Hawk Falls Bridge (Arch), Pennsylvania

Wind Engineering Study

Client: Modjeski and Masters Inc.	*Year Tested: 2017*	*Length of Bridge: 720 ft*
Arch Height: 189 ft	*Arch Width: 82.25 ft*	*Arch Section Model Scale: 1 to 51*

The Project

The Hawk Falls Bridge is located in the Hickory Run State Park in Pennsylvania along Interstate 476 and is situated over Mud Run near Hawk Falls. The existing bridge is scheduled for replacement because it is functionally obsolete due to the lack of roadway shoulders and nearing the end of its design service life. The replacement Hawk Falls Bridge will be a 720 ft long steel structure featuring a 480 ft arch span flanked by four 60 ft deck plate girder spans. As with the existing bridge, the new bridge will carry two traffic lanes in each direction, but will also provide 12 ft wide shoulders and 6 ft wide median shoulders. Three welded, steel box arch ribs will be utilized to create an aesthetically-pleasing structure that spans the deep Mud Run Valley located in Hickory Run State Park.

The study of the wind action on the arch section of the Hawk Falls Bridge was performed in the Boundary Layer Wind Tunnel Laboratory at the University of Western Ontario.

The Wind Tunnel Studies

A section model of the bridge arch section was designed and constructed at a geometric scale of 1:51.

The primary objectives of the section model study were to investigate the aeroelastic stability characteristics of the bridge arch in high wind conditions and to define the wind speeds associated with possible flutter (or galloping) instability and / or vortex shedding induced oscillation. An aim of the investigation was also to define the dynamic response characteristics of the bridge deck to turbulent wind over a full range of wind speed.

Analytical estimates of the critical wind speeds for flutter and the responses of the arch structure to turbulent buffeting were also a primary focus of the investigation. A 3-D multimode analysis was employed, which integrates the findings of the experimental study with the dynamic modes and frequencies of the structure. Another major output of this analytical study is the equivalent static wind loads, which are used to verify and improve the wind load distributions used for design of the structure.

The Boundary Layer Wind Tunnel Laboratory

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