Form travelers at either end of cantilever 1. Geometry control and monitoring during segment casting ensured accurate vertical and horizontal alignments. Photo: Malcolm International.

Concrete

For segmental construction, a high-performance concrete is required. This bridge's design specifically required concrete with a 28-day compressive strength of 6000 psi, and a 3500-psi minimum strength was required prior to tensioning the post-tensioned tendons. To meet the fast-paced construction schedule of the desired seven-day casting cycle, a high-early-strength concrete mixture was ideal.

To achieve a concrete mixture that met these requirements, more than 20 trial batches using local materials and admixtures were tested. A concrete mixture with an 8 to 9 in. slump to facilitate placement among congested reinforcement and a strength of 3500 psi within 12 hours was achieved.

The project's concrete supplier was located in Tucumcari, N.Mex., 25 miles south of the project site. To address the challenges of producing a special concrete mixture and transporting it over 30 minutes by truck, the contractor opted to set up a temporary batch plant at the project site. The on-site facility enabled easier communication and immediate response times, and provided concrete production that met the project specifications and demands.

Weather

Logan is located at an elevation of approximately 3800 ft above sea level, with a relatively dry climate. However, this region also sees a wide range of temperatures—with high temperatures above 100°F during the summer, and lows below freezing with periodic snow in the winter—and experiences extreme weather swings throughout the year. These drastic weather swings can occur within the same week or even within a 24-hour period.

Another weather obstacle for construction operations and schedule are high, gusty winds, which are common in this area. In March 2019, wind gusts of over 60 miles per hour derailed two dozen train cars on a rail bridge downstream from the project.

Design Support During Construction

Throughout the segmental construction, the project team—NMDOT, the design team, and the contractor—worked together to collaborate on the successful execution of vital construction operations.

Comprehensive Concrete Repair Plan

The design engineer and NMDOT coordinated with the segmental contractor to develop a comprehensive concrete repair plan that could be used as necessary throughout the construction to address repairs efficiently and effectively. In the early development of the optimal concrete mixture, concerns arose about slump, the effect of the dry desert climate on the mixture, and consolidation issues. Nondestructive testing, including the impact-echo method, was conducted in areas of significant repair to provide assurance and confidence regarding the quality of the final product.

Post-Tensioning and Grouting

During segmental post-tensioning operations, the design team and the contractor's engineer worked to fine-tune the design parameters based on field-verified values. The theoretical design prestressing parameters for

AESTHETICS **COMMENTARY**

by Frederick Gottemoeller

The challenge of inserting a new bridge into a spectacular natural scene is to design the bridge so that it complements, not clutters, the landscape. A new bridge will unavoidably become the center of attention, but it shouldn't fight for that attention. It should look like it has always been there. One way of accomplishing this is to fit the features of the bridge into the physical features of the site in an obvious and natural way. Here, the piers of the U.S. Route 54 bridge rest on the valley's slopes, out of the floodplain. Plus, the blocky, unadorned pier shafts give the piers an appearance similar to the blocky boulders of the nearby bluffs.

Simplicity itself usually helps fit a new bridge into a spectacular scene. That characteristic should extend to the basic geometry. Here the geometry consists of three horizontal curves: two at each end of the project to create the departure from U.S. 54, and a single, long curve in the middle. Its overall length matches the bridge to the scale of the desert landscape. Imagine how different the bridge would have looked if the designers had decided, for reasons of construction simplicity, to make the bridge straight. There would have been two short curves at each end of the bridge with a straight section in the middle, creating the "broken back curve" dreaded by highway engineers. The bridge would have had a choppy, cut-up appearance, completely out of place in this sweeping landscape.

Sloping the webs of the box girder is another direct, natural way of increasing the sculptural interest of the bridge. Simply by their geometric interplay with the haunches of the girders, the sloped sides create curved edges and varying widths for the girder soffits. Finally, deepening the haunches over the piers visually demonstrates the natural distribution of forces in the bridge, something I imagine the school kids in Logan grasped intuitively when they were given a chance to learn about the structure.