World's longest floating bridge buoyed by precast concrete in Washington

The Washington State Route (SR) 520 Evergreen Point Floating Bridge, which connects Seattle with a number of growing technology communities across Lake Washington, is 120 ft (36.6 m) wide (for six lanes of traffic, plus a bicycle/pedestrian path) and 7708 ft (2349 m) long (almost 1.5 mi [2.4 km]), making it the world's longest floating bridge.

The Washington State Department of Transportation (WSDOT) decided against a conventional suspension bridge based on the latter needing to travel a fairly straight line. However, SR 520 is a curved corridor. In addition, the deepest point in the lake is 214 ft (65.2 m), meaning that a suspension bridge's support towers would need to be about 630 ft (192 m) high (slightly higher than the Seattle Space Needle).

The bridge can float as a result of large, watertight cast-in-place concrete pontoons, designed by WSDOT and connected rigidly end to end, upon which the roadway was built. The pontoons are the largest, heaviest, and strongest pontoons ever built. Despite their heavy concrete composition, the weight of the water the pontoons displace is equal to the weight of the bridge structure, including all traffic, which allows the bridge to float.

The pontoons are held in place by large steel cables, hundreds of feet long, connected to a total of 58 anchors. Three types of anchors were used in the project: fluke, gravity, and shaft. Only the shaft anchors were buried deep in the lake bed. There are a total of 77 pontoons, the largest of which are 28 ft (8.5 m) tall, 75 ft (23 m) wide, and 360 ft (110 m) long, weighing 11,000 tons (98 kN). The pontoons were built in an off-site dry dock, then floated and towed by barges to the bridge site.

The Evergreen Point Floating Bridge uses 77 precast concrete pontoons to support Washington State Route 520 across Lake Washington in Seattle. Courtesy of Washington State Department of Transportation.

As might be expected on a project of this size and complexity, there were several challenges involved, says Gregory A. Banks, a project manager with BergerABAM of Federal Way, Wash., one of the engineering firms involved in the project. For the precast concrete portion, specifically, challenges included geometric height constraints of the travel way to the lake level, strict environmental restrictions for working in and over water, and maintenance of vehicular and maritime traffic.

To address the stringent project requirements, a solution was introduced to maximize the versatility of standard precast concrete girders and custom precast concrete segmental ribbed-slab segments across the 1 mi (1.6 km) long floating bridge superstructure. This solution was to focus on turning a marine job into a land job as much as possible. The land-based construction and precast concrete components provided a

Construction of the Evergreen Point Floating Bridge faced challenges such as geometric height constraints of the travel way to the lake level. Courtesy of BergerABAM.

safer environment, mitigated potential negative environmental effects to the lake, simplified access for materials and personnel, improved construction consistency and quality, allowed for standardization of equipment, shortened the project schedule, and greatly reduced costs. "Using precast greatly contributed to the project being delivered within 56 months and at a cost 10% lower than the next highest bid," he says.

The results have been impressive. One of the most important keys to success, Banks says, was working with the contractor to optimize the bridge design to fit the strength of the contractor's means and methods of construction. "The design builder provided a beautiful bridge that reduced temporary and permanent impacts to salmon spawning grounds and impacts to the traveling public and rapidly connected the land portions of the project to the marine world, allowing safer and quicker access to build the bridge," Banks says.

The project began in February 2011, and the bridge opened in April 2016. It is expected to last more than 75 years.
—William Atkinson

Lifesaving bridge over creek installed via team effort

Waynesville, Mo., in the southwestern part of the state, near Fort Leonard Wood, sits on about 6 mi^2 (16 km^2) of land. Being in the scenic Ozark Mountains, the population has grown from about 3000 in 1990 to almost 5500 today.

One of Waynesville's roads, Dyer Street, was the only low-water crossing in the town, actually running through the normally low-water-level Roubidoux Creek.

"It was just a paved concrete section of road that crossed the creek," says Rich Cooper, project manager for the County Materials precast concrete plant located in Salem, Ill. "However, every time there would be a big rain, people would have to drive through rising water. If there was a lot of water, it posed a danger because someone could get swept away."

After a devastating flood in 2013, city officials knew something needed to be done where Dyer Street crossed the creek. Roubidoux Creek, which normally has only about 1 ft (0.3 m) of water over the road on any given day, rose to 21 ft (6.4 m) during that flood. The city hired an architect to design a bridge, and the architect opted for an arch design for aesthetic reasons, Cooper says. The architect then selected the ArchCast precast concrete system from County Materials for the bridge because of its highly durable and simple three-sided design.

"We didn't really have any challenges building the sections," Cooper says. "We have been building ArchCast in this plant for years, so we had a lot of experience."

Delivery posed a bit of a challenge, though, especially because the precast concrete sections had to be trucked more than 200 mi (320 km) from the plant in Illinois to the bridge location in southwest Missouri on interstates as well as some winding and narrow two-lane highways. "We shipped the spans flat, and the legs ended up having to stick off the passenger side of the trucks a bit because the center of gravity was not in the middle of the section," Cooper says. In all, County Materials ended up delivering twelve 28 ft (8.5 m) span by 11 ft (3.4 m) rise precast concrete units, which were subsequently erected side by side to create two spans, each six arches wide.

The key to success, according to Cooper, was the seamless teamwork between County Materials and the city of Waynesville, which arranged for its own employees to install the bridge. "They have a lot of qualified people working for that city," he says. "They provided one or two people from the utility department, the construction department, the sewer department, and other departments to put the bridge together under our direction." The project ended up taking only three days to complete. "One of the city workers was a really good concrete man, so he put the footings in. I went over and helped him lay things out during that process to make sure everything would be in the right location." Once the arch units were in place, precast concrete headwalls and wingwalls were installed to complete the bridge. The project was finished in September 2016.
—William Atkinson

The Dyer Street Road bridge in Waynesville, Mo., used County Materials' ArchCast system to elevate a low-water crossing. The Roubidoux Creek can go from its typical 1 ft (0.3 m) of water to as much as 21 ft (6.4 m) when it floods. The stream bottom is in the process of reshaping, The low-water crossing caused fill to back up upstream of the new bridge. Photo courtesy of County Materials Corp.