Delicate & Desolate Bridge Replacement

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Combining an innovative approach and high-strength steel results in a picturesque and functional upgrade.

THE DIAMOND CREEK BRIDGE REPLACEMENT PROJECT in Oregon's Douglas County presented unusual challenges involving site access, geological and topographical variability, and traffic control limitations. The bridge is located along a remote and extremely windy stretch of Oregon highway near Crater Lake National Park in an environmentally sensitive watershed in Umpqua National Forest. The sharp curves on the road to the site limited construction equipment availability and the transport of bridge elements, in particular the steel girders.

Because the bridge is a main transportation link for area residents and is also used for commercial purposes, it could not be closed during the replacement. Therefore the new bridge was constructed adjacent to the existing structure.

The site includes steep rock formations at each end of the bridge. At one end a vertically fractured rock cliff created a significant test in designing the foundation elements. Furthermore, the steepness of the natural slopes at the bridge site posed serious challenges in accessing the area underneath the bridge. The existing Diamond Creek Bridge's main span, a 100-ft-long steel truss, prevented any type of staged construction and created the necessity to design a new alignment. In addition, the old truss was coated with lead-based paint. To minimize the associated environmental hazards, the old truss was to be removed in one piece and placed on the new bridge, from which it could be driven away for dismantlement.

In close coordination with Douglas County staff, the new bridge was designed from foundation to superstructure to optimally address the site challenges while assembling an aesthetically pleasing and balanced structure that blends well with its natural surroundings. Abutment footings were designed to follow the natural rock line at each end of the bridge and were placed strategically to avoid vertical fractures in the rock while minimizing span lengths.

The interior pier was placed at the center of the bridge not only to create a bridge with two balanced 135-ft spans, but also to avoid proximity to the environmentally-sensitive area within the ordinary high water mark, minimizing environmental impacts. Environmental impacts were further reduced at the interior pier by using small-diameter drilled shafts rather than a spread footing, significantly reducing the excavation required during construction. Designing for balanced spans also allowed a smaller column to be used.

The need for intermediate splice towers for erecting the steel girder superstructure was eliminated through the use of a creative

Opposite page: Although based on a technically challenging design, the new Diamond Creek Bridge is a simple and elegant blend of technical innovation and context-sensitive problem solving.

Above: To minimize disruption to its lead-based paint, the 100-ft truss from the old bridge was removed in one piece.

Below: Located along a remote and extremely windy stretch of Oregon highway, the Diamond Creek Bridge site required tight clearances to minimize environmental disturbance.

design technique. The steel girders were designed as simple spans with regard to the self-weight of the structure and as continuous spans under live load.

The structural steel beams were designed specifically to make site access possible. Due to the shipping restrictions on their size and length, the beams also were designed with the fewest structural components possible and were assembled at the site.

High-performance and high-strength weathering steels (ASTM A709 Grade HPS 70W) were implemented for the design of the structural steel beams. Using these progressive materials allowed the structural steel to be relatively light and easy to assemble during construction.

Recently bridge decks constructed in Oregon have been developing an increasingly greater number of cracks immediately after construction. To reduce the immediate and long-term cracking due to the shrinkage and seasonal freeze-thaw fluctuations, the client and the design team jointly decided to add plastic fiber reinforcement to the concrete mix design.

Although a technically challenging design, the result was a simple, original, and elegant structure. The Diamond Creek Bridge is an exceptional blend of technical innovation and context-sensitive problem solving, as well as an elegant structure that will serve the client and community for decades. MSC

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