# EL Carrizo Bridge, Mexico

## Wind Engineering Study

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| *Client: Universidad Naçional Autonoma de México (UNAM)* | *Year Tested: 2012* | *Main Span: 434.3 m* |
| *Pylon Height : 226 m* | *Deck Width: 18.4 m* | *Full Bridge Aeroelastic Model Scale: 1:200* |

### The Project

The El Carrizo Bridge is a cable-stayed bridge along the Durango-Mazatian superhighway crossing the gorges formed by the Carrizo river. The remarkable part of this bridge is its central pier with a height of 166m that, when adding the 60m tall tower, will reach 226m, becoming the tallest structure ever built in Mexico. The total length of the bridge is 434.3m. The bridge was designed with a roadway width of 18.4m.

The cross section of the bridge deck contains two structural solutions. The first one consists of 14 segments and a pair of box girders of post-tensioned pre-stressed concrete. This portion of the bridge is constructed as two double cantilever decks from pier No. 3. The second solution consists of 30 segments, formed by two lateral girders reinforced with structural steel I-shapes interconnected with bridge elements upon which the reinforced concrete slab is cast. Twenty eight of these segments are individually fastened to a pair of stays to connect them to the central tower.

The tower consists of a pair of masts above the deck level, each supporting 28 stays and the deck fabricated with steel segments (the second solution). The geometrical shape of the main tower under the deck level corresponds to a cellular box cross section of reinforced concrete.

### The Wind Tunnel Studies

A primary objective of the full aeroelastic model study was to investigate the overall aerodynamic stability in high wind conditions and to define the wind speeds associated with possible flutter instability and vortex shedding induced oscillation. The investigation was also intended to define the dynamic response characteristics of the bridge to turbulent wind over a full range of wind speed and to provide information to check the design of the structure against wind effects. The full bridge aeroelastic model was designed and constructed to determine the response characteristics of the bridge to three-dimensional turbulent flow in wind conditions considered to be characteristic of the site winds. Two configurations of the El Carrizo Bridge were studied in the full aeroelastic model investigation. These included the double cantilever construction stage and the completed bridge.

The behaviour of the full bridge aeroelastic model was tested under two wind conditions: "smooth" flow and turbulent boundary layer flow representative of those at the project site. Topographic features close to the bridge were also modelled in the test. Instrumentation on the model provided estimates of full scale structural responses that could be compared to design capacities.

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FSBR/ 53 / April 2020 / LK
Last Printed: April 6, 2020