

### Coal Combustion Product Type

Fly Ash

### Project Name

St. Croix Crossing Bridge

### Project Location

St. Croix River crossing on the Minnesota/Wisconsin border

### Project Participants

MnDOT, WisDOT, Lunda/Ames Joint Venture, Beton Consulting Engineers, Cemstone, Aggregate Industries, HDR, Holcim Technical Services Group

### Project Completion Date

2017

### Project Summary

The Stillwater Lift Bridge was constructed in 1931 as a two-lane overpass crossing the St. Croix River between Stillwater, Minnesota, and Houlton, Wisconsin. With only one lane in each direction, the crossing was a frequent traffic bottleneck, a situation compounded by the fact that the bridge's main span had to be lifted to allow boats to pass underneath. In 2008, after more than three-quarters of a century in service, the bridge was deemed structurally deficient and in need of replacement.

### Project Description

The existing bridge's location on the St. Croix National Scenic Riverway, a federally protected system of waterways, meant that the design and construction of its replacement would face particular environmental scrutiny—pertaining to such factors as the volume and sustainability of the materials used as well as the bridge's physical profile within the surrounding landscape.

Ultimately, an extradosed bridge design was settled upon—a hybrid configuration combining box girders and cable stays. Compared to a more traditional cable-stayed span of similar length, the design allowed for the use of fewer piers; shorter towers; less concrete, steel, and cable; and lower environmental impact. The specifications called for a minimum 100-year service life—making concrete fortified with supplementary cementitious materials (SCMs) the obvious choice of material over structural steel.



Photo: MnDot



Photo: MnDot

In spite of its streamlined design, the St. Croix Crossing Bridge—at almost one mile in length and 140 feet above the river—required the casting and shipment of massive precast concrete girders, some as large as 180 tons. The girders' size and relatively intricate form required very specific concrete mixes combining workability with both early strength gain (4,000 psi in 24 hours) and durability. Rigorous testing produced almost 20 mixes for the concrete elements used, each featuring liberal use of SCMs—ranging from a 10 percent fly ash mix for the bridge-approach segments (variously requiring 6,000 or 8,000 psi strength) to a 30 percent fly ash mix for the main span segments (requiring 8,000 psi strength). In total, 6,000 tons of fly ash were incorporated into the main span's 650 concrete girders.

Completed in 2017, the St. Croix Crossing Bridge represents only the fifth time an extradosed design has been employed in bridge construction in the U.S.—and stands as proof of the feasibility of using fly ash concrete in such designs to help achieve both environmental and aesthetic objectives. Since its opening, the bridge has earned a raft of awards, including a Public Works Project of the Year Award in 2018 from the American Public Works Association and Best Project (2018) in *Engineering News-Record Midwest's* Highway/Bridges category.