. Additionally, the location of the new trunk sewer was also challenged with the potential of type 4 soils. This includes sensitive clays, granite bedrock and varying water table characteristics. The Environmental Site Assessment was conducted by Houle Chevrier Engineering for CH2M Hill, the focus was to assess the soil and groundwater chemical conditions at various borehole locations.

Shipping cradles designed to maximize deliveries

The City of Ottawa selected to use PERFECT Pipe, manufactured by Con Cast Pipe, for this project. PERFECT Pipe's joint profile and coupler connection was a key characteristic that influenced the selection. PERFECT Pipe's joint profile and coupler connection eliminates the requirement for man entry into the pipe to seal the joints with a cap strip. This results in

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Lined Reinforced Concrete Pipe (RCP) Addresses Challenging Site Conditions

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PERFECT Pipe installation

reduced construction time and improves the quality of the sewer system. The advantage of PERFECT Pipe is that it mitigates any infiltration of contaminated groundwater that would exceed the Ministry of Environment Standard as well as the City of Ottawa's discharge criteria by preventing infiltration. Majority of the project utilized a 1200 mm diameter PERFECT Pipe. Con Cast Pipe also supplied standard 1350 mm diameter and 1800 mm diameter reinforced concrete pipe (RCP) with an Agru Sure-Grip liner (HDPE) that was cast into the RCP during the manufacturing process. The HDPE liner does require that the joint gaps be welded with an HDPE cap strip. Once installed, the pipe would also require additional labour to complete the welding of the joints. This is a typical requirement of reinforced concrete pipe, lined with HDPE.

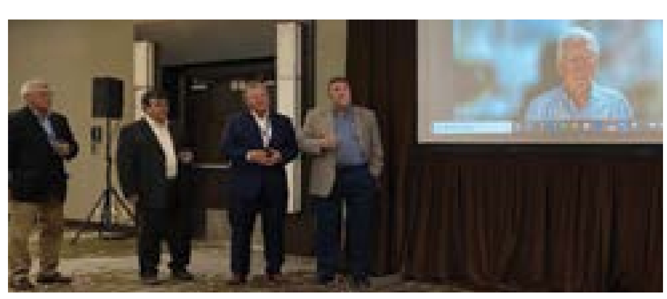
Con Cast Pipe also provided some logistical expertise to address a very limited staging area for this project. Custom-designed shipping cradles were utilized in order to maximize delivery of the pipe per load to the job site. This allowed for minimal inventory to be kept on-site while ensuring that installation would not be delayed due to lack of inventory.

Both Bray Construction and Jacobs would like to thank Con Cast Pipe for their contributions to this project and for providing innovative solutions that addressed the challenges encountered on the North Kanata Trunk Sewer Phase 2 project.

Honorary Memberships Awarded by the CCPPA

Five individuals were awarded Honorary Memberships at the recent Canadian Concrete Pipe & Precast Association (CCPPA) conference in Blue Mountain, Ontario. These five new honorary members have over 240 years of concrete pipe and precast experience combined.

An Honorary Membership is awarded by the CCPPA to a person who has made a significant and sustained contribution to the Canadian concrete pipe and precast industry over an extended period.



From Left to Right: Drew Black, Edwin Kling, Leo Steffler, Doug Galloway, Mel Marshall (on Zoom)

Honorary Members will enjoy a standing invitation to CCPPA meetings and will be welcomed to contribute to CCPPA affairs

The new Honorary Members inducted are Drew Black, Edwin Kling, Leo Steffler, Doug Galloway, and Mel Marshall. Jim Tully, Chair of the Nominating Committee, presented an outline of each new Honorary Members' contribution to the industry.

Unrealistic Roughness Coefficient Could Impair Pipe Capacity

Due to factors like climate change and intensified urban development, insurance claims in Canada from water damage exceed claims from fire, theft, and other natural disasters combined. This is compounded by the fact that the average cost of each home insurance claim is rising significantly because more homeowners are furnishing their basements as living spaces. This has prompted the Insurance Bureau of Canada to recognize the need to better understand their exposure from municipal-side factors and motivate them to develop the Municipal Risk Assessment Tool (MRAT), a pilot project which assesses the impact of severe weather events on urban drainage systems and identifies where potential municipal infrastructure vulnerabilities may exist.

One aspect of sewer and culvert design that may come under scrutiny is how the Manning formula is used to determine a pipe size that is sufficient to carry a design peak flow. More specifically, design engineers need to use an appropriate flow resistance coefficient or Manning's n roughness coefficient.

As indicated in Table 1 (see page 4), many jurisdictions across Canada seem to agree that a Manning's n Value of 0.012 or 0.013 is appropriate for all smooth wall pipe, which includes concrete, PVC, and HDPE pipe with a smooth interior surface. Surprisingly, a small number of Canadian municipalities are willing to ignore the best practices adopted by many of these jurisdictions and still allow the use of a Manning's n Value as low as 0.009 for plastic pipe.

Design engineers must keep in mind that the Manning formula, developed in 1890, is an empirical relationship with a roughness coefficient n Value that varies with pipe size, slope of the pipe, and flow depth. Engineers must also recognize that the Manning's n Value of 0.009, recommended by the plastic pipe industry, is derived from laboratory studies that examined small pipe sizes, or is based on clean water flowing through short sections of new pipe, not in-service sewers. Similar laboratory studies with concrete pipe have also resulted in Manning's n Values of 0.009, however, the concrete pipe industry has traditionally promoted the use of a more conservative n Value to account for the differences between laboratory testing and actual installed conditions.

Table comments: Engineers familiar with pipe design know that flow resistance in a pipe is significantly affected by more factors than just the

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M CON Products Provides Precast Concrete Solutions for a Combined Sewage Storage Tunnel Project

Brett McChesney, P.Eng.
Engineering Manager
M CON Products

Precast Producer: ***M CON Products***

Many municipalities across Canada are currently challenged with the impacts of climate change. For municipalities with combined storm and sanitary sewers, extreme rain events can result in the discharge of raw sewage into local rivers and lakes that surround these municipalities.

The Combined Sewage Storage Tunnel (CSST) is one of the key projects included in the Ottawa River Action Plan (ORAP) which is the City of Ottawa's roadmap to protect the Ottawa River for future generations. The CSST project is a $232.3 million investment.

The purpose of the CSST will be to greatly reduce the frequency of sewage overflows, during major rain events, from entering the Ottawa River, and will help protect the river's water quality and reduce beach closure as well as improve the long-term health of the river's ecosystem. The tunnels that make up the CSST will hold up to 43,000 m3 of sewer overflow during major rainfalls. This is the equivalent capacity of approximately 18 Olympic-sized pools. Once the rainfall has subsided, the sewer overflow water will then be treated and returned safely to the Ottawa River.

Since 2016, M CON has been working with project consultant engineers and structural design engineers to design and manufacture unique precast concrete products for various applications.

Some of the products made were:
- A custom-sized 4200 x 1200 mm box culvert
- 3000 mm and 1800 mm diameter jacking pipe
- Radius reinforced pipe
- Pipe bends of various sizes
- Custom roof panels
- Custom slabs

M CON provided products to fifteen different sites for this project scattered throughout downtown Ottawa. Although the products listed are typically used as drainage products in most projects, M CON inconjunction with the consultant proposed alternative uses for these structural elements.

Some of the alternate uses for them such as air ventilation structures (made with pipe or maintenance hole components) and access shafts of various sizes for gigantic cast-in-place structures. All the structures required custom grates and hardware, supplied by M CON for the customer's convenience.

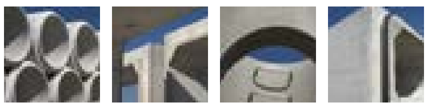
The 3000 mm diameter jacking pipe for Site 8 was designed as per CSA A257.4-19. They included ten 20-ton swift lift anchor points, as opposed to the usual two anchors because the shaft that the product was lowered down in was too narrow to lower the pipe in its final configuration. The 19,000 kg pipe had to be carefully lifted on a narrow street, lowered down the shaft in a vertical position and then carefully rotated to its horizontal position 18 m (or six stories) below the street and jacked into place.

3000 mm ID pipe delivered to the jobsite

M CON collaborated closely with the contractor and consultants to ensure the ease of installation. The 3000 mm jacking pipe was a quicker and safer alternative to a tunnel lined with panels or shotcrete. The 3000 mm jacking pipe was used at three different locations for a total of fifty-four metres.

Logistics was also an important aspect of this project as M CON provided products to fifteen different sites for this project scattered throughout downtown Ottawa. There were always multiple sites active at any given time. Since this was a joint venture, along with multiple sites there were multiple site supervisors from multiple companies. Clear communication and planning were required to ensure products arrived at the correct site at the correct time, especially with the 3000 mm pipe which can only be shipped one piece at a time due to their weight.

3000 mm ID diameter pipe lifted into place



100-Year-Old Dam Refurbished with Precast Elements

Mike Vogrig, P.Eng.
Project Engineer, Infrastructure & Operation Division
City of Thunder Bay
Precast Producer: ***Miller Precast Ltd.***

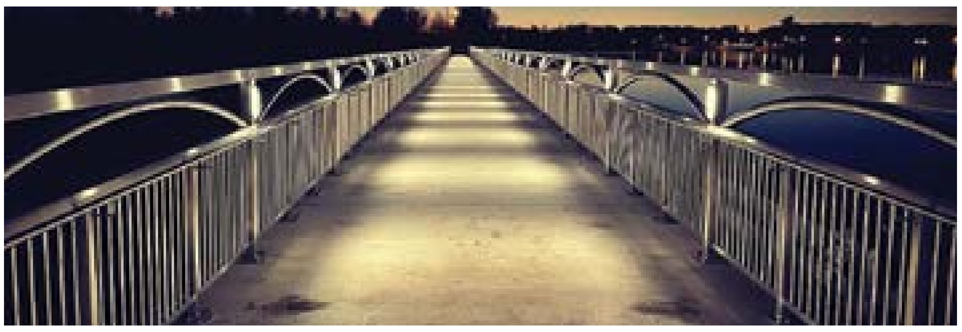
The original Boulevard Lake Dam in Thunder Bay, Ontario, was built in 1901-1902 and the current structure was built in 1906-1907. It was originally constructed to generate electricity for the surrounding area. Some of the electricity generated was used to power streetcars that ran up and down Cumberland Street. The dam created a reservoir, Boulevard Lake, which includes surrounding parkland as well as a 5 km pedestrian loop around the lake and over the dam. Boulevard Lake has become one of the most popular recreational spaces in the City of Thunder Bay. It is also home to the Thunder Bay Canoe Club.

Deck/arch segment lifted into place

The City of Thunder Bay decided that, included in the rehabilitation of the Boulevard Lake Dam structure, the pedestrian walkway would be widened to allow for the increase in pedestrian traffic as well as facilitate snow removal in the winter months.

During the Municipal Class EA leading up to the dam construction/refurbishment, the dam was identified as a heritage structure. The City of Thunder Bay was directed to study and maintain the characteristics of the original dam. A number of deck (pedestrian) panels would be required to have an arch incorporated in the element as well as a sloped broom finish for the walking surface.

The City of Thunder Bay specified precast concrete for the new walkway slabs and arches. Precast concrete provides both the long-term durability and the inherent characteristics of accelerated construction,



Completed dam walkway

two important factors for this project. Additionally, the high level of quality control that is achieved in a precast manufacturing facility helped ensure that the resulting structural elements would maintain the heritage characteristics of the original structure. Miller Precast Ltd., a local Thunder Bay precast concrete producer who supplies precast elements across northern Ontario, reviewed the project requirements and submitted pricing to construct the custom precast concrete slab and arch elements.

Miller Precast utilized its technical manufacturing expertise to construct custom formwork that would enable the rapid production of the arched walkway segment. The main challenge with the arch walkway elements was that each span was different. Miller designed the formwork to allow for flexibility in span of the arch sections while ensuring that each element met the required tolerances. A total of 18 arched deck panels and 11 regular deck panels were needed to complete the project. Each deck panel was 3.66 m wide by up to 4.3 m long. The weight of each panel was up to 10,000 kgs each. The variation in the length and the weight was due to the arch sections which were required to have a different length in order to meet the required span from abutment to abutment.

To add enhanced durability and ensure a service life of 100 years, the City of Thunder Bay required that each element would be temperature-controlled and wet cured for 96 hours. Since the elements were precast, they could be produced and stored prior to the contractor requiring them. The installation of the panels was coordinated with Miller's logistical team. Elements were shipped to the site and a crane was used to drop them into their final position. The precast concrete slabs and arch elements allowed the contractor to install up to five elements per day. The last elements were installed in mid-August 2021.

The refurbished Boulevard Lake Dam is now in operation providing local residents with walking trails and parkland for years to come. The City of Thunder Bay would like to thank Miller Precast for providing custom structural elements that met both the heritage requirements and the expected long service life of the Boulevard Lake Dam.

Roughness Coefficient: Could Impair Pipe Capacity

continued from page 2

Table 1 - Authorities Recommending the Same Manning's *n* Value for All Smooth Wall Pipe

Jurisdiction	*n Value*	Specifications
British Columbia	*0.013*	Master Municipal Construction Document (MMCD) - Municipal Design Guidelines
Edmonton, AB	*0.013*	City of Edmonton - Design & Construction Standards Vol.3
Saskatchewan	*0.012*	Ministry of Highways & Infrastructure - Hydraulic Manual
Regina, SK	*0.013*	City of Regina - Development Standards Manual
Winnipeg, MB	*0.013*	City of Winnipeg - Wastewater Design Guidelines
Ottawa, ON	*0.013*	City of Ottawa - Sewer Design Guidelines
Ontario	*0.013*	Ontario Ministry of the Environment - Design Guidelines for Sewage Works
Ontario	*0.012*	Ontario Ministry of Transportation - Gravity Pipeline Design Guidelines, Circular Culverts & Storm Sewers
Québec	*0.013*	Ministére du Développement durable, Environnement et Lutte contre les changements climatiques - Directive 004
US Federal Hwy Administration	*0.012*	FHWA - Hydraulic Design of Highway Culverts
Great Lakes-Upper Mississippi River Region	*0.013*	Ten State Standards - Recommended Standards for Wastewater Facilities

pipe material. Based on lab experiments, field studies, and hydraulic theory, it is evident that all hydraulically smooth wall pipes should be designed with the same Manning's n Value, regardless of pipe material.

For a simplified and conservative method of estimating pipe capacities and flow velocities in actual working conditions, a constant Manning's n Value of 0.013 for all smooth wall pipe materials will account for the head losses at manholes, pipe joints and fittings, and alignment changes. Sediment deposits and slime buildup inside an in-service pipe also results in the roughness coefficient to be essentially the same for all pipe materials.

Plastic pipe in service will experience ring deflection from external loads with a slight reduction in cross sectional area from a circular to elliptical shape and a flattened bottom. Plastic pipe with an open profile wall (smooth inside layer with corrugated outside layer) also has a thin inner or waterway wall thickness which gives it a wavy appearance and could experience corrugation growth over time. The actual inside diameter of a PVC or HDPE pipe is also generally smaller than a concrete pipe for most nominal pipe sizes. Using a Manning's n Value as low as 0.009 will result in a false notion that a smaller diameter plastic pipe could carry the required peak flow; however, this effort to achieve a more economical sewer design can actually result in a hydraulically inadequate pipe.

Any jurisdiction that still allows the use of an unrealistically low Manning's n roughness coefficient for a sewer or culvert design may be unintentionally putting its own infrastructure and residents at risk of future sewer backups and flooded basements

Precast Stormwater Solution Maximizes Usable Space On Large Distribution Warehouse Project.

Tas Candaras, P.Eng
President
AM Candaras Associates Inc.

Precast Producer: ***DECAST***

A 1 million square foot Amazon warehouse distribution centre located in Ajax, Ontario, just west of Toronto, was recently completed. As with many urban areas in Canada, locating a suitable development site that will accommodate a large distribution centre while meeting the stormwater management criteria is a challenge.

In addition to the building's footprint, a significant amount of area was required to accommodate the logistical vehicles that will be transporting the products. It was essential that the site layout including the stormwater management pond and design optimize the site coverage.

Overhead view of installed precast stormwater structure

The site storm management requirements would have required a large stormwater pond in order to satisfy the stormwater target flows. Based on the limited footprint available for a traditional stormwater management pond, A.M. Candaras Associates Inc. designed a portion of the pond to be extended below the trailer parking area. The DECAST O-Series arches were selected.

A belowground precast structure with a volume of 11,730 cubic metres was required in addition to the open stormwater management pond to satisfy the stormwater management criteria for the site. DECAST in conjunction with A.M. Candaras Associates Inc. worked together to provide the complete solution to Roxboro Excavation Inc., the General Servicing contractor responsible for the heavy civil works. The proposed belowground structures would utilize 144 "O-SERIES" arches, designed and manufactured by DECAST. Each of these arches would have a span of 13.716 m and a weight of 33.29 MT. In order to meet the tight timelines, DECAST was able to manufacture two arches per day. The design consisted of the arches installed on a cast-in-place slab (49 m x 128 m) and placed in three rows. One end of the arches would be capped while the other end would be open to the pond which would also provide access to maintain and clean out the structure as required.

The DECAST slab design contained a keyway where the legs of the arches would rest on shims. Once installed, the keyway was filled with non-shrink grout. The use of the shims allows for both ensuring the levelness of the arches and for the grout to flow under the leg and lock in the structure. DECAST also included joint detailing to ensure the structure would be watertight. This included a butyl mastic placed in the joint and covered with Mel-rol. Roxboro Excavation was able to install 12 to 14 arches per day and the complete installation was completed in 15 working days.

A.M. Candaras Associates Inc. provided the engineering layout design for the belowground stormwater storage with the project Geotechnical engineer providing geotechnical analysis and subdrain design. The DECAST engineering and technical team provided the design and detailing of the cast-in-place slab. The overall design allows for traffic loading and provides the option for the area above the structure to be utilized.

In addition to gaining useable land above the DECAST structures, the excavation volumes for a traditional pond would be less and thereby potentially reduce off-site disposal costs.

From preliminary design to providing the required logistical support, A.M. Candaras Associates Inc. worked closely with DECAST who provided the technical contributions. In addition, DECAST's manufacturing expertise helped ensure project success.

City of Sarnia Microtunneling Project

Bryan Prouse, P.Eng.
Manager, Operation Services
City of Sarnia
Precast Producer: **Forterra Pipe & Precast**

The City of Sarnia, Ontario is experiencing significant growth and like many other municipalities across Canada, Sarnia must upgrade segments of its infrastructure to meet this increase as well as the anticipated future growth.

One infrastructure project that was top of the list for the City of Sarnia was the Bedford Pumping Station Replacement that was rolled out in three phases:

Phase 1 – Trunk Sanitary Sewer and Forcemain

Phase 2 – Indian Road Pumping Station

Phase 3 – Trunk Sanitary Sewer Microtunneling

Construction commenced in 2019.

Phase 3 of the project was specified as a microtunneling installation for the sanitary trunk sewer. The microtunneling option was chosen due to the following challenges and advantages:

- Crossing of a major rail yard - CN.
  - Open cut installation would be very difficult since CN needed to continue to operate the yard. Any temporary rail line shutdowns would also be limited in duration and frequency.
- Sewer depth was approximately 15 m.
  - Using an open cut for the deep sewer installation would require extensive and complex shoring of existing hydro tower pylon bases as well as protecting the existing sanitary infrastructure that must remain in service.
- The use of microtunneling also mitigates disturbances at ground level, minimizes risks of encountering potential contamination from historic petroleum oil transportation methods.

Close up view of microtunneling jacking rig and pipe

Phase 3 would require 1791 m of 1350 mm diameter microtunneling pipe. The external dimension of the pipe is 1689 mm in diameter.

A total of three drives would be required with three shafts sized at 9 m in diameter and one shaft, one sized at 6.5 m in diameter. The shaft at the pumping station will be equipped with a vortex separator for odour control.

- Drive 1:
  - Shaft 3 (Launch – 6.5 m) to Shaft 4 (Receiving – 9 m)
    - Length 498 m
- Drive 2:
  - Shaft 2 (Launch – 9 m) to Shaft 1 (Receiving - 9 m)
    - Length – 675m – under CN rail yard
- Drive 3:
  - Shaft 2 (Launch – 9 m) to Shaft 3 (Receiving – 6.5 m)
    - Length – 618 m

View of launch shaft

In conjunction with CRS Tunnelling, the microtunneling contractor awarded the project, Forterra organized a plant tour for the City of Sarnia's engineering staff as well as AECOM the consulting engineering firm overseeing the project. This allowed for the City of Sarnia staff to better understand the various aspects of the microtunneling pipe product being produced as well as the manufacturing and engineering expertise that Forterra provided to the project.

Forterra prepared the required pipe design for the microtunneling pipe. As with standard reinforced concrete pipe, these structural elements are required to meet the dead and live loading that will be applied to them during their service life. In addition, a microtunneling pipe is required to meet very high axial loading due to the microtunneling installation process. This is typically the governing factor in the pipe's design.

Forterra was also able to mobilize specialized 1350 mm MT formwork, from their Ohio operation, to allow for local manufacturing to take place out of their Cambridge production facility. For this project, Forterra produced 732 pieces (2.4 m long) of 1350 mm inside diameter, 140-D microtunneling pipe. Grout ports are required to be cast into each pipe section in order to provide lubrication as the pipe sections are jacked into place behind the microtunneling machine. CRS requested that every 60 m should include a length of pipe with 5 grout ports. Of the 732 pieces produced, 30 were produced with 5 grout ports and the remainder produced with 1 grout port.

From the start of this project, the Covid-19 pandemic delayed the construction schedule. Setbacks were caused by individuals being quarantined as well as travel restrictions between the US and Canada which delayed the arrival of members of CRS's microtunneling team that are based in the US.

As part of the microtunneling process, CRS did utilize an Intermediate Jacking Station (IJS) for Drives #2 and #3. The IJS is used to ensure that the axial loads would not be exceeded given that both these drives exceeded 600 m in length. For Drive #1, the total length was only 498 m and axial loading would not be an issue.

Although Shaft 2 and Shaft 3 were designed as temporary tunnel launch/reception shafts and Shaft 1 and Shaft 4 were to be cast-in-place, AECOM and the City of Sarnia approached Forterra to see if a precast maintenance hole structure could also be designed and fabricated for Shaft 2 and Shaft 3.

Cooperation on this project was key to its success. One example was CRS, Forterra and Hamilton-Kent (gasket manufacturer) were able to quickly address an issue with the seal between the trail pipe and the steel housing of one of the intermediate jacking stations. Hamilton-Kent was able to redesign the gasket, produce it out of their Toronto manufacturing facility and had it delivered to the job site within 12 hours.

For the City of Sarnia, this was the largest microtunneling project that has ever been undertaken. We would like to thank AECOM, CRS Tunnelling and Forterra for their contribution to the success of this project.

Cement Association President & CEO Michael McSweeney to retire & Adam Auer appointed as new President & CEO.

Michael McSweeney

Adam Auer

On January 5, 2022, The Cement Association of Canada (CAC) announced the retirement of long-time President and CEO Michael McSweeney who led the organization for the past 12 years. Adam Auer, current Vice President of Environment and Sustainability, will step in as the new President and CEO, effective April 1, 2022.

"Michael transformed the CAC into a leading trade association focused on positioning Canada's cement industry as a global leader in the fight against climate change. He worked tirelessly on improving the industry's profile and getting governments and other stakeholders to recognize the importance of cement and concrete. We extend our sincere gratitude to Michael for his leadership and dedication to the cement industry and we wish him all the best in his retirement," said Marie Glenn, Chair of CAC.

Adam Auer joined the CAC in 2012. In his current role as Vice President, Environment and Sustainability, he works closely with government, industry, environmental and other civil society groups to promote and enhance concrete's contribution to sustainability.

"As the manufacturers of the world's second most-consumed material after water, the industry shares a responsibility to find solutions to the challenges of climate change, sustainable construction, and the circular economy," said Adam. "I couldn't be more excited to work with our members, allies, partners and all level of government to help deepen the cement and concrete sector's leadership in Canada's clean economy transition and in building a thriving, innovative and net-zero future."

Outgoing President and CEO Michael McSweeney will turn over the reins as President and CEO on March 31, 2022. He will remain as a strategic advisor to Adam Auer until June 30, 2022.

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