A Real Game-Changer // Thinking Outside the Circle // Beauty and Durability Shine // Going with the Flow

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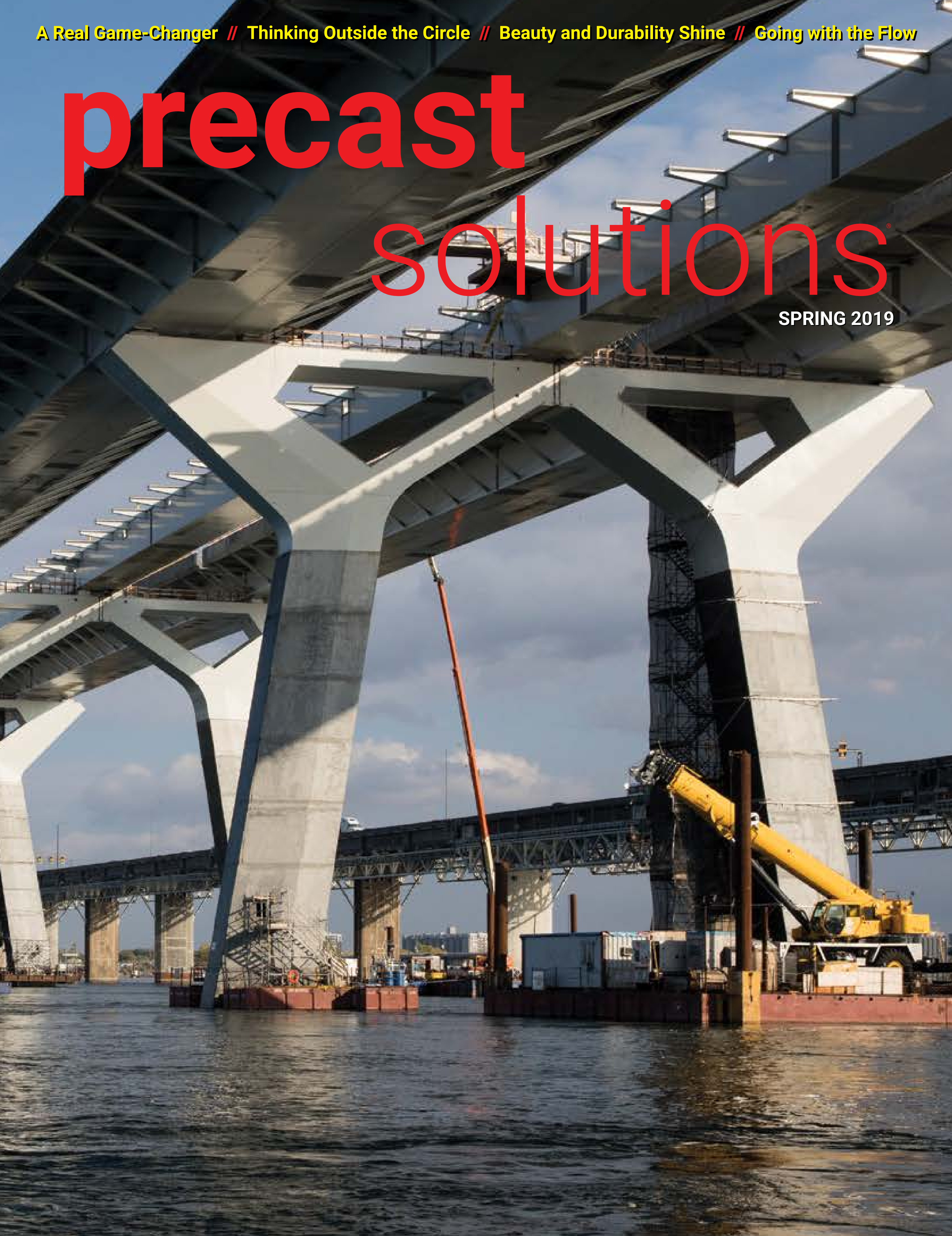
SPRING 2019



precast solutions

SPRING 2019
VOLUME 17 | NUMBER 2

ON THE COVER:
Facing harsh weather conditions, tight timelines and high expectations, replacing the Samuel De Champlain Bridge in Canada had many obstacles to overcome. Thanks to extensive use of precast concrete, the design team was able to accomplish all of its goals.

Photo courtesy of Brooke Duthie

Precast Solutions
(ISSN 1934-4066 print, ISSN 1934-4074 online)
is published quarterly by NPCA,
the association of the
manufactured concrete products industry.

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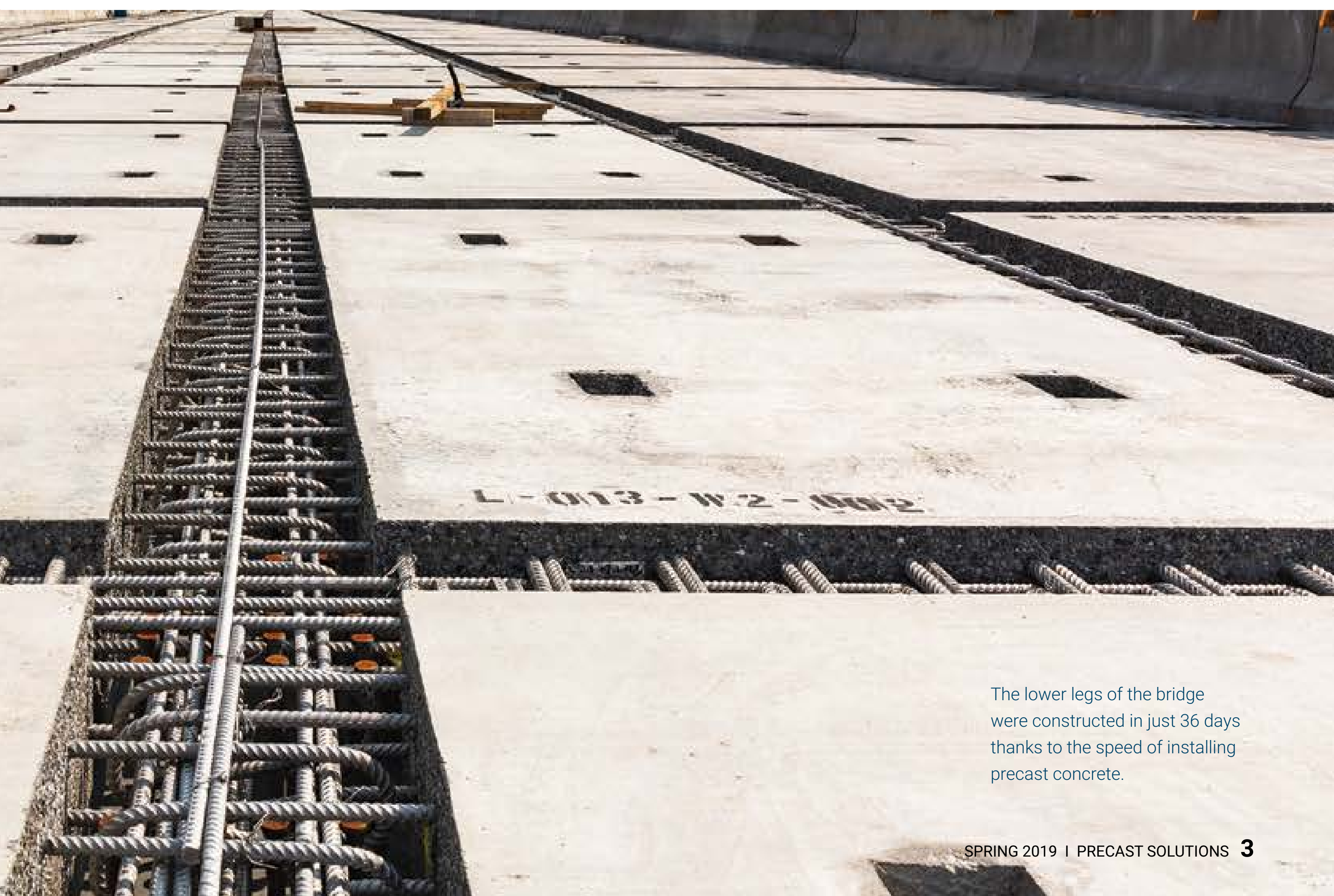
WHAT'S INSIDE

Photo courtesy of Infrastructure Canada



The lower legs of the bridge were constructed in just 36 days thanks to the speed of installing precast concrete.

Thinking Outside the Circle

In a world of round manholes, sometimes it's hip to be square.

By Eric Carleton, P.E.

Everyone knows the saying, "You can't fit a square peg in a round hole." But what if you can't fit the round peg into the round hole? When fitting circular pipes into a circular manhole this can sometimes be the case. Rather than increasing the manhole diameter, the solution may be to use a square precast structure to provide a better fit for the round peg.

Manhole structures serve many critical purposes in sewer and drainage systems. They may be the junction point where pipelines deflect to meet line and grade design conditions, where pipe diameters change, or the convergence of multiple incoming pipes with a single outlet pipe.

IN THE BEGINNING

Prior to the use of precast concrete manholes, sewer and drainage pipes were laid into trenches and the manholes were constructed in the field around the pipe. Typically, this was accomplished with brick and mortar or field-cast concrete. Those structures were either built on top of, or very closely to, the outside diameter of the pipe, and relied on the strength of the vitreous clay, concrete or constructed brick arch pipe for support.

Photo courtesy of Independent Concrete Pipe

Prior to the use of precast manholes - and before safety best practices became a top priority - pipe was laid into a trench such as this one with a manhole being constructed in the field around the pipe.

Panel forms like this one offer added variability of structure dimensions but added labor time to assemble.

Consequently, the primary consideration for the manhole size was to provide adequate room for workers to descend and ascend. Though some structures were built as small as 36 inches in diameter, most jurisdictions today have settled on 48 inches to be the minimum nominal manhole diameter.

Historically speaking, we cannot pinpoint the invention of the manhole structure. However, sometime in the early 20th century a contractor, engineer, or possibly a concrete pipe manufacturer, had a "light-bulb" moment and realized if precast concrete tubes can be installed horizontally, they can do the same vertically. That simple thought of shifting the installation axis 90 degrees brought all the benefits of precast concrete structures to sewer and drainage manholes.

A LITTLE BIT OF MATH

This new invention presented an interesting challenge. The intersection of two cylindrical shapes at 90 degrees creates an elliptical opening in the vertical cylinder rather than a simple circular opening.[1] The horizontal and vertical axes of this ellipse also need to be increased in order to provide adequate clearance for pipe connections. This means adequate annular space accounted for when grout filling if permitted, or the guidelines established by the resilient rubber pipe-to-manhole connector if specified.

National Precast Concrete Association has developed an excellent document on this subject, appropriately titled, "Manhole Sizing Recommendations."[2] This document provides the minimum circular manhole diameter for a variety of pipe types, diameters and deflection angles. The conservative design assumptions

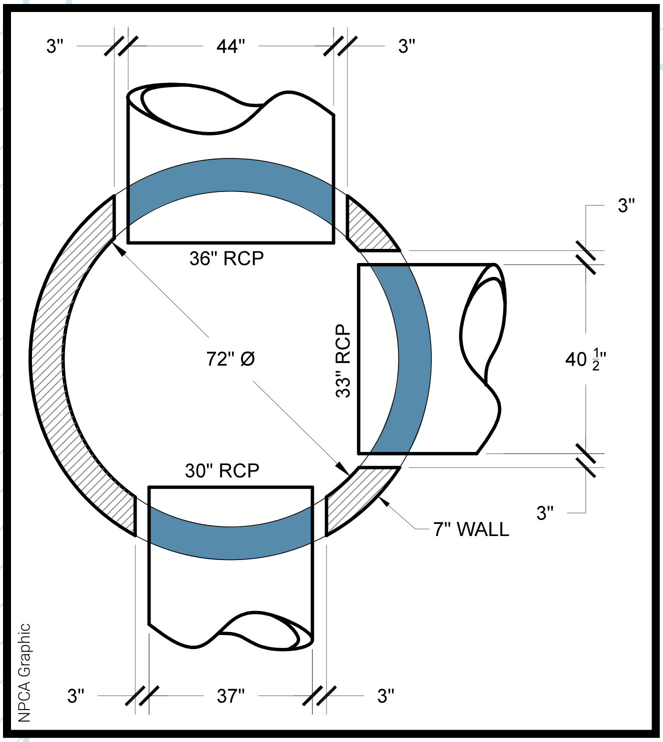


Figure XX: To accommodate a circular pipe, the openings in a circular manhole will be elliptical in shape.

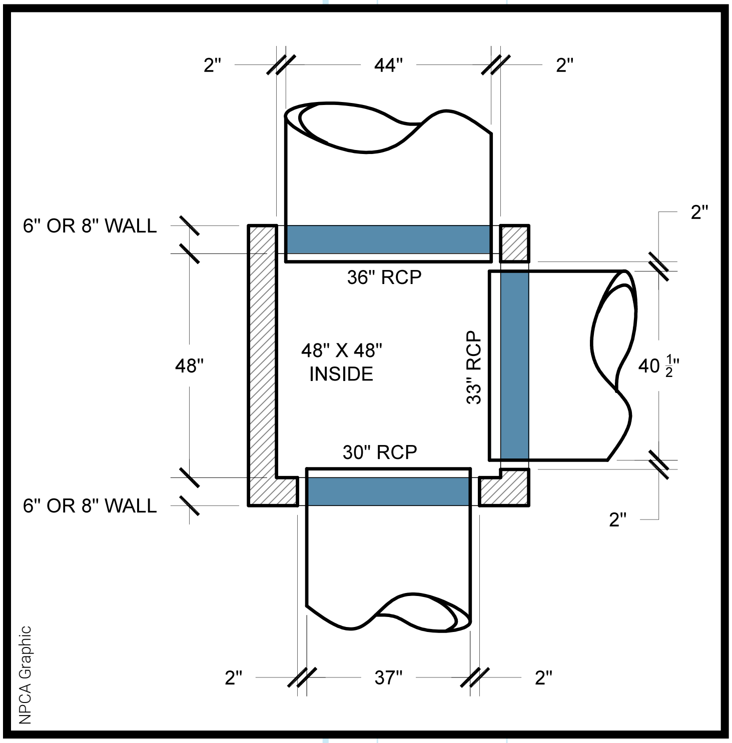


Figure YY - Example conversion of Figure XX to a square manhole. A perfectly round opening on the side of a square manhole will accommodate a round pipe.

provide for an elliptical opening 6 inches greater than the outside diameter of the pipe and a minimum inside wall spacing of 6 inches between the openings. This guide is intended for grouted connections only and not resilient rubber connectors. Resilient rubber pipe-to-structure connections require minimum rubber compression or solid steel band expansion on a curved surface. Consequently, manhole diameters may need to be increased beyond those shown on the sizing guide. Manhole sizing per the manufacturer's recommendations will ensure a good seal for applications using resilient rubber connections.

A DIFFERENT WAY OF THINKING

Circular manholes are ubiquitous today, but what happens if we think outside the circle? In other words, what if we eliminate the cylindrical manhole and replace it with a square or rectangular shape? As with the example shown in Figure XX, when pipe orientations are at 90 degrees to each other, the transition from round to square (Figure YY) becomes very feasible. Now the pipe-to-structure interface is transformed from the previously elliptical configuration to a true circle; and that simplifies everything. This configuration allows improved homing ease to possibly revise the normal cast or cored opening tolerance from outside diameter +6 inches to outside diameter +4 inches. Additionally, for the resilient connector there are true and uniform walls which rubber can be solidly cast into or be used to compress against. And importantly, this shape revision makes a dynamic change to the structure size accommodating the connection. For the 72-inch round manhole design in Figure XX, the same pipe configuration could fit within the smaller 48-inch-by-48-inch box structure shown in Figure YY.

This reduction in the size of the precast structure could provide many logistical benefits, including site storage, handling and pick weight,

A rectangular structure can provide a variety of benefits including making pipe-to-manhole connections eliminating utility conflicts or even reducing installation costs.

eliminating utility conflicts and potentially reducing the overall installed costs. However, specific delivered structure costs may or may not be less expensive depending on the precaster's type of rectangular forming system. Using fixed form or a panel-type system offers differing features and labor requirements for set up.

An important consideration when switching from a circular precast manhole to a rectangular shape is the reaction to the applied loads and the corresponding design and steel requirements to handle the loads. For the traditional circular manhole, the installed loading primarily creates a ring compression condition requiring minimal circumferential steel. A rectangular wall will need to


Photo courtesy of Independent Concrete Pipe

In certain cases, some reinforcement may be left intact to provide additional stability for shipping and installation.

resist the bending and shear reactions to the buried loads. Additionally, for minimum-sized structures the wall corners between two large pipe openings need to resist the vertical axial loading and may need to be evaluated more as a column rather than a wall section. For this reason, having the ability to easily vary structure wall thickness to optimize design for steel area and placement can be very beneficial.

AN IMPERFECT SEWER AND DRAINAGE WORLD

Certainly, traditional circular manholes provide a great solution. However, the benefits of a flat pipe-to-manhole intersection must also be considered. Precast formwork is adaptable, and the precast industry is advanced enough to fabricate a variety of geometric configurations:


Photo courtesy of Independent Concrete Pipe

triangles, hexagons and even octagons, if the need is there to offer that beneficial flat connection surface.

Perhaps the time is now to think outside the circle and consider an alternative manhole structure. PS

Eric Carleton, P.E., is NPCA's director of codes and standards. He is an ASTM Award of Merit recipient and currently serves as vice-chairman of ASTM C13 on Concrete Pipe.

Endnotes

1 Precast Math Tools: Calculate the Manhole Blockout Volumes: https://precast.org/2012/11/precast-math-tools-calculate-manhole-blockout-volumes/?fs=precast%20math%20tools

2 NPCA Manhole Sizing Recommendations: https://precast.org/precast-product/manholes/

These square manhole sections are awaiting placement on the jobsite. The vertical lines on the structure surface are indicative of using panel forms to fabricate the sections.

Photo courtesy of Garden State Precast

Going with the Flow

Precast concrete replaces cast-in-place to save time and labor on a new solid/floatable screening facility along the Hudson River.

By Shari Held

Photo courtesy of Garden State Precast

Weehawken, N.J., was dealing with a sewage problem, and precast concrete is helping protect the city and its residents.

Weehawken, N.J., has enjoyed its fair share of memorable moments in history. Henry Hudson dropped anchor in Weehawken Cove in 1609 during his third voyage to the New World. It served as the site of the famous duel between Alexander Hamilton and Aaron Burr, and it became a favorite retreat for the rich and famous in the late 19th century. But in recent times, Weehawken had a problem common to areas with combined sanitary and stormwater systems – how to stop raw sewage from polluting the Hudson River.

At low flow, discharge from Weehawken's two outfall pipes was directed to a sewage treatment plant. But during times of heavy rainfall, the combined sanitary and sewer system would overflow and head straight into the Hudson Rivler. Continued combine sewer overflow (CSO) would put Weehawken in violation of Environmental Protection Agency mandates and would not be healthy for the community.

Weehawken chose to install a twin-chamber screening station and connect it to the existing six-foot and eight-foot diameter outfall pipes. Nets, mounted in the two chambers, would collect the debris. The ambitious project also included a sophisticated bypass system that could divert water flow to one chamber while workers performed maintenance on the other chamber.

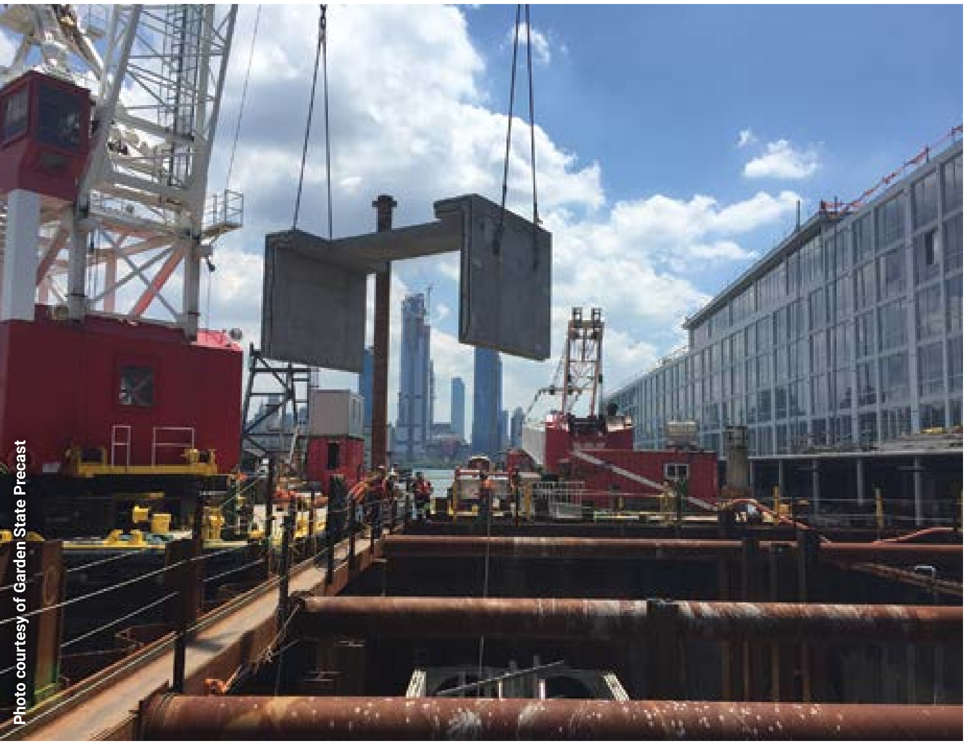
The original plan called for cast-in-place concrete. But Cranford, N.J.-based Weeks Marine, general contractor for the project, thought precast might be a better solution. The contractor invited Garden State Precast, which had successfully performed similar projects of this size and scope in New York City, to quote the job with precast. It was a pivotal decision.

PRECAST PREVAILS

"We took a cast-in-place project of a very large scope and made it precast," said Paul Heidt, vice president of specialty precast sales for Garden State Precast, based in Wall Township, N.J. "This allowed the project plan to be changed for the benefit of all parties."

Replacing cast-in-place with precast concrete saved money, reduced construction time and impact to the community, and created better on-site working conditions.

Weehawken didn't have to close a nearby road for 30 days and also didn't experience the inconvenience of concrete delivery trucks and



Crews assembled precast concrete elements on a barge and shipped them up the Hudson River to the jobsite.

concrete pumps during the pouring process. Plus, the precast elements could be shipped and staged on a barge, reducing the project's footprint.

In addition, using precast eliminated the need to keep the job site watertight during the on-site pouring and curing phases required by the cast-in-place process.

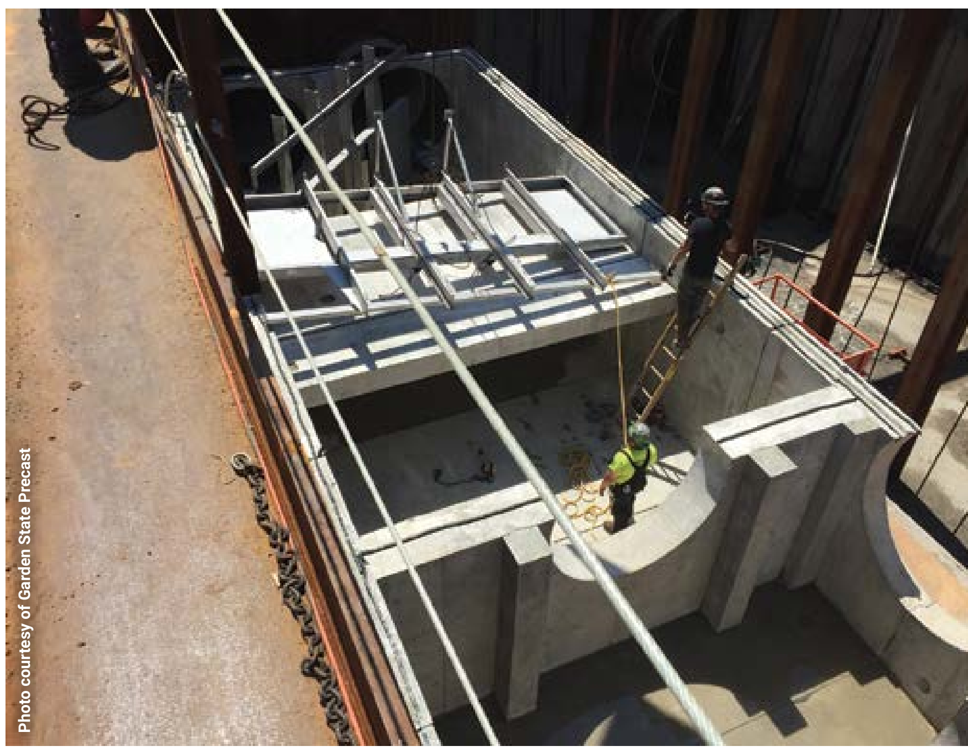
"That's a hard thing to do, and it's expensive," Heidt said. "Once the precast went in, the area could flood and then just be pumped out so the crew could go back to work."

It's a good thing, too, since the summer produced plenty of rain storms, some of which could flood the area within a mere five minutes.

"One of the main reasons we chose precast was for the time savings," said Sofia O'Brien, staff engineer for Weeks Marine. "While Garden State was casting the elements at their facility, we were able to continue other work on-site and have them deliver when we were ready for the installation. It really sped up the process."

FABRICATING FOR PRECISION

It was no small undertaking to fabricate the precast elements. Each chamber measures 16-feet-by-48-feet-by-16-feet tall and weighs 300,000 pounds. Garden State Precast



fabricated 11 elements for each chamber – 22 elements altogether. They ranged in weight from 33,000 pounds to 83,500 pounds. In terms of size, the smallest piece measured 5 feet long, 18 feet wide and 9 feet high, with the largest one coming in at 11 feet, 8 inches long, 18 feet wide and 9 feet high.

"Each piece was individual," Heidt said. "Each piece is unique to the setup."

Garden State Precast used the local preapproved Department of Transportation concrete mix (5,500 psi) that everyone was familiar with and reinforced it with epoxy-coated steel rebar.

Precision was imperative for the success of the project. To ensure the 11 pieces of each chamber would fit flush after fabrication, Garden State Precast cast the elements one against each other.

It took about six weeks to fabricate each chamber. Production on the North chamber began in April and production on the South chamber was complete in August.

The biggest challenge during the fabrication process was the amount of space required to accommodate a chamber. The Weehawken project took up to 50% of Garden State Precast's production area for six weeks at a time. It made fabricating other projects difficult. To maximize floorspace, workers extended the crane reel, putting more production area under the crane.

DELIVERY AND STAGING BY BARGE

Garden State Precast delivered the first 11 elements to Weeks Marine's Jersey City shipyard via truck. From there, they traveled up the Hudson River by barge to the job site. The logistics of barge loading was another challenge. Elements needed to be loaded in a sequence that balanced their total weight on the barge.

A 100-ton revolving crane on a second barge set each of the 11 pieces on the materials barge. Then both barges made the hour-long trip up the Hudson River past the Statue of Liberty to Weehawken. It was slow going to ensure the barge wouldn't capsize with its 300,000-pound load.

The job site was in a congested, urban residential area with minimal road access and lots of pedestrian activity along the sidewalk. To further complicate work on the project, construction of a new condominium community was in progress a scant five feet from the edge of the Weeks Marine job site. Working conditions wer tight even with using the barges as a staging area.

"Making sure the picks were good was very important for the safety of the public,"

Photo courtesy of Garden State Precast

Crews were able to assemble the pieces on barges and quickly install them on the job site.

The first chamber was installed in a mere four days, with Garden State's team providing assistance and training to the installation crew.

O'Brien said. "It was so tight we had to confirm that the equipment we were using had the right capacity to pick and set. One of our biggest concerns was whether it would reach 90 feet with a 45-ton piece."

GOING UNDERGROUND

No land was available near the two outfall pipes, which meant the twin-chamber facility had to be built in a pier slip along the coast. Conditions were challenging 25 feet below sidewalk level where workers would install the two chambers. As if the job site constraints weren't enough, Mother Nature played a part in the installation process challenge as well.

"They based the design for a capacity of 480 million gallons of water per day," O'Brien said. "But this past summer we had that 10-year storm event that you don't plan for pretty much every single week."

The rains didn't let up during the installation process either.

"Anything we did had to be able to be completed or left as is until the next day in anticipation that the site would flood overnight," Heidt said.

Despite the difficulties involved with cofferdam construction, the installation went without a hitch, taking only four days to install the North Chamber.

Garden State Precast oversaw the first installation, providing advice and training to Weeks Marine. Garden State Precast's crew needed to ensure there were no issues with the sealants or the cables used to post-tension the elements. Weeks Marine backfilled the excavation area, and the North Chamber was ready to go.

"It was a learning experience and a teachable moment for us," Heidt said. "Anytime you can be an ambassador for your company and for precast concrete while performing a valuable function of aiding the install, it's a good thing."

It took only two days for workers to install the South Chamber. Weeks Marine installed it while the Garden State Precast crew attended the National Precast Concrete Association's Annual Convention.

"My phone didn't ring once," Heidt said. "That was the best news I had all day."

The quick installation considerably reduced on-site labor costs. By installing the units in only

The new screening facility is up and running with trash and debris being collected in the massive chambers rather than flowing freely into the Hudson River.

six days instead of 10, crews were able to save up to $3,000 per day.

The original project plan also called for the creation of a park, situated atop a cast-in-place slab covering the two chambers, but that was changed to precast too. The park will also serve as the access point for the service truck that will collect the trapped debris. To meet H-20 traffic loading criteria, the roof of each chamber includes inserts that accommodate heavy-duty reinforcement rebar. Workers threaded the rebar through the inserts to tie the chambers to the top deck slab.

Weeks Marine also asked Garden State Precast to fabricate the park's 15-foot overhang deck. It was originally designated as cast-in-place.

"There's only so much work you can do when it's high tide, unless you have divers," O'Brien said. "That gets a little difficult, so we decided to go with precast for the overhang deck, too."

The park is slated to be finished this summer.

SUSTAINABLE FROM START TO FINISH

The Weehawken W 1234 Solids/Floatables Screening Facility was a sustainable project in many ways. Construction occurred with minimal disruption to residents and the surrounding area. And once the project is complete, they can enjoy the new green space.

More importantly, Weehawken's new trash removal system is in place and doing its job. No longer do waste solids and floatables flow unimpeded into the Hudson River when large storms pummel the area. Instead, the netting traps the majority of the debris, which is collected and disposed. Water flow is improved, and the negative impact to the environment will be substantially reduced.

"This will provide Weehawken with a watertight, long-term solution that's rated to last 75 years," Heidt said. PS

Shari Held is an Indianapolis, Ind.-based freelance writer who has covered the construction industry for more than 10 years.


Photo courtesy of Brooke Duthie

Beauty and Durabilit
Samuel De Champla

With a tight timeline and harsh conditions to overcome, the design-build team took on the challenges with high expectations and lofty ambitions.

By Kirk Stelsel, CAE

The Samuel De Champlain Bridge features extensive use of precast concrete and is one of Canada's most well-travelled bridges.

ty Shine with ain Bridge

Replacement of a bridge structure requires a deep understanding of current challenges and future needs, as well as thorough planning and coordinated execution. There are the obvious design, demolition and construction stages, but behind the scenes, many other factors loom such as environmental concerns, traffic mitigation plans, public support campaigns, funding models and the imperative selection of the right partners.

The larger the project, the more complex all these considerations become, so when the planned bridge is a $2.4 billion replacement for one of North America's busiest spans, with 50 million vehicles passing over it each year, the stakes ratchet up to peak levels.

A WORK OF ART MADE TO LAST

Among the top considerations for the Samuel De Champlain Bridge – a 2-plus mile span over the St. Lawrence River that serves as a major link between the U.S. and Canada and the gateway to Montreal – were the timeframe, aesthetics and lifespan. It's no easy task to design and build a bridge of that magnitude that will both complement the city it serves and have a useful lifespan of 125 years. To attempt to do so in just 42 months, due to the state of the existing bridge, takes things to a new level.

More than 10,000 precast concrete elements ranging from pier leg segments to architectural elements were produced by Beton Prefabrique for the project.

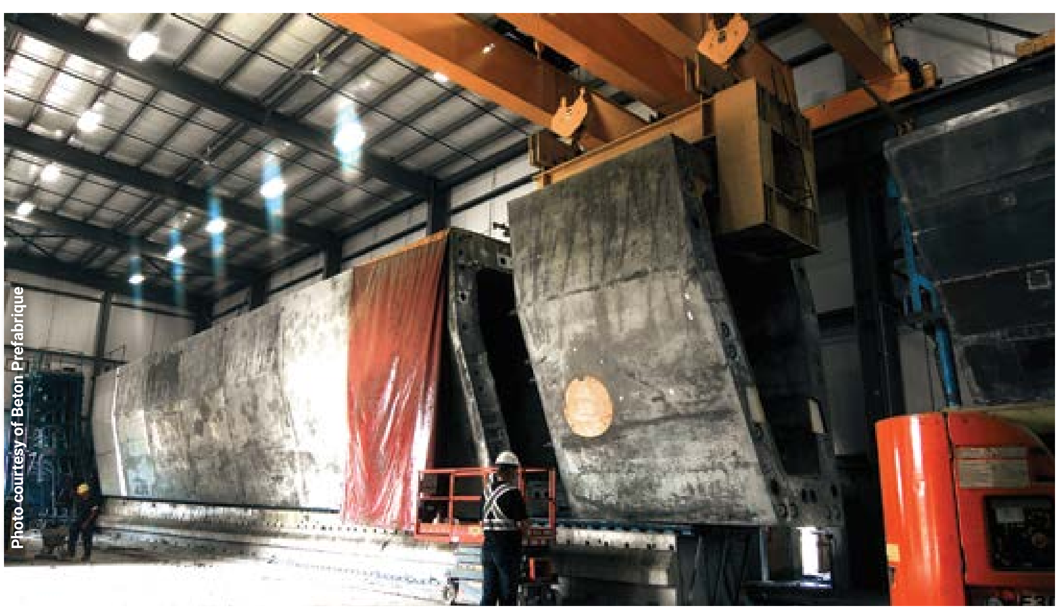


Photo courtesy of Beton Prefabrique

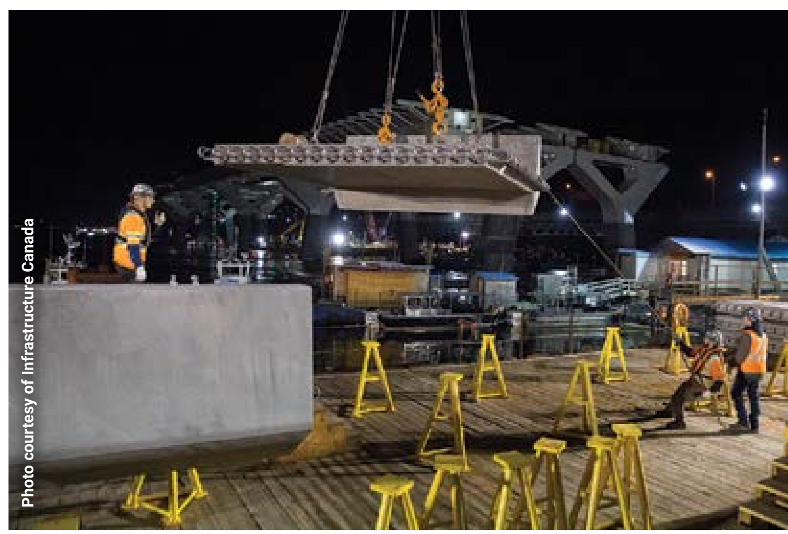


Photo courtesy of Infrastructure Canada

"On a megastructure like this, even if you're in very friendly weather, that would have been considered a very aggressive schedule," said Marwan Nader, senior vice president with T.Y. Lin International Group and engineer of record for the bridge. "When you come to Montreal, there will be at least 3-4 months of very harsh conditions so what happens is you're basically dealing with a much shorter duration of effective time. That, to some extent, was the focus of the design-build team when we were looking at construction means and methods."

The design team chose methods tailored to these factors. One element of the plan called for segments that a standard crane could lift to minimize the amount of field work and increase pace. In addition, construction crews performed work in parallel in three sectors: the west approach, the cable-stay bridge and east approach. The team also chose to use various precast products to accelerate the construction schedule. A major application was precast concrete pier sections to avoid having to deal with cast-in-place concrete and to be able to build during inclement weather while still having a high degree of quality.

"With precasting inside a shop, you have a lot more control in

Photo courtesy of Infrastructure Canada

The bridge deck is made up of 9,638 precast concrete deck slabs.

terms of the spacing of the rebar and where you place things and match casting," Nader said.

The structural precast concrete match-cast segments were used for the lower portion of piers along the west and east approaches and the inclined lower portion of the main span tower up to the upper crossbeam, referred to as the bow tie because of its peculiar shape. The segments of the west approach piers were set on gravity-based footings and pier starter segments cast in a CSA Group-certified temporary precast plant on-site due to weight.

One area of major concern for the design team was the effect ice abrasion has on bridge piers over time. Another was the generous use of

road de-icing salts through the winter seasons. To mitigate these future issues, the designers specified high-strength/high-performance concrete for the segmental precast pier starter pieces to create built-in ice abrasion resistance. In addition, all deck precast elements required stainless steel rebar to withstand the corrosive nature of the salts. Elements were also cured in humid chambers to achieve the required durability.

NO TIME TO WASTE

As the existing Champlain Bridge has approached the end of its service life, it has received extensive structural repairs and reinforcement just to keep it in operation until the new bridge opens. To keep time on their side, the designers specified precast concrete elements for not only the piers but also the deck panels and other facets of the project.

"Extensive use of precast concrete as a construction strategy for this project was based on a number of factors including the project's tight schedule, Canada's requirements for the delivery of a highly durable product and the fact that the bridge needed to be built while accounting for Montreal's rigorous winter season," said Guy Mailhot, chief engineer at Infrastructure Canada, the owner of the project. "The design-build team was able to achieve the expected results through careful planning, attention to detail and the use of good surveying methods to ensure proper geometrical control in assembling the large number of precast components."

BPDL, a precast company with its head office in Alma, Quebec, manufactured the precast elements. During the project, four BPDL plants – primarily the St-Eugene's plant, which is 56 miles from the job site – manufactured 315 pier leg segments; 44 pylon segments; 9,636 deck slabs; 32 box girders; 142 girders; 66,415 square feet of architectural precast panels; 495 precast panels for the electrical rooms; and other precast concrete elements including retaining walls, pipes and more. Once on site, crews installed the deck slabs at a rate of 440 panels per week and constructed the lower legs in just 36 days. The architectural panels were used for the walls of the uniquely shaped east and west abutments, the latter of which is 231 feet wide.

"As the project was design built, it required a lot of flexibility for our whole team," said Robert Bouchard, CEO of BPDL. "We had six draftsmen

The new bridge was constructed adjacent to the old one to limit traffic disruptions. With the old bridge nearing the end of its service life, crews wanted to build the new bridge as quickly as possible.

full time during the two years dedicated to this project. We had to double our labor in a situation where Quebec is struggling with a lack of labor and workers and double, even triple our transport teams – we are talking here of approximately 5,000 loads in a timeline of a year and a half."

READY FOR THE SPOTLIGHT

The team completed the bridge's major structural works in December, and the bridge is expected to open to traffic in June 2019. This spring, some of the permanent finishing work, notably waterproofing and paving, will be completed.

The new bridge was built just downstream of the existing Champlain Bridge, which remained fully operation during construction. This approach kept traffic disruption at a minimum. The new bridge includes two three-lane roadways, a path for pedestrians and cyclists, and accommodations for a light-rail system.

Photo courtesy of Beton Prefabrique

"I would say everyone has been pleased," Nader said. "It's really a streamlined process, and I think you'd get folks from design and construction to say that they are quite satisfied."

Bouchard agreed. "All BPDL employees are particularly proud to have participated in such an important project – after all, the Champlain bridge is one of the bridges with the most important traffic demands in Canada!"

Most importantly, the Canadian government is pleased with the work completed to date and the overall appearance of the structure, and feedback from the public about the construction process and the appearance of the structure has been overwhelmingly positive. Adding to the kudos, the bridge has earned high honors for its sustainability. The project earned the Envision Platinum award – the highest there is – from the Institute for Sustainable Infrastructure, the first large-scale bridge to do so in Canada.

As millions of motorists, cyclists and pedestrians begin to use the structure for its intended purpose for the first time later this year, its safety, beauty, functionality and sustainability are sure to earn their admiration and appreciation as well. PS

Kirk Stelsel, CAE, is NPCA's director of communication.

The Samuel De Champlain Bridge should be open to traffic this summer with finishing work being completed this spring.

A Real Game-Changer

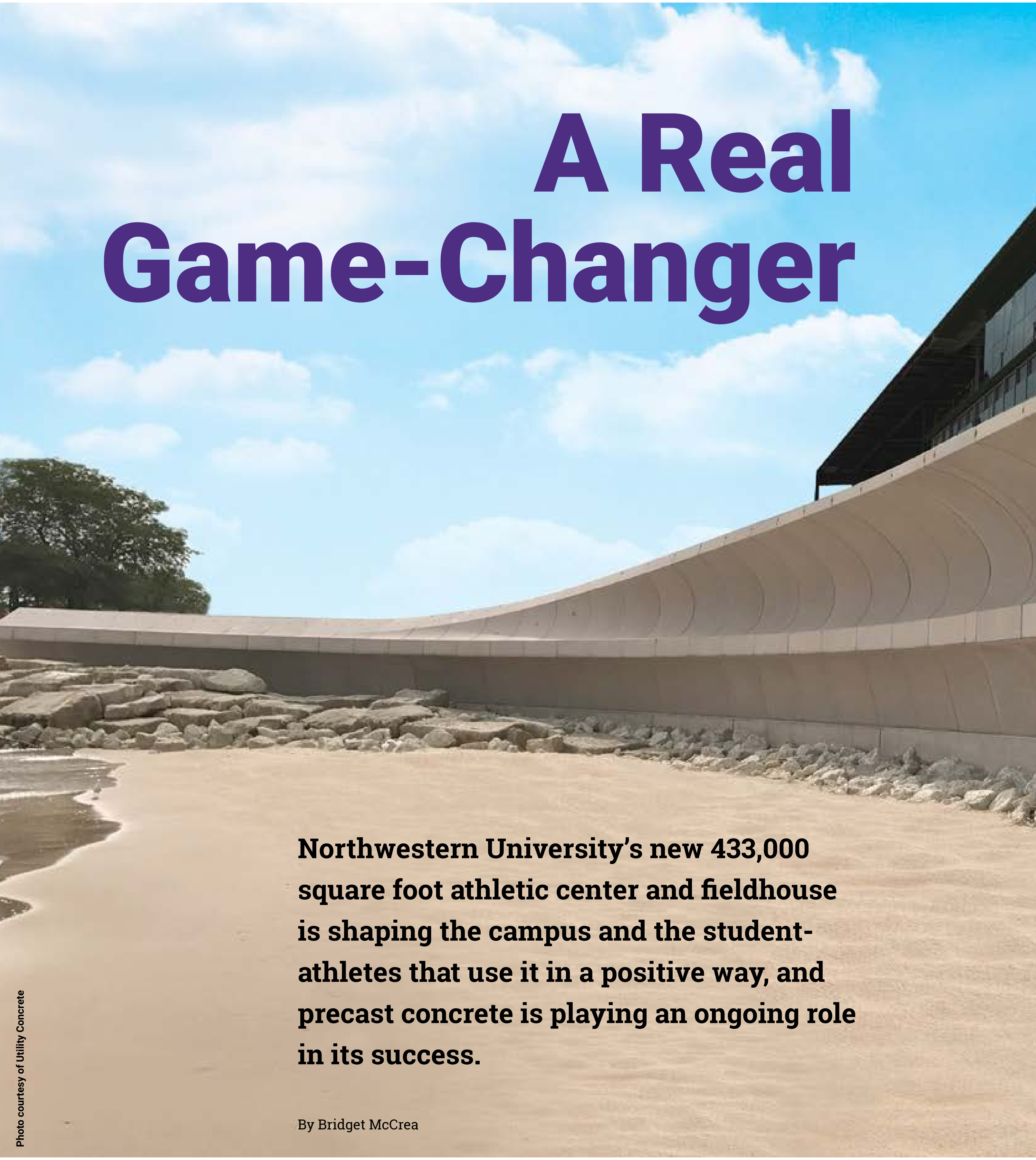


Photo courtesy of Utility Concrete

Northwestern University's new 433,000 square foot athletic center and fieldhouse is shaping the campus and the student-athletes that use it in a positive way, and precast concrete is playing an ongoing role in its success.

By Bridget McCrea

When Northwestern University decided to build an ultra-modern athletic facility on Lake Michigan, it knew it would have to come up with a solid plan for dealing with Mother Nature and the storm waves she likes to spin up from time to time.

Built right on the water's edge in Evanston, Ill., the $270 million Ryan Fieldhouse and Walter Athletics Center project spans 433,000 square feet. Completed last year, the state-of-the-art facility is one of the premier sports centers in college athletics.

"The Walter Athletics Center has been an absolute game-changer for Northwestern student-athletes," said Brian Baptiste, Northwestern's deputy athletic director. "For the first time, core support services like academics, sports performance, athletic training, performance nutrition and professional development are under one roof, and integrated within the heart of Northwestern's incomparable campus."

Achieving that goal took some ingenuity on the part of project engineers, who had to come up with a way to buffer the waterfront facility, and the people who use it, from Lake Michigan's waves. To solve this fundamental challenge, Chicago-based SmithGroupJJR, engineer of record, used a precast concrete wall that not only shields the beautiful new facility from the elements, but also includes an aesthetic that matches the shoreline environment where it's located.

Patrick Brawley, principal at SmithGroupJJR, said the wall needed to serve two purposes.

"We worked with the university and the

A precast concrete wave wall was crucial in protecting the building and people using the nearby trail from the harsh conditions of Lake Michigan.

architects to site the building and design a coastal wall that would enable construction of the facility and ensure that it wouldn't be adversely impacted by the coast action that occurs when Mother Nature decides to let loose," he said.

A TRIP TO TEXAS

For the precast wall, Brawley's team conducted various numerical and physical modeling tests to devise design scenarios. Early in the design phase, both filling in the lake and using offshore breakwaters were taken off the table.

"We were exploring alternative options – including moving the building back away from the shore, but there were still concerns about the wave actions and the fluctuation of the lake levels," he said.

In search of a viable solution, the engineers conducted a metric survey of the lake and then took their data to Texas A&M University's Offshore Technology Research Center, which operates a unique model testing basin that's used for offshore technology, education, research and testing.

"It's basically a large wave pool that we used to recreate the site for the new athletic center," said Brawley, whose team used historical wave data obtained from lake buoy surveys to model


Photo courtesy of Utility Concrete

The wall is designed to deflect both the waves and splashes of Lake Michigan, redirecting the water back into the lake.

Precast concrete was chosen for the project because of its aesthetics, durability and flexible design qualities.

certain storm events. It didn't take long for engineers to realize that a wall barrier would be Northwestern's best option. Without a wall, both the water and spray would be elevated into the air and would not only impact the structure, but also the pedestrians walking in and out of the building along the shoreline.

"We also looked at the climatic conditions and potential ice buildup and what these could do to the building," Brawley said. "That started dictating the need for a curved wall to serve as a

because those were U.S. waters and not on private property; our permits didn't allow us to stage work there."

The engineers also considered plastic for the project, mainly due to its translucent qualities, but the team had concerns about its durability so that idea was scrapped as well.

In the end, precast concrete won for its durability, flexible design qualities, and ability to blend well with its surroundings by curving and undulating to match the shoreline where it's located.

"We didn't want the wall to just be a utilitarian piece," Brawley said. "We wanted it to be integrated into the site, and precast enabled design flexibility. We didn't just want standard concrete. We wanted it to blend in with and be responsive to the environment."

barrier between the lake and the center."

As for the wall materials, the project design team explored its options before deciding on precast concrete.

"The level of design and finish we were looking for was hard to achieve with cast-in-place and there were also some regulatory constraints because the wall could only be implemented from its backside," Brawley continued. "We weren't allowed to be on the lake side of the wall during implementation

KEY PROJECT CONSIDERATIONS

Using precast provided the most watertight solution on the wall's backside, opening up the engineers' options for anchoring the wall and proper securing of the structure from the back of the wall.

"We were able to reduce the use of mechanical fasteners and fill in the gaps on the lake-facing side of the wall," Brawley said. "That was another unique aspect of the precast."

Precast concrete's durability also came into play during the material selection process. Knowing just how much force Lake Michigan can unleash during storms, both upward lift and potential torque were taken into consideration.

"We actually have more caissons supporting the weight-wall than there are caissons supporting the entire building, which is unique from a site standpoint," he said.

Envisioning a wall with distinct curves that replicated the appearance of a wave, the project's architects wanted a structure that was both durable and aesthetically pleasing. Consisting of 109 5-foot-wide segments, the precast wall was designed to stand at 20' tall and taper at each end where it begins to flatten, similar to a wave.


Photo courtesy of Utility Concrete

According to Tom Heraty, vice president of sales and engineering at Utility Concrete Products in Morris, Ill., who produced the pieces for the project, the self-consolidating concrete mix design incorporated Scofield SG "Sand Buff" liquid integral color, which was altered to match a sample of existing building limestone. The segments were sandblasted by UCP's team for a final product that achieved the architect's desired appearance.

Other important considerations included the precise placement of epoxy-coated reinforcement, embedded stainless steel angles and hot-dipped galvanized/epoxy connectors within the high-strength concrete. Using UCP's design, the contractor bolted down the wall at specific points and then continued with the expedited installation process, instead of using a bracing system and waiting for the grout in the sleeves to set up.

The location of the connection elements was critical and required very tight tolerances, but all the segments were placed with no fit issues.

MEETING CREATIVE AND STRUCTURAL REQUIREMENTS

Designed with inward and outward radii, the wall includes two levels of wave breakers that catch, deflect and redirect the water as it hits the structure. The first level stops the waves from eroding the building's foundation while the top level keeps pedestrians dry.

"When waves come up, they hit the wall, climb up it and then hit the horizontal lip,"

The new Ryan Fieldhouse and Walter Athletics Center at Northwestern University is a state-of-the-art facility, and precast concrete made the project feasible.

Heraty said. “We also added a 20-foot-tall top portion that prevents splashing over the wall.”

Time was of the essence on the project, and precast made the tight timeline possible.

“The foundation for the building was in place, but in order for the other phases of the project to continue, the wall needed to go in within a certain period of time,” Heraty explained. “They wouldn’t have had time to cast-in-place on that schedule.”

The only challenge during construction was setting the first piece of precast, which was actually in the middle of the wall rather than the beginning or end.

“Once that was done, the pieces were set and ready to go,” said Brawley, who often recommends precast to other engineers for its ability to meet specification requirements. For example, on this project, designers had specific strength requirements that had to be incorporated, including those impacting the wall’s final shape and form.

“We reached that goal,” he added. “By selecting precast, we got a material that was flexible and fluid enough to respond to our creativity while also meeting the structural requirements.”

Asked how everything is going with the university’s new athletic center and field house, Baptiste said that just six months into its existence, the facility is already transforming student athletes’ lives. As proof that the wall is one of the most interesting aspects of the project, Northwestern Football Coach Pat Fitzgerald points it out every time he gives a tour of the facility.

“It has built a foundation for the world-class experience we aim to provide each of the more than 500 young men and women that represent Northwestern across 19 varsity teams,” he said. “Walter Athletics Center has established a new standard for student-athlete development in college athletics.” **PS**

Bridget McCrea is a freelance writer who covers manufacturing, industry and technology. She is a winner of the Florida Magazine Association’s Gold Award for best trade-technical feature statewide.