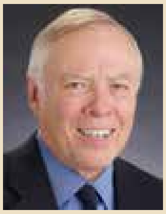
AESTHETICS
COMMENTARY
by Frederick Gottemoeller



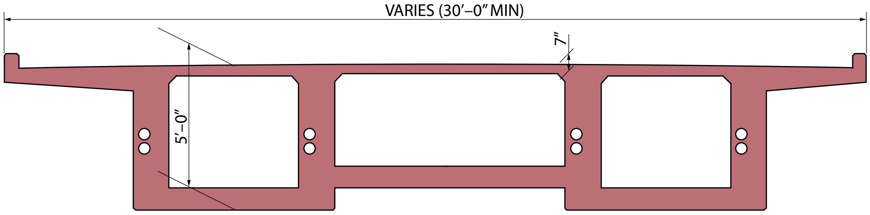
This bridge reminds me of the old television advertisements for Perdue chickens. In those advertisements, Frank Perdue would talk at length about chickens, and then end his spiel with, "It takes a tough man to grow a tender chicken." This bridge demonstrates that it takes excellent engineering to make a complicated bridge look so simple. And that's important because this bridge's aesthetic appeal is based on the simplicity with which its complex geometry is addressed. The bridge is an interesting shape, and it is unencumbered by pier caps, straddle bents, expansion joints, or any of the other details that may be distracting.

The girders are relatively shallow, giving the pedestrian areas under the bridge a feeling of spaciousness. They curve to follow the curve of the deck, creating a generous and constant-width overhang that contributes a consistent shadow line, making the girders seem even thinner. The smooth undersides of the girders provide a clean and light-colored ceiling for this outdoor space; space that pedestrians and bicyclists can occupy without worrying about birds and debris overhead.

The circular piers have no axes or planes that would conflict with the curves of the girders floating above. They also allow the myriad paths of pedestrians and bicycles to flow past them with a minimum of interference. The straightforward railing allows the overall geometry of the bridge to dominate, creating no secondary rhythms or panelization that would distract. The light poles serve their function without attracting the eye away from the bridge itself.

Once the Sound Transit University link is in service, the Montlake Triangle will be filled with the activity of pedestrians, bicyclists, and transit riders. This bridge will provide a dignified and memorable setting for all of them.

Frederick Gottemoeller is an engineer and architect, who specializes in the aesthetic aspects of bridges and highways. He is the author of Bridgescape*, a reference book on aesthetics and was deputy administrator of the Maryland State Highway Administration.*



Typical section at frame 1. Rendering: AECOM.

The girder web stirrups also needed to be designed to resist vertical shear and lateral web bending caused by the horizontally curved post-tensioning. The strut-and-tie method was used to analyze and design the duct-tie and web-tie reinforcement to resist the local out-of-plane lateral post-tensioning forces. Special attention had to be paid to the placement of the duct-tie and web-tie reinforcement during construction, as this reinforcement was critical in resisting the post-tensioning, out-of-plane forces.

Two measures incorporated to enhance the durability of the bridge were the use of epoxy-coated reinforcement in the 7-in.-thick deck, and the use of high-density polyethylene corrugated ducts for the post-tensioning tendons.

Substructure

The girders are integral with 4-ft -diameter columns at piers 2, 3, 4E, and 4W, and with 2-ft 6-in.-diameter columns at piers 5W through 8W. The girders are supported on expansion bearings at piers 1, 5E, 6E, 9W, and at the span 3E and 4W hinges.

Another unique feature of this bridge is that the foundations are dissimilar between piers. Pier 1 is founded on two, 4-ft-diameter drilled shafts, one under the centerline of each box girder alignment. Piers 2 and 3 are founded on two-column combined spread footings 4 ft 6 in. thick. Pier 4E is founded on top of a large roof beam within the underground light-rail station. Piers 5E and 6E are part of the Headhouse building frame. Pier 4W is supported on a single-column spread footing 4 ft 6 in. thick. Piers 5W through 8W (supporting the bicycle ramp) are all founded on single-column spread footings 2 ft 6 in. thick. Pier 9W is an abutment bearing wall with wingwalls, which all bear on a spread footing that is 1 ft 9 in. thick.

Because piers 4E, 5E, and 6E are all founded on the building frame of either the Headhouse or the station roof, the bridge engineers provided all design loads and displacements to the station designer, and included the Headhouse frame in the bridge analysis model. A special seismic design criterion was developed to satisfy bridge (displacement based) and building (force based) code philosophies for the spans supported by the Headhouse.

Final Remarks

The design of the MTP Bridge has pushed the limits for the use of post-tensioning in highly curved bridges, demonstrating that with the proper analysis and detailing, durable and low maintenance post-tensioned concrete bridges can be used for bridges. A

Claudio Osses is a bridge engineer and Richard Patterson is the Washington practice lead with Buckland & Taylor in Seattle, Wash. Both Osses and Patterson were formerly with AECOM. Orin Brown and Huanzi Wang are bridge engineers with AECOM in Sacramento and Oakland, Calif., respectively.

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.