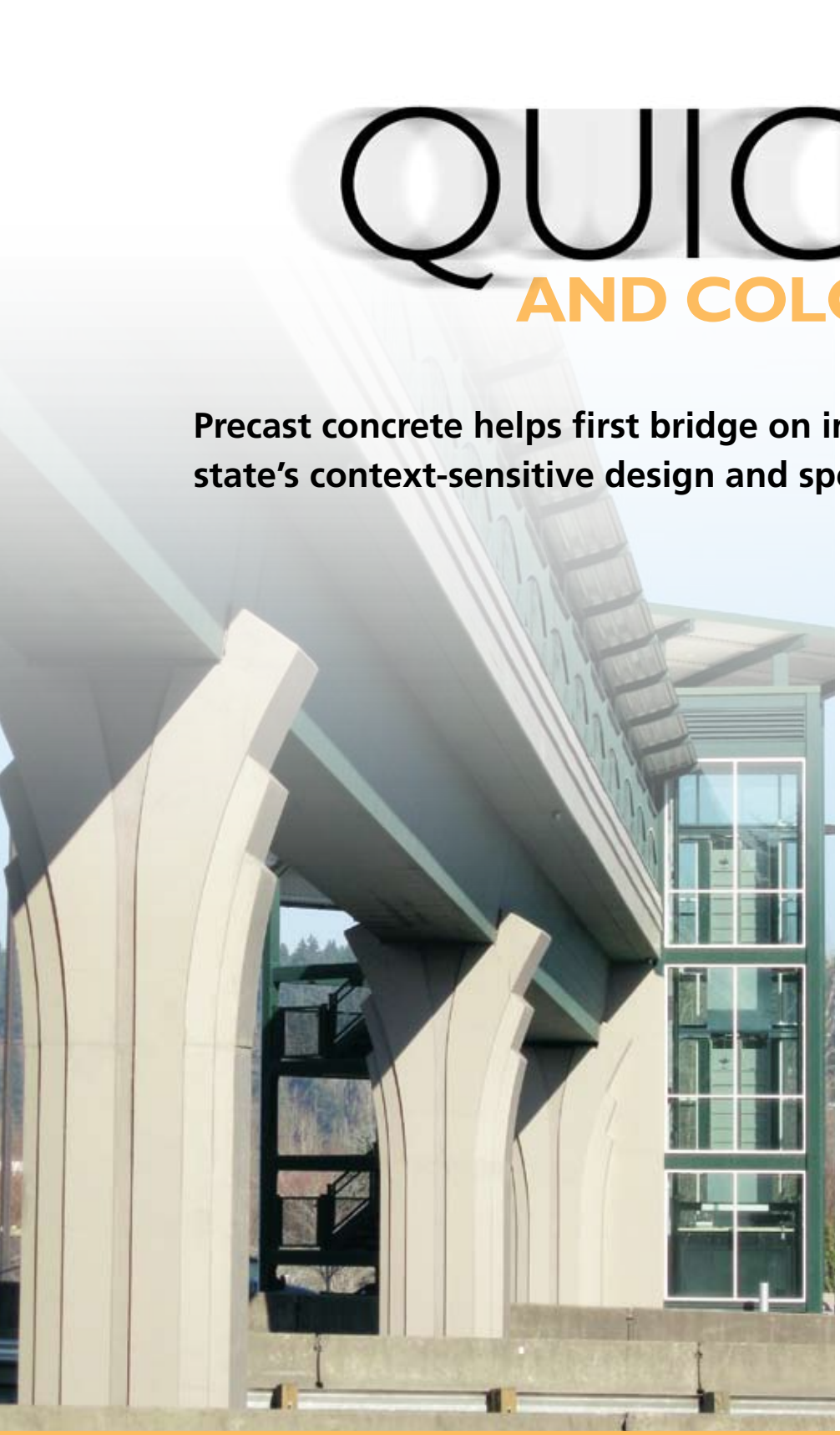
QUICK AND COLORFUL

by Brian Aldrich,
Washington State Department
of Transportation

Precast concrete helps first bridge on interstate corridor meet state's context-sensitive design and speed construction



Administrators at Sound Transit (Central Puget Sound Regional Transit Authority) wanted to connect their new interstate bus transit station to an existing park-and-ride lot across the interstate highway. Their goal was to improve bus transit speed and reliability by eliminating the circuitous route previously required to access the lot.

The connection required a 607-ft-long bridge over the interstate, along with an elevator and stairs down to the surface parking. The bridge had to be built while keeping traffic flowing as smoothly as possible during the construction. In addition, the park-and-ride lot had to remain open with minimal disruption or reduced capacity. To accomplish these goals, designers used precast concrete trapezoidal tub girders that also allowed for the incorporation of context-sensitive features that will serve as an inspiration for other bridges on the interstate corridor.

The bridge is the first on the interstate to use the state's new Context-Sensitive Solution guidelines, which resulted in flared columns and other embellishments. All photos: Washington State Department of Transportation.

profile

CANYON PARK FREEWAY STATION / BOTHELL, WASH.

ENGINEER: Washington State Department of Transportation, Olympia, Wash.

PRELIMINARY ARCHITECT: Streeter Associates, Seattle, Wash.

CONTEXT-SENSITIVE SOLUTION ARCHITECT: HNTB, Bellevue, Wash.

AWARDS: *Best Non-Highway Bridge co-winner, Precast/Prestressed Concrete Institute's 2008 Design Awards*

Precasting the girders increased the public's safety and convenience during construction.

The bridge consists of six spans varying in length from 70 ft to 124 ft, with a width of 12 ft 6 in. and a usable walkway width of 10 ft 7 in. An inclined ramp is provided at one end and an elevator/stair tower at the other. The walkway is enclosed under a structural steel roof supported by concrete pedestals integrated into the concrete barriers. Throw-screens installed on both sides provide safety for bridge users and travelers on the highway below. A roof is not typical for freeway pedestrian bridges in the state, but it was necessary to encourage transit use by providing protection from inclement weather.

Transit-Government Partnership

The project was a joint production of Sound Transit, which owns the bridge, and the Washington State Department of Transportation (WSDOT), in whose right of way the bridge would be built. Transit officials essentially hired WSDOT to manage the program, and WSDOT's project manager contracted with the WSDOT Bridge and Structures Office to provide the structural design.

It was an easy choice to use precast concrete for the superstructure design, as most of the bridge superstructures in Washington use precast. It offers good durability and extremely low maintenance over its lifetime. Cast-in-place concrete superstructures require falsework over the roadway, creating a hazard to the travelling public.

Steel structures often require more regular maintenance and inspections, especially when they have little redundancy and are fracture-critical. We avoid building a structure that is fracture-critical, which steers us toward concrete designs when there are only one or two girders per span. Steel also has been more expensive and volatile in its pricing, making it more difficult to estimate construction costs.

Traffic on the adjacent freeway ramp had to be stopped while the long ramp up to the bridge crossing was completed.

The ultimate choice was between trapezoidal tub girders and traditional I-beams. The decision for the tub girders was based on aesthetics. These girders are new for our state, with few projects having been completed to recoup costs on the forms. So, these early projects are more expensive than we anticipate for later ones. However, tub girder bottom flanges are wider than for typical I-beams, and they have two webs, allowing one tub girder to replace two I-beams on this project. This saved both casting and erecting time.

The cost for the tub girder superstructure was higher than a typical I-beam superstructure, but it was chosen by Sound Transit due to the aesthetic appeal. The shape complements and enhances the aesthetic elements, including the columns, barriers, and throw-screen panels. The shape also provides an efficient way to resist additional lateral loads from the pedestrian-bridge roof and throw-screen panels.

Precasting the girders increased the public's safety and convenience during construction by minimizing interstate closures and eliminating falsework over the traveled lanes. The concrete superstructure also provides some protection for pedestrians against the harsh freeway environment.

Foundations

Foundations for the bridge columns and elevator/stair tower consist of 2-ft-diameter cast-in-place concrete piles with cast-in-place concrete pile caps, typical for a WSDOT design. The abutment adjacent to the new bus transit station and the connected entry structure were built on concrete spread footings.

Designers on the Canyon Park Freeway Station in Bothell, Wash., used precast concrete trapezoidal tub girders to provide quick erection of the pedestrian bridge that crosses the interstate, connecting a new bus terminal with an existing parking lot.

PRECAST, PRESTRESSED CONCRETE PEDESTRIAN BRIDGE / SOUND TRANSIT, OWNER

CIVIL DESIGN: INCA Engineers Inc., Bellevue, Wash.

PRIME CONTRACTOR: Granite Construction (formerly Wilder Construction), Everett, Wash.

PRECASTER: Central Pre-Mix Prestress Co., Spokane, Wash., a PCI-certified producer

BRIDGE DESCRIPTION: A 607-ft-long pedestrian bridge consisting of six spans of single precast, prestressed concrete trapezoidal tub girders

BRIDGE CONSTRUCTION COST: $5.5 million

The stair tower was constructed simultaneously with the bridge construction, as the end span rested on the tower wall.

Cast-in-place columns were built for the intermediate piers, using designs influenced by the state's new Context-Sensitive Solution guidelines.

Piers and Tower Core

The piers were erected first, along with the core of the elevator/stair tower, since the end span girder sits on the tower. The core of the elevator/stair tower consists of cast-in-place concrete shear walls, which enclose an electrical room and an elevator machine room. The walls form the abutment, which was shaped to match the flare of the bridge columns.

AESTHETICS AND CONTEXT SENSITIVITY

Consideration of aesthetics was a critical element of the design process. The project was designated to be the first on the I-405 corridor to be designed using the new Context-Sensitive Solution guidelines produced for the state. The guidelines were developed by landscape architects, who considered suggestions garnered from public-outreach programs to create architectural elements to be included in bridge designs. This structure was the first in the pipeline that designers felt comfortable producing in this style, and Sound Transit officials agreed to follow the guidelines to create a distinctive appearance that could serve as an influence on later projects.

The result of the careful design and use of the context-sensitive solutions is a structure that was quickly erected to achieve a dramatic appearance. It features flared columns inspired by rhododendrons, horizontal ridges on the outside face of the barrier, and an arched pattern for the throw-screen panels.

To accent the design further, three colors of pigmented sealer were used on different components. "Cascade Green" was used for the precast trapezoidal tub girders, spanning the highway, as well as for the underside of the deck overhangs and structural steel. "Mt. Baker Grey" was used for the central recess of the flared columns. "Mt. St. Helens Grey" was used for all other concrete surfaces.

Girders

The girders were each cast and delivered as single-span units, and all were 5 ft deep, with a 5-ft-wide and 6-in.-thick bottom flange. The out-to-out web dimension at the top is 6 ft 5.14 in., with 7-in.-thick webs sloped at 7:1. Each end of each girder has a 1-ft-thick diaphragm.

Delivery of the precast concrete girders to meet the project's schedule was a challenge. This required the girders to arrive in December, traveling over the Cascade Mountain Range. The large girders had to be parked on the roadway's shoulder overnight in the pass during a snowstorm. Upon arrival, they were unloaded to a staging area and then delivered for the crane to erect as needed.

Erection of the key spans over the roadway was completed in only two nights.

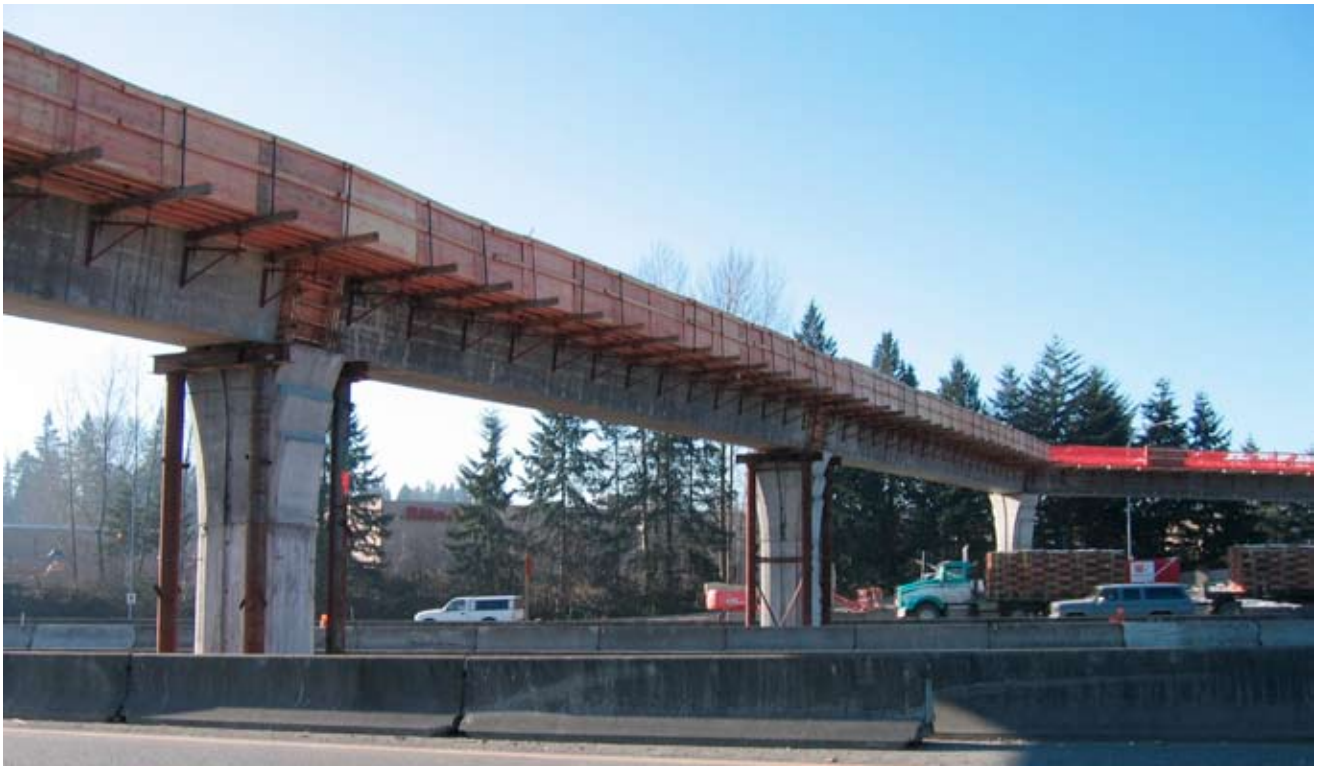
Erection of the key spans over the freeway and ramps was completed in only two nights. Spans one and two with lengths of 70 ft and 86 ft were set on the first night over the northbound lanes and off-ramp. Span three with a length of 124 ft was set on another night over the southbound lanes and on-ramp. A cast-in-place deck was used to provide the walkway. Overall, the erection went smoothly. Construction of the entire project took approximately 11 months.

Both WSDOT and Sound Transit officials were pleased with the resulting design, especially as it met the context-sensitive solution requirements while minimizing road closures. Precasting the girders increased the public's safety and convenience during construction by minimizing interstate closures and eliminating falsework over the traveled lanes.

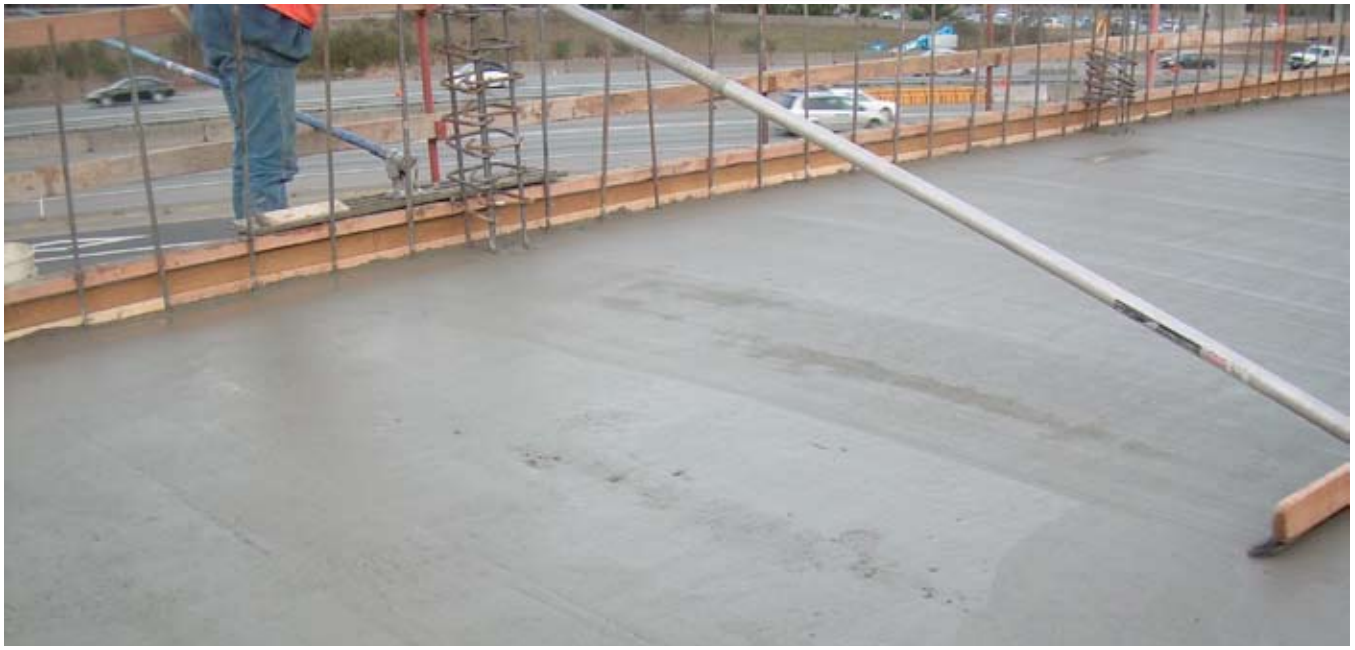
Brian Aldrich is a bridge engineer specializing in concrete structural systems with the Washington State Department of Transportation.

For more information on this or other projects, visit www.aspirebridge.org.

The precast concrete tub girders were placed in only two nights, with two crossing the northbound side of the highway set in one night, and the span crossing the southbound side set another night.



A cast-in-place deck was used for the walkway (Deck pour span six).



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