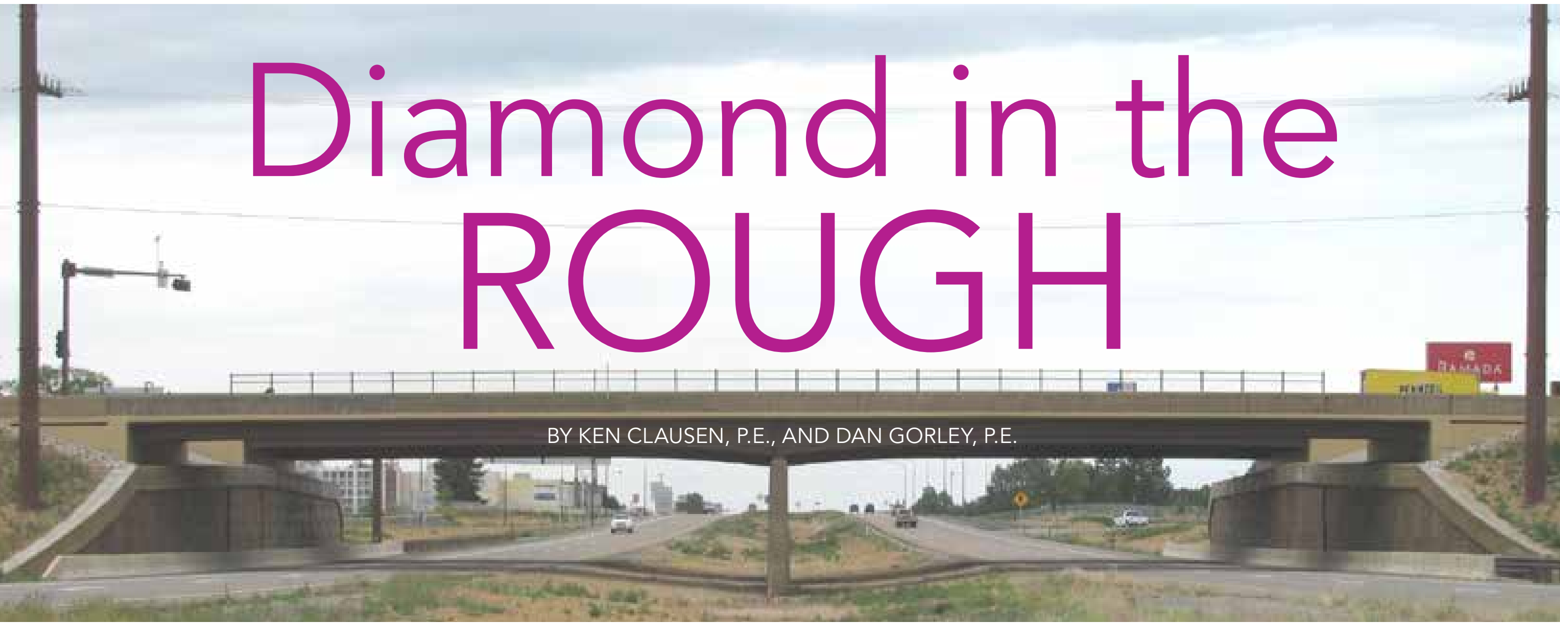
A diverging diamond interchange in southeast Idaho is the first of its kind for the state and facilitates increased integration between two growing communities.

# Diamond in the ROUGH



BY KEN CLAUSEN, P.E., AND DAN GORLEY, P.E.

**THE CHUBBUCK INTERCHANGE** needed a change.

Situated at the intersection of I-86 and US-91 in southeast Idaho, it joins the towns of Chubbuck (to the north of I-86) and Pocatello (to the south). Both communities have seen increased population growth and its associated traffic for many years, resulting in the need for increased capacity at this interchange. The old five-span concrete girder structure, built in the early 1960s, restricted capacity and traffic flow and was below current standards in several areas. It had insuffcent load capacity, was too narrow for the increased traffic on US-91, had spans that were too short and clearance that was too low over the Interstate—and it had been hit by overheight loads on multiple occasions. It also wasn't able to accommodate potential future widening of I-86.

## Designing a Diamond

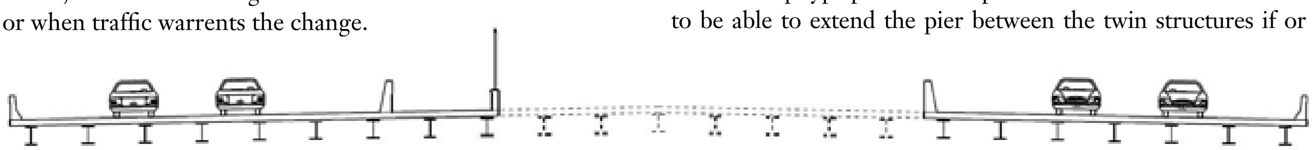
After reviewing several options, Idaho Transporation Department (ITD) District 5 chose to build the state's first diverging diamond interchange (DDI) with the idea that it could be modified in the future to a single-point urban interchange (SPUI). The main structural difference between a DDI and an SPUI is that the DDI requies two relatively narrow structures set apart to accommodate the weaving traffic pattern; in the case of the Chubbuck Interchange, the clear distance between the two parallel twin bridges is 48 ft. On the other hand, an SPUI, which can handle higher volumes of traffic, requires a wide single bridge to opperate as a center point for all traffic movements. Because the SPUI can handle a higher volume of traffic, the DDI was designed to accommodate a future SPUI if or when traffic warrents the change.

Due to the required sight distances and the need to minimize the grades on the interchange ramps, it was determined that the new US-91 crossing (which also includes pedestrian access across the bridges) could not be raised above its existing grade. Therefore, with the constraints of 17 ft of vertical clearance, no grade raise and two 85-ft spans, the superstructure could not exceed a depth of 36 in. over interstate traffic lanes, including the 8-in. deck.

In addition to these functional requirements, an important objective of this project was meeting the desire by the local community for an aesthetically pleasing structure. This interchange is in a highly visible part of the community and is the gateway to both cities for eastbound traffic on I-86. While there were no formal requirements or guidelines for what constituted an attractive bridge in this particular setting, the general principles of form following function, clean lines, slender profile and appropriate coloring were used to guide the design.

Because the geometry already dictated that the structure needed to be very shallow over the westbound and eastbound lanes of the Interstate, an effective solution was a two-span continuous girder with a variable-depth web. Welded steel plate girders also fit well with the aesthetic aspects of the project. The parabolic shape of a variable-depth girder is not only structurally efficient, but the curved line of the web haunch at the pier is also visually appealing. And, the color of the weathering steel chosen for the project fit well into the overall theme of earth tones.

A tapered wall pier was selected over a more traditional column and cap type pier for a couple of reasons. First was the need to be able to extend the pier between the twin structures if or



The new Chubbuck Interchange replaces a structure that had insufficent load capacity, had become too narrow for current traffic and whose clearance was too low over the Interstate.

The project is Idaho's first diverging diamond interchange. It can be modified to a single-point urban interchange in the future, as necessary.

when it becomes necessary to join the two bridges into a single structure to accommodate a future SPUI. This is easy to do with a wall because the load at each girder bearing is transferred directly through the wall to the footing and is relatively independent of the other girder loads. Second, because the overall structure depth is shallow and the bridge appears very light, a slender wall pier would continue that look. The wall can also be tapered to a thin bearing seat and does not require a massive cap to support the girder loads between columns.

Mechanically stabilized earth (MSE) walls were constructed in front of the abutments in order to minimize the span lengths yet still provide for future interstate widening. To accommodate widening, corrugated metal pipe (CMP) sleeves were used in the MSE fills to prevent damaging the soil reinforcement when piles are driven in the future. The integral abutments eliminated the need for expansion joints and bearings at the ends of the girders, two items that have historically required regular maintenance.

Traffic patterns on a portion of the interchange.

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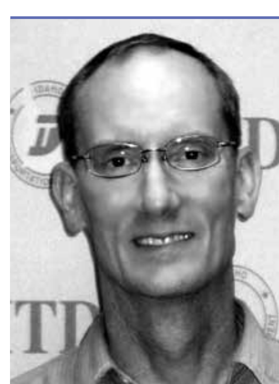

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Girders were erected at night to limit disruption to traffic and consisted of three sections with a 60-ft variable-depth section over the pier.

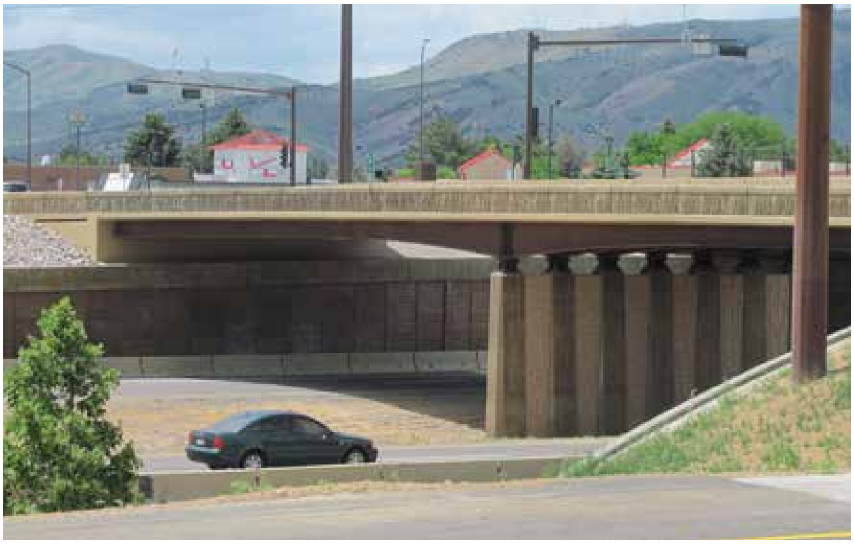
To accommodate widening, corrugated metal pipe (CMP) sleeves were used in the MSE fills to prevent damaging the soil reinforcement when future piles are driven. The integral abutments eliminated the need for expansion joints and bearings at the ends of the girders.


Mechanically stabilized earth (MSE) walls were constructed in front of the abutments in order to minimize the span lengths, yet still provide for future Interstate widening.

Steel superstructure connecting to the piers.

▲ The bridge uses 276 tons of steel.

▼ It has been operating since the fall of 2013, and the local community has quickly adapted to the new traffic pattern of a DDI.



## Bridging the Gap (Between Bridges)

As mentioned above, the two bridges are designed to be one bridge in the future. Both bridges were built on a 2% shed, so if they are indeed connected the combined bridge will have a 2% crown. The bridges were built on an accelerated schedule, using conventional, staged construction methods, in one building season (spring, summer and fall of 2013) and the DDI was open to traffic before winter. Stage 1 consisted of removing the eastern portion of the existing structure while still allowing enough width to carry four lanes of traffic while the east bridge was built. In Stage 2, a portion of the west side of the existing structure was removed and traffic was reduced to two lanes on the existing bridge while two lanes were in place on the new east bridge, maintaining four lanes; this allowed enough room to build the new west bridge. Once the west bridge was complete and traffic moved to the new birdge, Stage 3 could proceed, which involved removing the final portions of the existing bridge. Landscaping and aesthetic treatments were completed the following spring (2014).

The girders were erected at night to limit disruption to traffic and consisted of three sections with a 60-ft variable depth section over the pier; the web ranged from 23 in. to 42 in. There were also 55-ft sections at both ends with a constant web depth of 23 in. The contractor and steel fabricator chose to assemble the pier section and one of the end sections of the girder prior to shipment in order to accelerate placement. Additionally, the shear studs were installed at the fabrication facility. The total weight of structural steel on the project is 276 tons.

The bridge has been operating since the fall of 2013, and the local community has quickly adapted to the new traffic pattern of a DDI; drivers and pedestrians now enjoy improved access over and onto the freeway. ■

**Owner and Structural Engineer**
Idaho Transportation Department

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Ralph L. Wadsworth

**Steel Team**

**Fabricator**
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