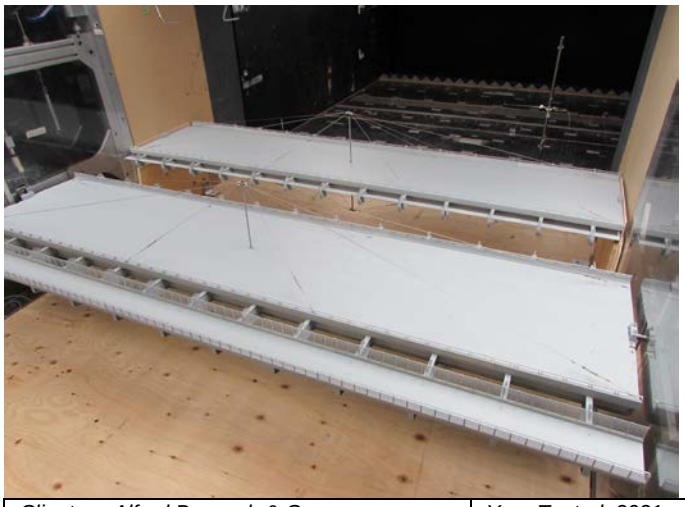
I-74 Mississippi River Bridge, Iowa

Wind Engineering Study



Clients: Alfred Benesch & Company	*Year Tested: 2021*	*Main Arch Span Length: 795 ft*
Arch Crown Height above Water: 240 ft	*Deck Width: 72 ft*	*Deck Section Model Scale: 1 to 50*

The Project

The I-74 Arch Bridge connecting Bettendorf, Iowa and Moline, Illinois across the Mississippi River. The crossing includes two independent structures comprised of twin "basket handle" true-arch bridges. The first bridge carries westbound traffic, while a second, similar structure will carry eastbound traffic as well as a cantilevered Bike Trail. Each bridge has steel deck framing with a concrete slab deck 72 ft in overall width with four lanes of traffic. The main arch span is 795 ft. The WB bridge has a "winglet" included on both sides of the bridge, designed to reduce vortex shedding induced oscillation (VIO), which was developed in the original wind engineering studies performed by West Wind Laboratory (WWL) in 2012. The effectiveness of the winglet was confirmed in subsequent studies performed by RWDI in 2016 in turbulent flow conditions as part of a follow-up investigation concerning the isolated WB bridge situation, prior to the start of construction of the EB bridge. However, RWDI did conclude that the winglet was not as effective as other devices (e.g. baffle plate) in low turbulence conditions. The EB bridge has a 14 ft wide bike path on the west side of the bridge, separated from the main structure by a 13'6" gap. The WWL study concluded that the presence of the bike path was found to mitigate the VIO, much as the presence of the winglet had done for the WB bridge.

The Wind Tunnel Studies

The section models of the I-74 Arch Bridge deck was studied at the Boundary Layer Wind Tunnel Laboratory (BLWTL) of the University of Western Ontario.

The main focus of the section model tests performed by BLWTL was to verify satisfactory behavior for the bridge in the in-service condition. This mandate was expanded during the study to include selected construction configurations of the EB bridge while the WB bridge was being used to carry two-way traffic.

The primary objectives of the section model study of the I-74 Arch Bridge were to investigate the aeroelastic stability characteristics of the bridge deck and to define the wind speeds associated with vortex shedding induced oscillation, as well as the mitigation measures used to suppress VIO motion. 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 responses of the bridge to turbulent buffeting were also carried out using a 3-D multimode analysis, which integrates the findings of the experimental study with the dynamic modes and frequencies of the structure. Another major output of the analytical study is the equivalent static wind loads, which are used to verify the wind load distributions used for design of the structure.

The Boundary Layer Wind Tunnel Laboratory

Western

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