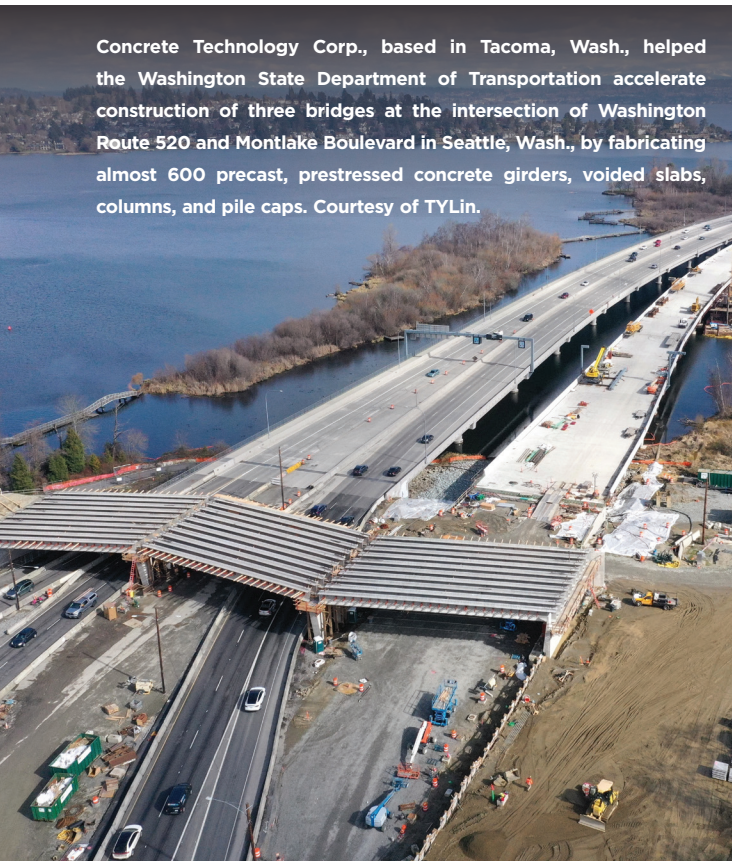
Three bridges, 10 miles of precast concrete girders, one award-winning project

Linking Seattle, Wash., with its suburbs across Washington's second-largest lake has challenged transportation engineers and contractors since before the state joined the Union in 1889.

For more than a century, ferries carried people and goods from one side of Lake Washington to the other. Then came a two-lane highway, Washington Route 520, with a floating bridge. As businesses like Microsoft Corp. and Amazon set up headquarters in Seattle's suburbs, the state widened these assets to accommodate ever more vehicles.

The state has been improving the 13 mi (21 km) corridor almost from its opening in 1963, and it's not finished. Each multiyear, multi-billion-dollar improvement program builds, expands, or replaces bridges, ramps, roads, and interchanges; adds pedestrian and cycling paths; and incorporates mass transit.

PCI-certified precast concrete producer Concrete Technology Corp. (CTC) of Tacoma, Wash., has supplied these projects with key structural components since the company's founding in 1951.



Concrete Technology Corp., based in Tacoma, Wash., helped the Washington State Department of Transportation accelerate construction of three bridges at the intersection of Washington Route 520 and Montlake Boulevard in Seattle, Wash., by fabricating almost 600 precast, prestressed concrete girders, voided slabs, columns, and pile caps. Courtesy of TYLin.

A recent example is the state's $1.6 billion Rest of the West program launched in 2015. A phase completed in 2025 with 593 CTC-fabricated columns, pile caps, and almost 10 mi (16 km) of girders expands access to the floating bridge at Montlake Boulevard, one of Seattle's busiest streets.

One improvement in that phase replaced an old bridge with a 1 mi (1.6 km), three-lane bridge from an enlarged interchange over a bay to the floating bridge over the lake.

For visual appeal, above-water columns have a smaller diameter at the base and a larger diameter at the top for a flared look. To fabricate these, CTC cast a concrete shell around thick steel pipe. On-site, the contractor inserted these architectural precast concrete/steel columns into steel casings embedded underground, dropped in a steel reinforcing bar cage, and placed concrete into the column.

CTC's 43 precast concrete abutments, prestressed with up to 74 American Association of State Highway and Transportation Officials' (AASHTO) M 203 Grade 270 (1860 MPa) strands tensioned to 43.9 kip (195 kN), rest on these columns. CTC also fabricated 40 UF72G4 tub girders with up to 4200 kip (18,680 kN) of pretension and 185 WF74G girders with up to 3400 kip (15,120 kN) of pretension.

CTC also fabricated girders for two more bridges: a 3-acre (1.2-hectare) interchange expansion over State Route 250—called a cut-and-cover tunnel lid—and a pedestrian/cyclist bridge over Route 520.

The tunnel lid comprises four prestressed concrete tub girders, 180 prestressed concrete standard girders incorporating 0.5 in. (13 mm) extra cover on all sides for fire protection, and 24 prestressed 30 in. (760 mm) voided slabs. Girders can't be installed over live traffic, so all 208 were placed in only four weekend closures, another time-saving convenience of precast concrete.

The pedestrian/cyclist bridge over Route 520 comprises 30 WF66G girders.

Design-build teams choose precast concrete to accelerate bridge construction. In this case, offsite fabrication also enabled crews to work around the state's fish window. To protect spawning salmon, overwater construction isn't allowed between April 15 and September 1. Thanks to precast concrete, the three-lane replacement bridge opened almost one year before substantial completion.

Precast, prestressed concrete represented about 9% of the total cost for the Route 520 Montlake to Lake Washington Interchange and Bridge Replacement project.

—Stephanie Johnston

Curved precast concrete U beams form sweeping S-shaped pedestrian bridge

Since the 1980s, Pennsylvania has been connecting sections of a recreational trail that runs through farmland, suburbs, and cities along the 130 mi (209 km) Schuylkill River.

Until recently, a gap in the trail remained in downtown Philadelphia, separating residents in southern neighborhoods from the Center City business district. That gap closed a year ago, in May 2025, when a 650 ft (198 m) long bridge built with a precast concrete superstructure opened. Opening weekend saw 20,000 user trips on this bridge.

Pennsylvania bulb tee precast concrete girders support the bridge's approach spans. But only precast concrete curved U beams could produce the gentle S shape, called a reverse curve, that winds along the river bank and under elevated railroad tracks and an elevated highway to connect Philadelphians to the trails to the south.

Owners Schuylkill River Development Corp. and the city of Philadelphia wanted to minimize future maintenance costs, which eliminated steel box girders. Segmental cast-in-place concrete requires specialized expertise, which limited the bidding pool of potential contractors. Engineering firm AECOM wanted a torsionally rigid superstructure with a visually striking profile.

Meeting these goals led the design-bid-build team to develop the only pedestrian bridge (that they know of) featuring curved, spliced, reinforced precast concrete U beams in a single-box configuration with cable-stayed support.

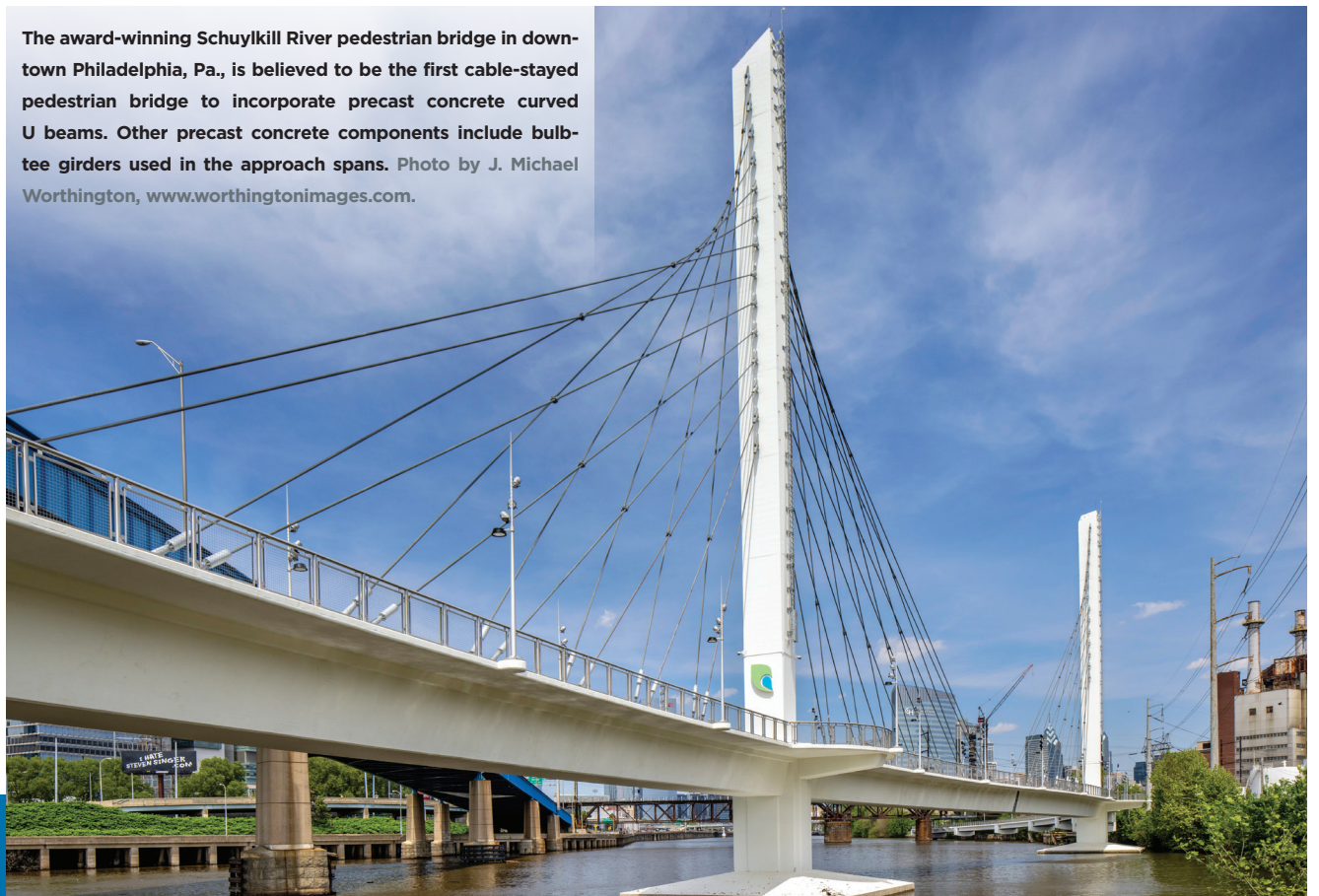
PCI-certified precast concrete producer Fort Miller Co. Inc. of Schuylerville, N.Y., fabricated eight of these beams for the project. They are 7 ft (2.1 m) tall and 73 ft 9 in. to 80 ft (22 to 24 m) long and weigh 117 to 148 tons (106 to 134 tonnes). They conform to PCI's *Guide Document for the Design of Curved, Spliced Precast Concrete U-Beam Bridges*, U84 guidelines, except for the bottom flange, which was widened from 10 ft 9 in. to 13 ft (3 to 4 m) to accommodate the 25 ft (7.6 m) wide deck.

All eight have a 950 ft (290 m) radius at the centerline, large enough for Fort Miller to build a wood form with custom-milled ribs and plywood sheathing with a 6-degree curve on the inside. Each is reinforced with ASTM A615 Grade 60 (414 MPa) epoxy-coated steel reinforcement, and a portion of the post-tensioning was performed at the plant. They're embedded with shear keys to facilitate continuous reinforcement connections for cast-in-place cable diaphragms. Two concrete masts with 56 interwoven wire rope cables support the U-beam superstructure and anchor to clevis pins in the deck.

Lap splices for reinforcement and heat-shrink tubing connections for post-tensioning ducts are encased by 2 ft (0.61 m) cast-in-place closure joints connecting the U beams.

The curved U beams were delivered via barge, allowing for efficient assembly on the water. Although the entire project lasted four years, the precast concrete U beams were installed in two weeks.

—Stephanie Johnston



The award-winning Schuylkill River pedestrian bridge in downtown Philadelphia, Pa., is believed to be the first cable-stayed pedestrian bridge to incorporate precast concrete curved U beams. Other precast concrete components include bulb-tee girders used in the approach spans. Photo by J. Michael Worthington, www.worthingtonimages.com.