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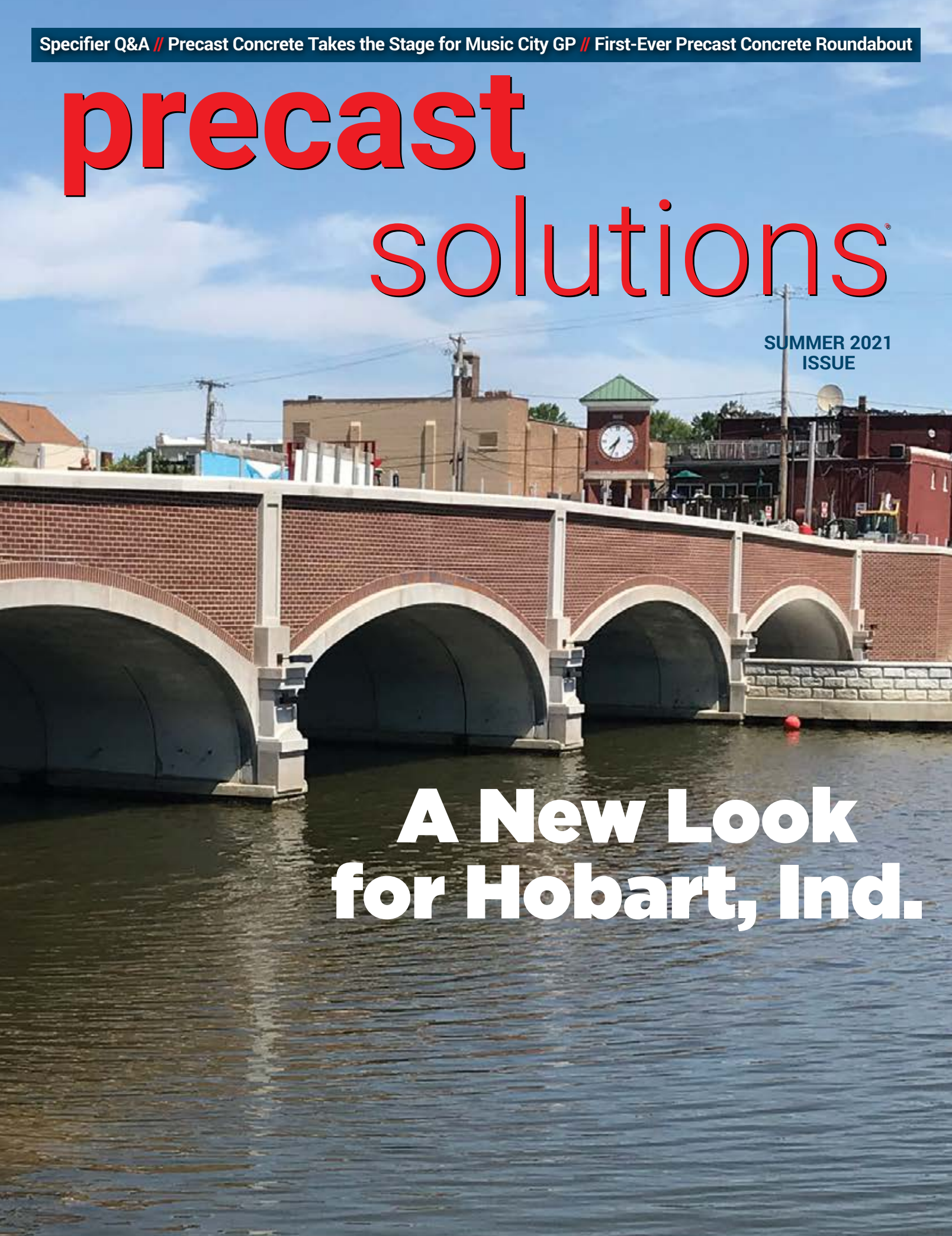

A New Look for Hobart, Ind.

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ON THE COVER:
The Third Street Bridge in Hobart, Ind., is the first of three projects that will reshape drainage and bring new life to the downtown.

Image courtesy of County Materials Corp.

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Specifier Q&A

Richard S. Giessel, P.E.

State Quality Assurance Engineer at
Alaska DOT & Public Facilities

What's your background and area of expertise?

I have been a professional civil engineer in Alaska since 1981, but my interest in science and engineering began 15-20 years earlier with a subscription to Popular Mechanics and participation in science fairs. In high school, I was president of the Science Research Club. We ground a 12.5-inch diameter mirror for a refractor telescope that was so big we needed to design and build an observatory building to house it. I had completed mechanical and architectural drawing classes, so it was natural for me to design the structure and get the required approvals for construction. My role then evolved to construction superintendent and chief block layer. Completing the observatory building with my science club teammates was the highlight of my senior year in high school. My experience placing concrete footings and a slab, mixing mortar and laying block led to an interest in materials engineering that has never gone away, even though I have done significant work in hydraulics/hydrology and structural design over the last 40 years.

Richard S. Giessel, P.E.

What's your role with Alaska DOT?

As State Quality Assurance Engineer, my responsibilities are very broad yet with the common theme of improving quality and eliminating defects in the roads, bridges, ferry terminals,

Photo courtesy of Alaska DOT & PF

This is the Diverging Diamond Interchange at Muldoon Road over Glenn Highway in Anchorage, Alaska. The bridge girders, decorative panels with alder leaf theme and approximately 1,200 reinforced earth panels (also with alder leaf theme) all were precast in Anchorage for this 2017 project.

airfields and buildings designed, built and maintained under the authority of DOT & PF. I also am advocating for increased use of intelligent construction technologies through grants and shadow projects that provide continuous full coverage compaction mapping of soils, aggregates and asphalt mixtures.

What are some unique or noteworthy projects that used precast concrete?

My first major project after obtaining my civil engineering degree from the University of Michigan was hydraulic design of the wastewater collection and treatment facility for the Trail Lakes Fish Hatchery in Moose Pass, Alaska. This was Alaska's first central salmon hatchery. It was designed to both enhance current salmon populations and restore natural salmon runs to other streams. A central hatchery collecting eggs and milt from multiple stream populations faces the danger of introducing viral pathogens into the entire population and any fishery downstream. In this case, the downstream fishery was the Kenai River, famous for its runs of king, red and silver salmon. A very interesting challenge was sterilizing up to 4,000 gallons per minute (gpm) of wastewater with the technology available in the 1979-80 time frame. How we solved that challenge is covered in a paper that I presented at a conference in 1981.

What benefits did precast concrete offer on that project?

For Trail Lakes Hatchery, we designed modules of precast concrete raceways to rear the fry. The modules allowed us to keep the populations isolated so an introduced virus from one egg take area would not wipe out the entire hatchery population. Precast raceways made installation of baffles and plumbing very efficient and consistent during construction. The precast raceway is still functioning well today after 40 years of production of approximately 35 million salmon fry per year.

How do you see the role of precast changing in the future?

Ultra-High-Performance Concrete (UHPC) will greatly improve the durability of many precast products in the future, especially elements with severe exposure like bridges in marine or freeze-thaw environments. UHPC has a compressive strength of 21-30 ksi and tensile strength of 3-5 ksi, so it could eliminate the need for shear reinforcing in many structural elements. The high strength, ductility and durability will allow significant reductions in the amount of concrete used, conserving raw materials. I'm very happy that my oldest son, Peter Giessel, P.E., S.E., is on ACI Committee 239, Ultra-High-Performance Concrete. It is rewarding to pass the torch to the next generation! PS

Precast Concrete Takes the Stage for Music City GP

Photo courtesy of Music City GR

Photo courtesy of Middle Tennesee State University

Heather Brown, PhD (center), provides instruction on special concrete mix trials to Middle Tennessee State students with help from the crew at Jarrett Concrete.

A not-so-standard precast concrete barrier is helping keep cars and fans safe for Nashville's first IndyCar race.

By Matt Werner

Nashville is known for its honky tonks, live music and partygoers dancing the night away downtown. Come August, the sounds of country music will be overtaken by the roar of engines as IndyCar makes its first trip to the Nashville streets for the Music City Grand Prix.

Cars will race through the streets and over the iconic Korean Veterans Memorial Bridge, marking the first time a race course will pass over a body of water. Creating a 2.17-mile track in the heart of a city is no easy endeavor, but precast concrete is taking center stage as officials hope to create Music City's next big event.

INGREDIENTS FOR A GOOD SHOW

Discussions about having an IndyCar race in Nashville had been ongoing for years, but coming up with a track design that worked for the racing series, city and local businesses proved difficult. Eventually, an idea was pitched – having the cars race across the bridge.

"It creates a fantastic visual for the people here and those watching at home," Music City GP President Christian Parker said. "So we designed the track with that in mind. It also elongated the track quite a bit to where we didn't have to interfere with downtown businesses."

The actual track design came from Tony Cotman with NZRConsulting, who has designed tracks around the world. The key to any track design is making sure the racing is great but also that spectators are entertained and have great visuals, too.

"When we're designing any track, those are the basic fundamentals," Cotman said. "Then we start thinking, 'This would be nice,' or in this case, 'Wouldn't it be cool to use the bridge?' and getting those pieces to be plausible.

"In this situation, it just so happened that the bridge would play a major part. When you see that bridge, you'll know exactly where you are."

THE BUSINESS SIDE

Early on, Music City GP officials engaged with Dr. Heather Brown, a former professor in the School of Concrete and Construction Management at nearby Middle Tennessee State University. She served as a resource on all things concrete, helping officials understand what would be needed and what was possible with concrete.

With top speeds expected to be around 195 mph, several upgrades are being made to the streets that will become the race circuit. Ensuring a proper racing surface is key. Having a precast concrete barrier along the entire track is equally important to prevent cars from running off the track and to protect spectators from possible debris.

While highway barrier is a standard product among many precast concrete producers, what's being used for the Music City GP is anything but. Should a car get loose coming out of a turn or lock wheels with another, the barrier will help absorb and dispense the energy.

"When you look at the barrier from the outside, it probably just looks like a slab of concrete sitting there," Cotman said. "On the inside, that's the business side. That's where all the components and cage link together."

In tandem with Brown and wanting to keep things local, Music City GP officials engaged with local precasters to manufacture the barrier. NPCA Member Jarrett Concrete Products in nearby Ashland City, Tenn., took on the challenge.

IMPRESSIVE REINFORCEMENT

Each barrier measures approximately 12 feet long, 40 inches tall and 22 inches wide at the base. Each piece also weighs a whopping 9,500 pounds.

"They're pretty robust and have linking systems in it unlike any barrier we've seen before," said Frank Bowen, Jarrett's business development manager. "The reinforcing design is just as impressive as the piece itself."

The linking system is made by a company in Europe that specializes in avalanche fall protection for cliffside roads. Each connector is welded to ASTM A706 No. 5 rebar, which runs continuous throughout the entire length of the barrier. The reinforcement design also includes a welded wire cage connected to No. 4 rebar.

Despite the number of connections, the team at Jarrett picked things up quickly.

"We don't regularly manufacture barriers here, so this was a new, custom project for us, all-in-all," Bowen said. "It has a pretty detailed reinforcing design, but it's a relatively simple shape to make."

The other key item was proportioning the mix design so it would have a 5,000-psi compressive strength and have a minimum unit weight of 140 pounds per cubic foot. Coming up with the design was an opportunity for Brown and her students to get their hands dirty and learn more about concrete.

"The whole project came at a good time to incorporate it

Photo courtesy Jarrett Concrete

into our senior research class," Brown said. "They could think about what the concrete was being used for, and having an introduction into precast is priceless from a learning standpoint for them."

Students were able to test, sample and even mix concrete to see the different ways to satisfy the specifications. They also learned how temperature impacts concrete since Jarrett would be producing pieces in winter and spring months.

What they came up with was two different designs, one that included Class C fly ash and one that included Class F fly ash. With inconsistent supplies of fly ash in some areas, Brown and the students wanted to give Jarrett options.

"The whole idea was just to see what they could do," Brown said. "It showed students what it takes to develop a mix, so they have a better understanding about what goes into concrete, the quality control, testing and everything."

PLANNING AT A HIGH LEVEL

With only a few months to manufacture nearly 2,000 segments, planning was key for the Jarrett team. Bowen developed a Gantt chart for the project schedule that outlined when they would order components, when forms would arrive and how many pieces would be produced each day.

"I am absolutely reliant on my Gantt chart," Bowen said. "I set that up from the very beginning, and look at it every single day. Without having that Gantt chart, we would have been lost, absolutely lost."

Photo courtesy of Jarrett Concrete

Jarrett added a crane and more production space to keep up with producing 10-15 barriers per day. The company needed to reorganize and make space in the storage yard to accommodate all the barriers.

"By doing that, we can hold about 600 pieces at a time," Bowen said. "At that point, we have to ship them to the storage

Photo courtesy of the Music City Grand Prix

site by the track. We're just trying to fill it up and ship them out, fill it up, ship them out."

Cotman noted how well everything has gone from green to checkered flag.

"They have produced a really high-quality barrier," he said.

Parker paid a visit to the plant and came away impressed with everything as well.

"Being in the plant, you get a newfound appreciation for the sophistication and science and math that really goes into concrete," he said. "Jarrett's done a tremendous job at not only maximizing their facility but their employees too.

"It's such a sophisticated operation, and watching it in action is pretty impressive."

Production, planning and teamwork all were key. Now, officials hope to make the Music City GP the next great race on the IndyCar calendar.

"I think the racing should be great, and the location for fans is going to be killer," Cotman said. "Everyone seems to really like Nashville, so it has all the makings to be dynamite. We'll find out in August." PS

Photo courtesy of the Music City Grand Prix

Matt Werner is a former NPCA communications manager.

A New Look fo

The new Northwest Indiana bridge, more than 10 years in the making, resists flooding while serving as the centerpiece to the city's lakefront redesign and beautification

By Joe Frollo

or Hobart

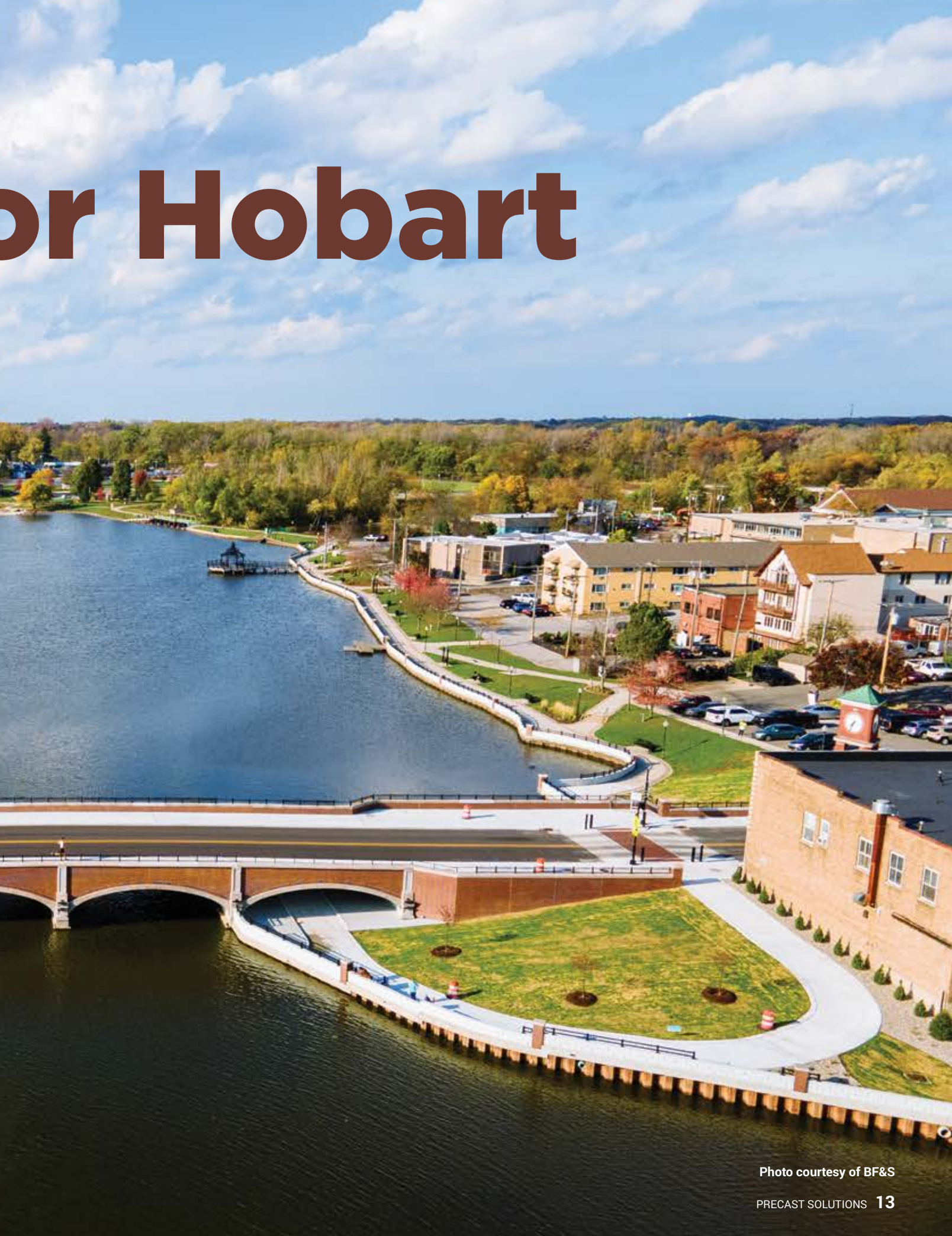

Photo courtesy of BF&S

Photo courtesy of County Materials Corp.

Sections for the Third Street Bridge in Hobart, Ind., made a 150-mile trek from County Materials Corp in Whitestown, Ind., before being assembled over Lake George.

Nothing beats a summer walk along a lake.

Cool breeze blowing. Birds swooping. Boaters floating by as families set up picnics.

It is an area that brings people together. It is for communities. It also benefits businesses that depend on foot traffic to thrive.

Designed and constructed correctly, a lakefront walkway can be the cornerstone in a city's revitalization plan.

What Hobart, Ind., had before a new bridge went up over its Third Street thoroughfare was the opposite of that.

Wet, sloppy banks that too often flooded. Low clearance that cut boats off from a large section of Lake George. Crisscrossing utility wires overhead that added to the inaesthetics.

All of that changed thanks in large part to precast concrete allowing the new bridge to be more functional, thematic and picturesque as well.

"The mayor really wanted to tie the bridge in with the rest of the area's development in order to bring everything together and create a showcase bridge that can be used and seen by thousands of people every day in the summer," said Jake Dammarell,

Photo courtesy of County Materials Corp.

The wingwalls on the Third Street Bridge include blockouts for pipes and dove tail slots to allow for hand-laid bricks.

executive vice president with the Indianapolis engineering firm Butler, Fairman & Seufert. "With precast concrete serving as the base, it has a brick and limestone front. Another neat thing is the lighting and ornamental pieces that precast allowed us to construct, creating an atmosphere that ties into the streetscape and lights up the night."

FROM SINGLE-SPAN TO FOUR-SPAN

The former 65-foot single-span bridge included just 44 inches of clearance, often leading to backup and flooding as water seeped into walkways and city streets. Replacing the bridge also meant addressing a water main and more than 12,000 paired copper wire utility lines that ran under the bridge deck.

Starting with a concept meeting in 2008 and culminating in the $7 million project that opened in October, the result is a four-span bridge with each span consisting of nine individual precast concrete arches that set from pier to pier and abut together, locked in place by keyways.

Pretek Group of Dayton, Ohio, designed the precast bridge under contract with County Materials of Maxwell, Ind., which manufactured the components, including wingwalls, headwalls and arch sections.

"For the wing walls, we put dove tail slots into them so they could use hand-laid brick to create the type of texture they wanted on the outside," County Materials Technical Resource Engineer Steve Smart said. "It was the same way with the head walls – precast inserts and galvanized steel apron bolted to the front so the brick ledge could be laid on top of that."

With the utility lines not just converted and condensed to fiber optics but moved downstream, that cleared away any distractions for the added touch of LED lighting.

"The really neat thing is there are light boxes cast into the arch spans so they can actually illuminate under the bridge sections at night to give a nice, soft look," Smart said.

A NOT-SO-SOLID FOUNDATION

The biggest surprise arrived early on when soil tests showed – to put it mildly – a poor state.

"The soil in that area is complete garbage," said Michael Eichenauer, executive vice president and bridge department manager at BF&S. "It made it a challenge to design the foundation. Usually, we'd have 30 feet for the piles at the foundation. We ended up going 70 feet because the soil was so bad for the first 30 to 40 feet that the geotechnical consultant

Photo courtesy of BF&S

Nine arch sections per span precisely laid side by side went into the bridge construction. Because of the soft earth near the lake, once one side of the bridge was set, the crane was moved to the other side to continue.

said as soon as you stand those things up, they will sink 20 feet without even doing anything."

Compared to that, the actual bridge design came together fairly quickly.

Engineers investigated multiple options. BF&S first considered box beams, but that didn't provide the needed clearance. After that, engineers started looking closer at arches, and the city liked the look.

Plans were drawn up for a three-span bridge until the city decided it wanted to add a trail on the north end, which created the need for a fourth span.

The proximity of existing driveways and businesses prevented the adjacent road's elevation from being raised. This created a challenging constraint. Another constraint was the water pipeline that the city would not move or bury under the river.

"We had some pretty tight clearances on that," Eichenauer said. "It was really tight on the fill and pavement on top of these arches, and that's about all we had."

The arches worked and are only about a foot thick, Eichenauer said.

"When it was all said and done, the arch just looks more pristine, a lot better visual look," he said. "The hard part with four spans is now we have multiple structures coming together and making sure everything fits on the foundation properly."

ACCOMMODATING TRAFFIC AND WATER

Each of the bridge's four spans is comprised of nine individual 36-foot-by-9-foot arch sections positioned side by side. The arch sections range in width from 4 feet, 6 inches to 5 feet, 11 inches, which create the bridge's 51-foot width. The four spans have out-to-out dimensions of just more than 38 feet, and

Photo courtesy of County Materials Corp.

The four-span bridge includes three throughways for boats along with a walkway for pedestrians.

the 9-foot interior arch height provides an additional 5 feet of clearance in comparison to the previous bridge to better handle water level fluctuations throughout the year.

The bridge accommodates one lane of traffic in each direction along with sidewalks. The bridge's fourth span also serves as a walkway that runs underneath to the bridge's travel lanes.

Smart said because of the soft earth and the length of the bridge, crews could only set half the bridge at a time before moving the 400-plus-ton crane to the other side of the lake. The crane stretched out about 150 feet at its maximum.

"You really have to maintain how you lay these things," Smart said. "There were nine sections in each run, and they had to go 36 feet inside, 38 feet out to out. You set one side, maintain it, then get to the other end, and something could be two or three inches ahead of where it should be before you put everything together.

"The location also had a very tight working area. The sections were hauled on their sides and had to be unloaded and rotated in the air into the setting position. It was pretty elaborate the way they had to do it."

County Materials also provided 24 headwalls.

The contractor, ICC of Elburn, Ill., favored using precast on this job.

"An advantage of precast is once we had the substructure complete, the precast was ready to go," ICC Project Manager Tony Frazzini said. "We were able to schedule our trucks precisely and have them arrive on site as we set the precast in place. Precast really allows you to strategically plan work, coinciding with material deliveries, to expedite production and completion of the superstructure. Using precast made it much faster to complete this phase of the project."

Photo courtesy of County Materials Corp.

The addition of a walkway under the bridge necessitated the construction of a fourth span for the bridge.

Photo courtesy of BF&S

The Third Street Bridge is part of a downtown revitalization project in Hobart, Ind., that includes blending the past with the present for this Northwest Indiana city.

The wing walls are 20-40 feet long and segmented with holes for drainage pipes. They also are built to specific angles in order to meet and follow the road, which runs right up to the bridge and doesn't leave much wiggle room.

In all, County Materials worked 10 months on the 18-month project, which included generating shop drawings, ordering steel and other materials, casting and curing the precast components, installation and inspections. The head walls were cast in 24 days, and the wing walls were cast in 12 days, while the 36 arch sections were cast in 36 days.

The final touch was applying a waterproofing membrane that lays overtop of the precast arch sections to ensure watertightness at the joints.

'A CENTERPIECE FOR DOWNTOWN'

Hobart Mayor Bryan Snedecor called the new Third Street Bridge "the centerpiece for downtown" at its opening last fall. Along with flood mitigation and additional room for boaters, it also is historical as support logs from the previous bridge estimated at 100 years old were used as part of the decorations.

Work will continue along Lake George with this project serving as the template of what's to come.

"The advantage of a precast bridge of this nature is an aesthetically beautiful structure," Frazzini said. "The arches and wing walls allowed for the limestone façade and brick veneer installation, which provided just a magnificent final product. Everyone from the city and residents have given it nothing but compliments."

"The advantage of a precast bridge of this nature is an aesthetically beautiful structure," Frazzini said.

Now, boaters do not just traverse the entire width of Lake George, but have a popular backdrop for selfies to remember their fun.

"Folks on the lake are thrilled," Dammarell said. "We see a lot of social media posts with the bridge in the background. It's become really popular." PS

Joe Frollo is NPCA's director of communications and public affairs and editor of Precast Inc. magazine.

First of its Kind

The Virginia Department of Transportation partners with The Fort Miller Co. to install the first-ever precast concrete roundabout in the United States.

By Mason Nichols
Photos courtesy of The Fort Miller Co.

New York-based The Fort Miller Co. worked with the Virginia Department of Transportation to design and install the first-ever precast concrete roundabout in the United States.

From floating docks to basement foundations, building envelopes and beyond, precast concrete is cemented as the ultimate building material.

Throughout the precast industry's history, innovative approaches to product development, engineering and production have sparked countless unique projects.

And because the industry's manufacturers remain nimble – always thinking of what's next – there's never a shortage of fresh ideas to fuel the search for solutions that are durable, resilient and capable of adapting to seemingly any situation.

Take the Virginia Department of Transportation for example. In 2020, VDOT partnered with New York-based The Fort Miller Co. to design and install the first-ever precast concrete roundabout in the United States.

NEED FOR SPEED

Roundabouts provide a slew of benefits for drivers, including increased traffic flow, improved safety and enhanced aesthetics. The yield-controlled design means fewer stops, resulting in shorter queues and reduced delays. Additionally, because vehicles travel at slower speeds through roundabouts, collisions that do occur tend to be less severe.

As a result, many state departments of transportation are converting traditional intersections to roundabouts. And in most of these cases, DOTs are seeking long-term solutions that can be quickly installed, limiting the impact to the traveling public.

According to Tommy Schinkel, P.E., Richmond District materials engineer for VDOT, installation speed was crucial to his agency's project at the intersection of Laburnum Avenue and the I-195 south off-ramp in Richmond, Va.

"A big part of this project was that we had to have it built quickly," he said. "There's a railroad facility located right at this intersection, so we couldn't have it closed for long periods of time."

To meet this demand, Schinkel and his team turned to precast concrete paving slabs. While precast concrete paving slabs have been used on a wide variety of jobs over the past few decades, they recently have experienced significant growth throughout the United States and Canada because of myriad benefits. Precast paving slabs are produced off-site in a controlled manufacturing environment, meaning they can be delivered to the project site ready to be installed, perfectly fitting the need for an extremely tight construction site and timeline.

AN EXPERIENCED PARTNER

With a building material selected, VDOT needed a partner that not only could produce the precast panels but also handle the intricate engineering associated with the roundabout's design, which called for 23 panels with complex geometry to create the truck apron portion of the roundabout. VDOT officials selected Fort Miller, a long-time producer member and contributor to the National Precast Concrete Association's Manual for Jointed Precast Concrete Pavement.[1]

"We've been manufacturing precast concrete pavement since 2001," said Mike Quaid, senior project manager for Fort Miller. "In that time span, we've completed approximately 150 jobs. On each and every one of them, we've learned a little trick or picked up something new."

Quaid said the Fort Miller team was confident in its ability to devise a solution that would meet the project's needs. Still, the group – which consisted of VDOT, Fort Miller and the general contractor – participated in a "trial fit" ahead of the in-field installation. The trial fit was held at Fort Miller's manufacturing facility in Greenwich, N.Y., and livestreamed so that all project teams could participate.

"We had a short time frame in the roadway, so we wanted to make sure that all the pieces fit together properly and that the contractor knew what was happening," Schinkel said. "We didn't want to get into the field and discover we had a flaw that would keep the area closed longer than anticipated."

Fort Miller walked through the steps necessary to install the panels in the field. Each of the project partners could ask questions and collaborate as the trial run proceeded.

"Going this route made sense because of the complicated geometry," Quaid said. "The process gave everyone that extra level of comfort to see all the pieces fit together beforehand."

MAKING IT HAPPEN

After the trial run, Fort Miller prepared the precast panels for shipment from New York to Virginia. Most of the slabs were trapezoidal, weighing 6-7 tons each and ranging from 8- to-10-feet wide by 12-to-16-feet long. The panels boasted a special stamped brick pattern and integral pigmentation.

While the driving force behind these features was aesthetics, Shabbir Hossain, P.E., associate principal research scientist for the Virginia Transportation Research Council division of VDOT, said that the brick appearance also deters the traveling public from driving on top of the roundabout's apron, which is meant only for semis.

With the panels on-site, the contractor got to work with the first step in the installation process – milling the existing pavement. According to Quaid, this presented more difficulty than initially anticipated because of the existing pavement's cross-section. The existing pavement consisted of a crowned road, and the roundabout was designed to be a flat plain. As a result, milling had to go 2 inches deep into the existing pavement on the edges and up to about 6 inches deep at the crown.

"Getting this part right is all about experience, touch and finesse," Quaid said. "Grade control is imperative in these situations. This project was milled on a Friday night, but there were high spots, so the team had to come back and re-mill."

Once the team navigated through the milling process, the rest of the installation was a breeze. Thanks in part to the trial run that took place ahead of time, crews installed all 23 panels in just a few days, with the roundabout opening up for use at the conclusion of the weekend. Schinkel said that because the project took place in December under cold weather conditions, the use of precast was paramount in getting things done quickly.

"We wouldn't have been able to pour the concrete out in the field with the temperatures where they were at," he said. "Going this route allowed us to close the intersection for just one weekend instead of having our normal process of closing it four or more times to do different quadrants of building the concrete."

Using cast-in-place concrete would have required multiple closures and several months to complete the job.

READY FOR THE FUTURE

Shiraz Tayabji, president of Advanced Concrete Pavement Consultancy, observed the roundabout project on behalf of the Federal Highway Administration. In addition to the quick installation and the long-term resiliency of the precast panels, he noted another important aspect of the work.

"With good specifications and plans, any contractor – even those who haven't done previous precast work – can successfully construct something just like this," he said.

Schinkel agreed, adding that with a successful proof of concept in place, VDOT hopes to expand on its use of precast concrete pavement for similar projects in the future. "Now that we've gotten through the learning curve and we fully understand how timely and cost-effective going this route can be, this is something we want to repeat throughout the state." PS

Mason Nichols is a Grand Rapids, Mich.-based writer and editor who has covered the precast concrete industry since 2013.

Endnotes

[1]https://precast.org/jprcp-manual/

Thin-Skinned

A dilapidated, outdated wooden bridge is slated to be replaced by a three-sided precast concrete culvert bridge featuring a 13 1/2-inch top slab.

By Shari Held
Photos courtesy of Garden State Precast

Originally built in 1945, the R-27 bridge in Keansburg, N.J., crosses Waackaach Creek, a tributary of Raritan Bay. The three-span, continuous nail laminated timber deck structure, supported by a timber pile substructure, was reconstructed in 1966. By 2020, it was structurally deficient and in dire need of repair. In addition, at 24 feet, the bridge's width was substandard.

So, it was no surprise when the owner, Monmouth County, tapped it for demolition and replacement.

The replacement bridge will have a substructure consisting of a concrete foundation poured around concrete-filled pipe piles. The bridge's superstructure will be made up of a precast concrete three-sided culvert and a reinforced concrete cast-in-place riding surface a minimum of 5 inches thick.

So, what's so unusual about this project? The top slab on the three-sided culvert is only 13 1/2 inches thick while the bridge span is 32 feet.

"It's a very thin top slab for that span," said Paul Heidt, vice president of specialty sales for Garden State Precast in Wall Township, N.J. "It's going to be an interesting project."

PRECAST: THE BEST MATERIAL OPTION

Designer T&M Associates, headquartered in Middletown, N.J., evaluated three potential solutions for the Fourth Street Waackaach Bridge. An alternative analysis included a voided slab box beam bridge, a steel stringer bridge and the precast concrete three-sided culvert bridge. These three solutions were reviewed-based on cost, maintenance requirements and suitability for the project, which is on a fast track.

"If we have to close the roadway and propose a detour, we look at what type of structure can minimize that full closure and minimize disturbance to residents in the area," T&M Associates Project Manager Hiral Gaudani, P.E., said.

Other considerations for the new bridge include aesthetics, durability, safety, easy access to materials and impact on the environment. All these factors pointed to the precast concrete three-sided culvert bridge as the best solution.

Precast is one of the preferred materials for Accelerated Bridge Construction because elements can be cast, inspected and ready to install prior to bridge closure, reducing construction time and the impact on the general public. There's no forming, reinforcement assembly or curing that needs to be done on-site.

A culvert section is removed from its formwork and lifted by a crane at Garden State. Production for this project is taking place outdoors due to the size and weight of the culvert sections.

As far as aesthetics, other bridges in Monmouth County – although different in construction – are similar enough that the new bridge design will blend in and provide a uniform look and feel to the area.

"Because precast materials are fabricated in the shop, precast is a better product precision-wise, and you get a better lifespan from it," Gaudani said.

Ultimately, the precast concrete three-sided culvert won out over the other options.

WHY GO SO THIN?

The superstructure depth was dictated by the hydraulic design. To prevent bridge overtopping in the event of a 100-year flood, the lowest portion of the bridge superstructure is set above the flood elevation. Since the bridge is located near the intersection of Kennedy Way and Creek Road, the vertical profile is designed so it doesn't impact roadway approaches.

This results in a superstructure that is 18 1/2 inches thick – a 13 1/2-inch precast culvert top slab and a 5-inch riding surface.

At 13 1/2 inches, the top slab of precast concrete may be thinner than most, but it meets all strength and service limit state criteria of the AASHTO Bridge Design Standards and NJDOT Bridge Design Requirements.

"The higher strength concrete that's now available makes it possible to do that," Gaudani said. "With today's technologies, we can go with a thinner section."

While the design is relatively simple, the thin top slab creates several challenges for Garden State Precast, such as the inclusion of shear reinforcement. This bridge project involves a more intricate casting and transportation process.

MEETING THE CHALLENGE

The project called for eight three-sided precast concrete culverts. The outside dimensions of each element measure 15 feet, 8 inches high by 32 feet, 9 inches wide with an interior measurement of 14 1/2 feet high by 29 feet, 9 inches wide. The legs are 18 inches thick. Six of the elements are 66 inches in length. The two at either end measure 72 inches to accommodate the bridge rails. The weight of each element ranges from 64,000-75,000 pounds.

The design calls for a high steel-to-concrete ratio. According to Heidt, typically 250-300 pounds of concrete per cubic yard of

Garden State is using all-steel forms for the project while incorporating some wooden components to assist with placement of lifting inserts. The precast concrete culvert sections will comply with Monmouth County's recently revised tolerance scheme, which cut the previous alignment tolerances in half.

concrete produces a balanced structure for precast. But once a project gets in the 350-400 pounds of reinforcement per cubic yard of concrete range, the precast concrete is not as forgiving.

"In the culvert world, a higher steel ratio per yard means it's going to be more difficult to produce and handle," Heidt said.

Although this wasn't a mega-million-dollar project, the planning process for Garden State was extensive. The 13 1/2-inch top slab could be susceptible to cracking, necessitating special consideration for lifting, handling and rigging the elements.

"We did a lot of drafting and concept sketches, and we printed 3-D models of it to make sure it would all go together right," Heidt said.

THE FABRICATION PROCESS

Garden State used NJDOT- Class P concrete with a compressive a strength of 5,000 psi for the project. Weighing 3.4 pounds per foot, 1 1/8-inch-diameter (No. 9) steel reinforcement bars are positioned every 6 inches in the culvert elements. Ensuring they are all placed within tolerance was crucial for the precast's thin top slab. Additionally, one hundred and twenty six pieces of stirrup reinforcement was placed per section to increase shear capacity.

Garden State rented materials from EFCO Formwork, headquartered in Des Moines, Iowa, to create an all-steel form for the project. The form needed to adhere to Monmouth County's new tolerance requirements, which cut the tolerances for the vertical and horizontal alignment in half, from 2 inches to 1 inch. The county also introduced staining as a cause for rejection. Concrete elements can become discolored from form oil or the steel form itself. If necessary, Garden State will use formliners during the fabrication process.

The pouring plan was carefully choreographed during the planning process to ensure the elements were all poured so they aligned in one direction, right-leg-to-right-leg and left-leg-to-left-leg. An "L" or "R" was cast on the end of each element so construction workers could identify the left and right legs and place them correctly. That process kept everything within tolerance.

Each element contains an embedded lifting pin system with 12 pick points for ease of rotation – eight on the roof and four on the legs.

Garden State began production of the elements in May 2021 and planned to ship the elements to the jobsite in late June.

The precast concrete culverts are reinforced with 1 1/8-inch diameter (No. 9) steel reinforcing bars spaced every 6 inches. The design also uses stirrup reinforcement to increase the culvert sections' shear capacity.

THE EASE OF PRECAST INSTALLATION

Installation of the new bridge is anticipated to go quickly and without a hitch.

"When we have segmental construction using precast structures, it minimizes errors because it's very easy to put it together in the field," Gaudani said. "No specialized labor is required."

The only hiccup might come from work limitations imposed by the New Jersey Department of Environmental Protection. During the time when the fish spawn, workers won't be allowed in the waterway.

Completion of the new Fourth Street bridge over Waackaach Creek is slated for August 2021. PS

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

NPCA PRECAST DAYS

November 1-12, 2021

The National Precast Concrete Association presents Precast Days 2021, a unique educational opportunity to provide students, specifiers, engineers and contractors with an up close experience at a local precast concrete plant.

Between Nov. 1–12, 2021, NPCA plants are opening their doors to showcase the precast manufacturing process and demonstrate the equipment, technology and engineering expertise that goes into making precast concrete products.

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