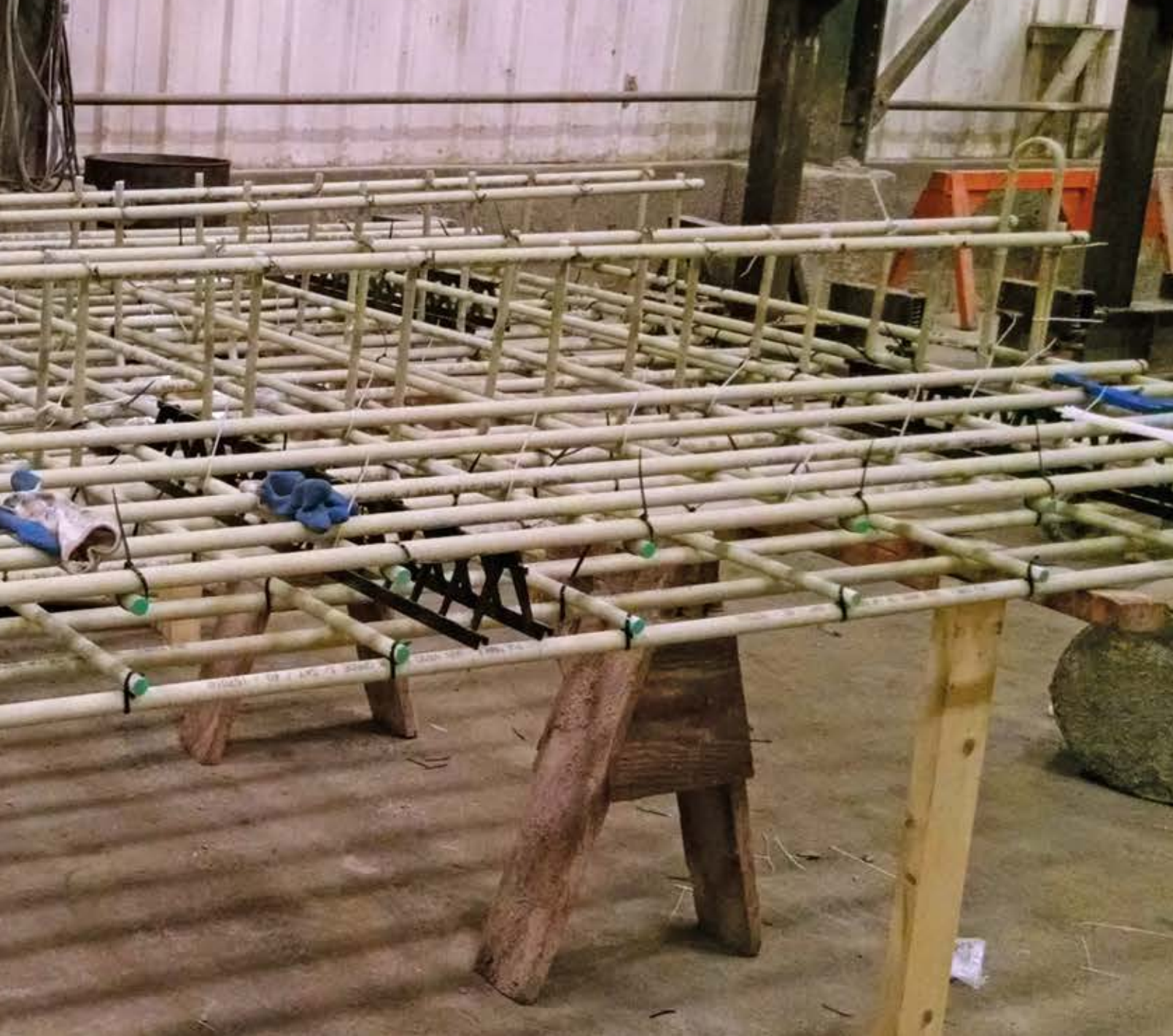


Photo courtesy of Fort Miller and Sold by ALP Supply

Rethinking Reinforcement



ent

Alternative reinforcement technologies create opportunities for precasters and specifiers.

By Shari Held



By using steel fibers in their mix, Dalmaray Concrete Products was able to reduce production time on precast electrical vaults for a Google Data Center project.

Steel rebar and welded wire have long been the standard for reinforcing concrete structures. But as the precast concrete and construction industries continue to evolve, so too does reinforcement technology. Alternative materials can significantly reduce or even completely replace traditional steel reinforcement for some applications – leading to a variety of benefits for manufacturers and designers.

Here's a look at how two such materials – fiber reinforcement and glass fiber reinforced polymer rebar – compare to traditional reinforcement, along with projects in which precasters used them to achieve success.

STEEL FIBER

Precast concrete manufacturers have used fiber reinforcement in their products for decades. But in recent years, fiber technology has advanced significantly. As a result, precasters have steadily increased their adoption of fibers, which can provide enhanced strength, durability and impermeability for their products. Despite these advantages, precasters must consider many factors when deciding whether to incorporate fibers in their mix designs.

Fibers vary in shape and size, which can affect the manufacturing process. Additionally, with a wide range of options to choose from – including steel, nylon, polypropylene, fiberglass, acrylic and polyvinyl alcohol – precasters must ensure

the fibers will be uniformly distributed in the mix and serve as an optimal solution, which can prove difficult. Despite the recent advancements made, most fibers are still primarily used to complement primary reinforcing and control early age cracking. Using fibers to replace primary reinforcing is possible in certain instances, but such an application must be performed with extreme caution. The design should be approved by an engineer and performance tests should be conducted.

Steel fiber is one popular choice among precasters, particularly because of its ability to mitigate cracking. These fibers, which are generally made from carbon or stainless steel, are produced in varying geometries by manufacturers. Helix Steel of Ann Arbor, Mich., produces its solution – Twisted Steel Micro Rebar (TSMR) – from cold-drawn, high-tensile (246 ksi) carbon steel wire cut into pieces measuring from 1/2 inch to 2 inches in length and 1/2 millimeter to 4/5 millimeter wide. It can be distributed uniformly throughout the concrete mix with proper batching and mixing practices. Higher fiber count may permit broader distribution of fiber reinforcement throughout the matrix – but this can cause slump and workability loss that may make it harder to place. Still, using TSMR makes the concrete more ductile and less prone to cracking.

“Even if it (the concrete) does crack, the crack is then held tightly together,” said Wes Dees, director of Helix Steel's Eastern region.

Precasters have been using the material as a partial replacement for traditional rebar for about 10 years – typically for septic tanks, grease interceptors, manholes, electrical vaults and drainage structures. Other uses include reinforced concrete pipe, footings, foundations, vertical walls, beams and columns, cladding, bridges and tunnels.

Dees offers precasters a test run, mixing and pouring the product at their plants and taking it out of the form the next day. In 2014, he demonstrated the product to Aaron Ausen, vice president of Janesville, Wis.-based Dalmaray Concrete Products. After trying the product, Ausen placed his first order.

GOOGLE DATA CENTER – PRYOR, OKLA.

Dalmaray Concrete Products quickly found an opportunity to use TSMR. Wisconsin-based Faith Technologies Inc. needed a series of electrical vaults for its Google Data Center project in Pryor, Okla. Precast was chosen because speed and quality were of critical importance for the work. Also, because the project was scheduled for early spring, using cast-in-place would have been difficult.

The original project design specified #5 steel rebar hoops every 6 inches on center and vertical bars at 6 inches on center.

“That’s a lot of rebar to cut, bend and tie in,” Ausen said.

TSMR proved to be more efficient.

“The Helix design was better because we were able to reduce those hoops and verticals down to just hoops,” Ausen said. “And those hoops were only every 12 inches on center. We were able to cut 45% of the rebar out of the equation.”

Dalmaray was also able to shave about two hours off cage fabrication, taking it down to less than one hour per piece.

“That was huge when it came to labor savings,” Ausen said.

In addition to time and labor savings, workers didn’t have to snake 14-foot steel bars from one end of the plant to the other. That reduced risk of injury.

Since 2015, Dalmaray has produced 38 electrical vaults – each weighing approximately 43,500 pounds – for the ongoing job. The vaults range in size, with the largest boasting 6-inch-thick walls and 8-inch-thick lid sections. To date, they’re the largest vaults Dalmaray has produced.

Ausen said the mix time didn’t change and the precast easily met the minimum compressive strength requirement of 5,000 psi. But he admits there was a learning curve when it came to distributing the TSMR to meet the dosage criteria.

“After we got the distribution down, it was smooth sailing from then on,” Ausen said. “We were able to set vaults up extremely fast, meet their deadline and produce a nice product.”

The biggest challenges were keeping up with the changes involved with a design-build project more than 1,000 miles away in Oklahoma and transporting vaults via a wide-load truck.

Dalmaray now uses TSMR for manholes, septic tanks, grease interceptors and electrical vaults.

The biggest benefit Ausen sees is in labor savings – especially in its manhole risers and bases.

“We can turn product around a lot faster and reduce our costs,” Ausen said. “Ultimately that leads to a better margin and more sales.”

GFRP REBAR

Glass fiber reinforced polymer rebar is formed from thousands of glass filaments saturated with liquid resin and then pulled through a heated die. It is manufactured in bars the same diameter as traditional steel rebar and reels. The material, which has a tensile strength up to 199 ksi, is increasingly being used across a wide range of precast applications in the U.S and Canada.

According to Chris Rescate, COO of Pennsylvania-based ALP Supply (formerly A.L. Patterson), GFRP rebar possesses many advantages when compared to steel rebar for precast producers.

“Coverage requirements are typically half of what they are for carbon steel, so the precast elements can be thinner but still supply continuous reinforcement,” he said.

In many non-structural applications, precasters can substitute smaller GFRP rebar and still achieve steel rebar reinforcement strength goals. Additionally, GFRP rebar is non-corrosive, produces no ghosting or shadowing effect, and is non-magnetic and non-electrical.

Because GFRP rebar is about 1/4 the weight of steel rebar, it can help save on overall project costs and reduce safety risks. GFRP rebar also does not yield under stress like conventional reinforcement, which means structural analysis is conducted differently and engineers should reference ACI 440.1R-15, “Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer Bars.” Additionally, bent bars must be made to order.

GFRP rebar has been used extensively on bridge decks. According to Rescate, more than 450 bridge decks in the U.S. and Canada have been built using the material.

“GFRP is another tool in the toolbox for precasters,” Rescate said. “It gives them more flexibility when designing or bidding projects and allows them to compete against products they traditionally couldn’t compete against.”

TAPPAN ZEE BRIDGE TOLL PLAZA – SOUTH NYACK, N.Y.

Fort Miller Co. Inc. produced specialty precast concrete pavement panels with GFRP rebar from V-ROD for a temporary E-ZPass toll plaza near the Tappan Zee Bridge in South Nyack, N.Y. Located on the west side of the Hudson River, the temporary toll plaza was to remain in service while the existing plaza was removed and reconstructed. The project included 30 panels – five for the ramp and 25 on the mainline. Following the removal of the temporary toll equipment, the GFRP-reinforced precast panels remained as a critical component of the approach to the bridge.



GFRP REBAR

High-Performance // Cost-Effective



CARBON, EPOXY & STAINLESS STEEL REBAR ALTERNATIVE

For insulated wall panels, manholes, pipes, retaining walls, box culverts, highway barriers, foundations, underground utility vaults and precast steps.

- **RUST PROOF & CORROSION RESISTANT** Not affected by salt water or chemicals
- **STRENGTH** 3x tensile strength of steel. Requires less concrete coverage
- **ELECTROMAGNETIC NEUTRAL** Will not cause interference
- **LIGHTWEIGHT** 1/4 the weight of steel, less expensive transportation



Learn More:

800-332-7090 // gfrp@alpsupply.com



Photo courtesy of New York State Thruway Authority

Precast panels produced with glass fiber reinforced rebar allowed the New York State Thruway Authority to accurately monitor toll plaza traffic.

Each of the panels contains special sensors which, in tandem with cameras and other equipment, allowed the New York State Thruway Authority to accurately monitor traffic as it moved through the toll plaza. GFRP rebar was vital for the work, as it minimized potential interference in the sensor system.

“If there’s anything metallic in the slabs, it can throw off the count when cars go by,” said Michael Ortler, field engineer for Tappan Zee Constructors. “We wanted to avoid any interference with the toll collection system.”

Due to the location of the project, this wasn’t a typical pavement replacement job. Work had to be completed during night hours with live traffic in adjacent lanes. Some panels contained conduit and drainage, and sensing loops had to be installed after the panels were set.

“To try to do all that overnight in a short work window on the mainline of the New York Thruway would have been impossible without using precast,” said Michael Quaid, senior project manager with Fort Miller.

And precast is more durable. According to Quaid, CALTRANS Heavy Vehicle Simulator testing on Fort Miller’s precast panels ran for 1.5 years. When the repetitive loading was extrapolated, it was equivalent to a 40-year pavement life. By comparison, cast-in-place concrete with a rapid-setting, high-early-strength mix has a lifespan of up to eight years.

Fort Miller substituted V-ROD’s #4, #5, #6 and #7 GFRP rebar for the typical steel rebar. Although wire ties can be used with GFRP rebar, for this application, the designers specified plastic zip ties to further reduce potential metallic interference in the slabs. That made the production work a bit more labor-intensive, but installation proceeded as planned over three months.

“It went like clockwork,” Ortler said.

This specialty application doesn’t happen every day. But the current emphasis on replacing the nation’s infrastructure means construction like this will become more commonplace in the future.

“If the project needs to limit electro-magnetic interference and not disadvantage the public by shutting down the roads, this is a technology that can do the job,” Quaid said.

CAPABLE OF ANYTHING

While traditional reinforcement will continue to play an important role in precast projects moving forward, new technologies are shaking up the construction industry. With more options available, designers and owners who select precast concrete for their projects can tackle nearly any imaginable scenario. **PS**

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