



# #1 Seismically resilient

## King County, Wash., builds a toughie

By **Brian W. Budzynski**  
Managing Editor

**S**eattle's Duwamish Waterway near King County, Wash., is the industrialized estuary of the Duwamish River valley, a seismically volatile region with a long history of being battered by earthquakes.

The South Park Bridge, which spanned this estuary, had become structurally deficient after decades of seismic pummeling. After a planning initiative more than a decade in the making, the \$167 million South Park Bascule Bridge Replacement project was completed and opened to traffic in June 2014. From its inception to completion, the project was an exercise in targeted design implementation.

The new South Park Bridge is the first bascule bridge designed to meet post-seismic operational requirements of an AASHTO Seismic Zone 4 with 70- to 105-ft-deep soft soils. "Our goal was to design a movable bridge to remain open to traffic immediately after a 100-year return-period earthquake and closed to traffic for a matter of only hours or days after a 1,000-year return-period earthquake," Rich Johnson, HNTB's project manager on the South Park Bridge, told *ROADS & BRIDGES*. "We achieved this by developing innovative design solutions, such as the sunken caisson foundations, isolated trunnion frames and a collapsible center joint on the bascule leaves."

### A trio of innovations

Compared to drilled shaft foundations, the sunken caissons provided enhanced stiffness and resilience, reducing seismically induced displacements, such as tilting, and minimizing the potential for a permanent set resulting from an earthquake.

Furthermore, each bascule leaf was supported on a free-standing steel frame within each pier that was designed to respond elastically in the case of a higher-level event. The machinery platform also was connected to the same frame; thus during an earthquake, the machinery and bascule move as one, and relative displacements between components after the earthquake will be small, which limits damage to the machinery. In addition, the entire frame can be modestly re-positioned for global span realignment if the foundation experiences any permanent displacement.

Finally, at mid-span, where the tips of the moveable spans come together, a gap measuring 18 in. just under the deck level precludes contact between the leaves during a higher-level event. This will minimize the transfer of loads to the support frames in each pier and economize the design of the trunnion frame and bearings. This 18-in. gap is bridged at deck level with a large, finger-type joint cantilevered from the tips of the leaves. These finger joints are minimally

#### PROJECT:

South Park Bascule Bridge Replacement

**LOCATION:** Seattle, Wash.

#### OWNER:

King County Department of Transportation

**DESIGNER:** HNTB Corp.

**CONTRACTOR:** Kiewit-Massman

**COST:** \$167 million

**LENGTH:** 1,045 ft

**COMPLETION DATE:** June 30, 2014



secured to the bridge so that they can become sacrificial if the leaves should come in contact with one another.

## Keeping the look

The new South Park Bridge was designed to look like its iconic predecessor, which served the community from 1931 to 2010. When the county asked residents what a replacement bridge should look like, they were insistent that the new bridge reflect the basic architecture of the historic bridge. The county's design consultant called for the use of innovative plate girders with clean lines to mimic the look of the historic approach trusses. These truss girders provided the desired visual appeal the public sought and had the added benefit of reducing the long-term maintenance cost to the county by eliminating most fasteners and joints where debris typically collects.

"The old Scherzer rolling lift bascule bridge was listed on the National Register of Historic Places and was designated as a county landmark," Jim Markus, managing engineer, bridge section, King County Road Services, told *ROADS & BRIDGES*. "Both the county and residents wanted to save and reuse as much of the historic structure as was feasible. The four rockers and guide tracks became portals on each end of the new bridge. A gear set, railing panels, streetlight standards, latticed

structural members, bridge deck grating and rail posts were all saved from demolition and cleaned up and painted by local companies so they could be put on display in public spaces at the new bridge, including in the new rain garden. Decades-old road bricks were salvaged and reused as walkway pavers and landscape accents. Gears and rail panels were incorporated into the bridge rail, where people can see them as they travel over the river and pedestrians can touch them as they walk by."

## Environmental respect

After a thorough environmental assessment with particular attention to the various local species listed under the Endangered Species Act, measures to minimize the disturbance of contaminated sediment during in-water pile work were taken. Containment systems were employed to keep all construction debris and runoff out of the river, and all excavation work was carefully monitored to avoid potential impacts from erosion and contaminated soil and groundwater. The project team carefully monitored water quality in the Duwamish Waterway. Pile driving, which can create in-water noise impacts to marine life, was not used in this project. A vibrating pile-driving system was used instead.

The new bridge was designed so that no untreated storm water entered the

river—unlike the old bridge. The new bridge discharges runoff to a storm-water vault connected to the sanitary sewer on the bridge's north end. At the south end, runoff is diverted to a landscaped rain garden. The storm water is treated and filtered naturally through soil before it enters the river ecosystem. The rain garden placed no new demands on Seattle's overcapacity storm-water collection system.

## Why it's our No. 1

Erecting a new structure in the face of a treasured progenitor is a daunting task in the best of circumstances. Those surrounding the construction of the South Park Bascule Bridge were beyond extreme—this project towed narrow lines of strict operational quality, and did so amidst input from residents. In this sense, the new South Park Bascule Bridge is more than a bridge; it is a connector of communities on both shores of the Duwamish. "We delivered on our promise—thanks to the commitment of our funding partners, and the determination of the people and businesses of South Park who inspired us never to give up," said King County Executive Dow Constantine. This restored link to the South Park community preserves the historic features of its predecessor and improves the overall landscape of the river valley. **R&B**