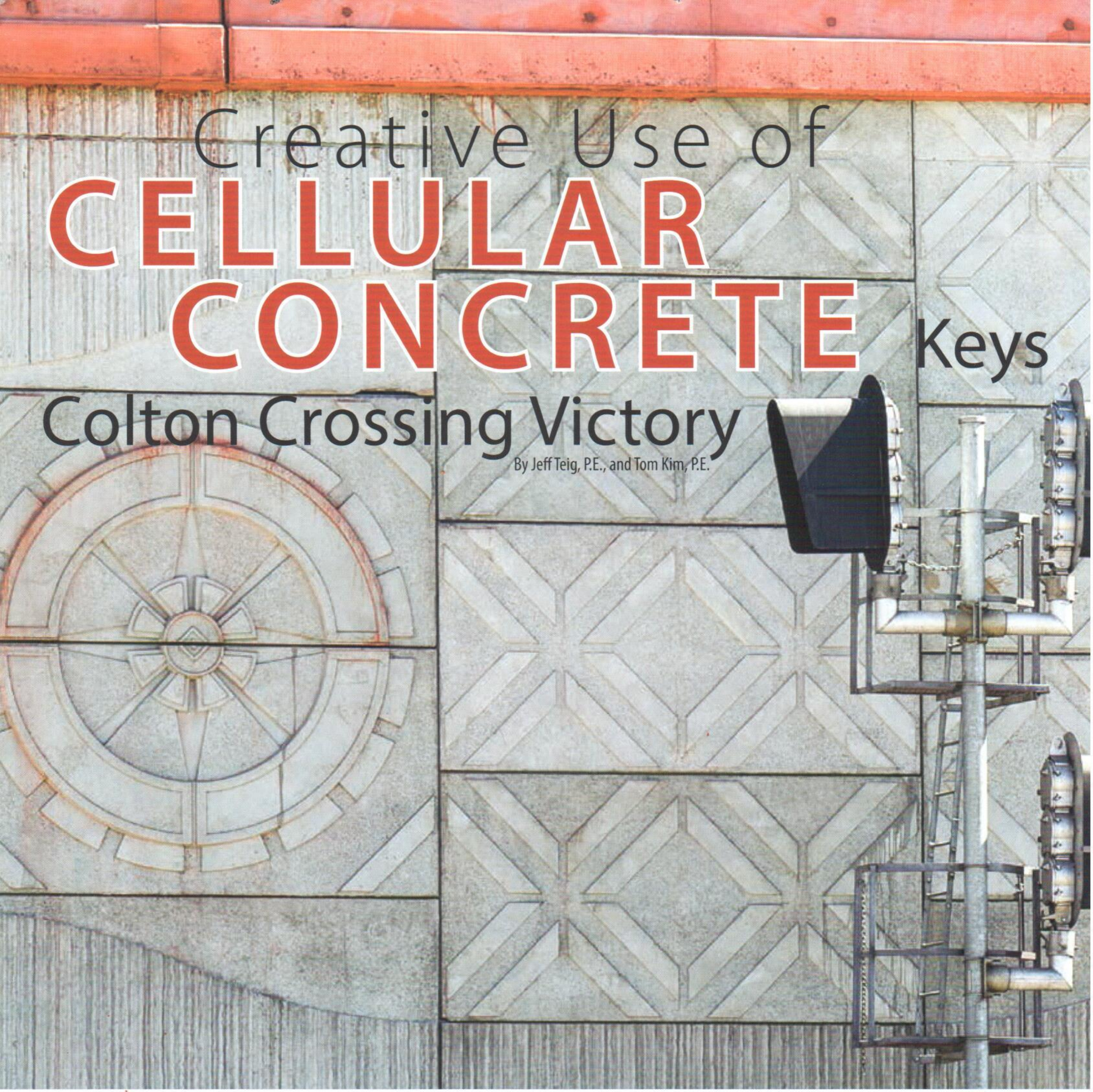
Creative Use of CELLULAR CONCRETE Keys Colton Crossing Victory

By Jeff Teig, P.E., and Tom Kim, P.E.



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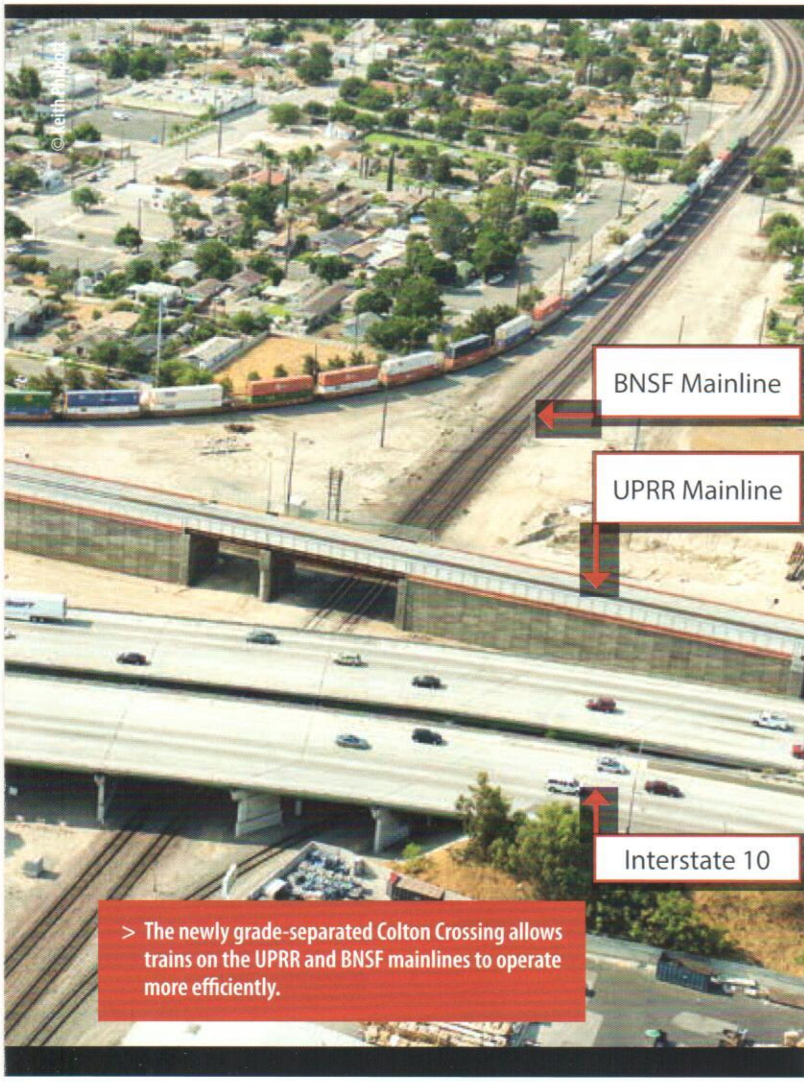
Colton Crossing has come a long way in the 130 years since it first opened. Back then, Southern Pacific Railroad hired Virgil Earp to stand guard and prevent California Southern from crossing its track in Colton, Calif. Ultimately, Earp was forced to step aside, and the crossing was completed.

Traffic through Colton Crossing has grown substantially since Earp's time. By 2008, it would handle more than 100 freight and passenger trains each day, making it one of the busiest at-grade rail-to-rail crossings in the United States.

The modern-day Colton Crossing comprises Union Pacific Railroad's (UPRR's) east/west tracks and BNSF Railway's north/south tracks, with Amtrak and Metrolink using the lines for passenger rail. The nearby ports of Long Beach and Los Angeles rank as the largest combined harbor in the country, and the metropolitan area is home to nearly 18 million residents. To better serve freight and passenger movement in the region, San Bernardino Associated Governments (SANBAG) partnered with UPRR, BNSF and other stakeholders to construct a flyover structure to elevate the UPRR mainline tracks approximately 35 feet above the BNSF tracks. The project would deliver economic, environmental and social benefits, while improving operations for the railroads.



> The newly grade-separated Colton Crossing allows trains on the UPRR and BNSF mainlines to operate more efficiently.

No Challenge Too Great

Building a flyover at Colton Crossing required creative solutions to physical, operational and phasing constraints as well as an aggressive design and construction schedule.

Schedule—The Colton Crossing project evolved into a public-private partnership (P3), with more than 20 stakeholders and funding provided by a combination of state bond money, a federal TIGER grant, investment by the railroads and Caltrans. This creative and collaborative funding approach required an accelerated schedule to meet construction milestones mandated by the various funding agreements. Specifically, the TIGER grant funding agreement required that the project be completed by March 2014. For that to happen, construction had to be finished by December 2013. Calculating the schedule backward from there, final design needed to be completed in nine months.

A number of key decisions went into achieving this goal. For example, the project team reached right-of-way approvals and utility agreements before advertising for construction. Also, HDR established separate teams to work on the design and project approval/environmental processes. We then performed these tasks concurrently and met the nine-month deadline for bid-ready documents.

Phasing—Typically, one of the new east/west tracks would be installed and the corresponding mainline shifted to the new alignment before proceeding with the second track. However, limited availability of the track laying machine, which is in high demand throughout the system, dictated that both tracks be constructed simultaneously. To address this issue, additional right-of-way was purchased from Caltrans and the new alignment was placed north of the existing alignment.

The proposed alignment precluded the use of typical soil embankment side slopes for the flyover construction. Vertical sides would be required for the entire south side embankment and the north side embankment from Rancho Avenue to La Cadena Avenue. This would lead, in part, to an innovative design choice discussed later in this article.

Operational—A number of steps were taken to reduce impacts both to train operations and the construction schedule. For example, the tie-ins were designed to minimize the time required to connect the new and existing alignments. Also, because any work inside the 15-foot safety zone required construction to stop while trains passed, significant consideration was given to minimizing the amount of work that needed to take place within this zone.

Physical—The Colton Crossing site is in a populated area of San Bernardino County, about 60 miles east of Los Angeles. It is bordered by Interstate 10 to the north, neighborhoods on the southwest and an existing rail yard to the southeast. I-10 limited the availability of right-of way to the north for the portion between Rancho Avenue and the BNSF crossing. All of these constraints factored into where the new alignment could be placed. Also, both Rancho Avenue at the west end and Mount Vernon Avenue at the east end have overhead roadway crossings that controlled the location of the new alignment tie-ins both vertically and horizontally.

Cellular Concrete Emerges as Design Key

The Colton Crossing grade-separation required construction of an 8,150-foot flyover carrying the UPRR tracks above the BNSF tracks, with approach structures, three steel bridges to support two mainline tracks and an access road. The design had to address all of the challenges—it had to fit the site, minimize interruptions to train traffic, facilitate construction of the new tracks concurrently and allow construction within the prescribed timeframe.

Because maintaining rail service during construction was one of the most critical considerations, the flyover could not be constructed along the existing alignment. To minimize delays to train traffic during tie-in and fit within the physical constraints of the site, the team settled on an alignment between the existing UPRR mainlines to the south and Interstate 10 to the north.

The problem was that the limited footprint did not allow for typical sloped embankments for the approaches to the bridge. The design would have added 40 percent to the estimated cost of the flyover structure. Furthermore, the site needed ground improvements to support the embankments. The top 15 feet of soil would have to be replaced due to poor soil quality and potential seismic activity.

As the design team worked to solve this puzzle, an innovative solution emerged that addressed the issues of cost and poor soil quality—cellular concrete. Though it had never been used in this quantity or at this height, cellular concrete offered the exact properties needed for this situation. Comprising a cement and water slurry infused with very small air bubbles, cellular concrete has roughly one-third the density of earth backfill.

The strong, yet lightweight nature of cellular concrete eliminated the need for conventional retaining structures because of the material's self-supporting quality. As a result, the design no longer required replacement of underlying soils to support a heavier structure. The lightweight quality also reduced the impact of designing for an area high in seismic activity.

This novel approach not only benefited the design, it also aided construction within the restricted site footprint by reducing the amount and size of equipment needed to construct the approaches. The cellular concrete could be pumped hundreds of feet from the batch plant, which consisted of just two or three semi-trailers taking up very little space.

By contrast, replacing the top 15 feet of soil and building earthen embankments would have required several thousand truckloads of imported fill material. Contractors would need bulldozers to spread the imported fill and compaction equipment to compact the material. Cellular concrete played a critical role in meeting the operational demands of the projects. Rail service continued during construction as placement of cellular concrete occurred only 15 feet from the centerline of a mainline track.

Innovation Equals Benefits

Using approximately 200,000 cubic yards of cellular concrete reaching a peak height of 39 feet, the Colton Crossing Flyover sets records for use of the material. Those numbers translated into even more meaningful numbers for UPRR and the more than 20 other stakeholders involved. Cellular concrete lowered the project cost by $45 million compared to building conventional retaining structures on top of earth backfill. Combined with other cost-saving measures, the final budget came in at less than half of the original estimate.

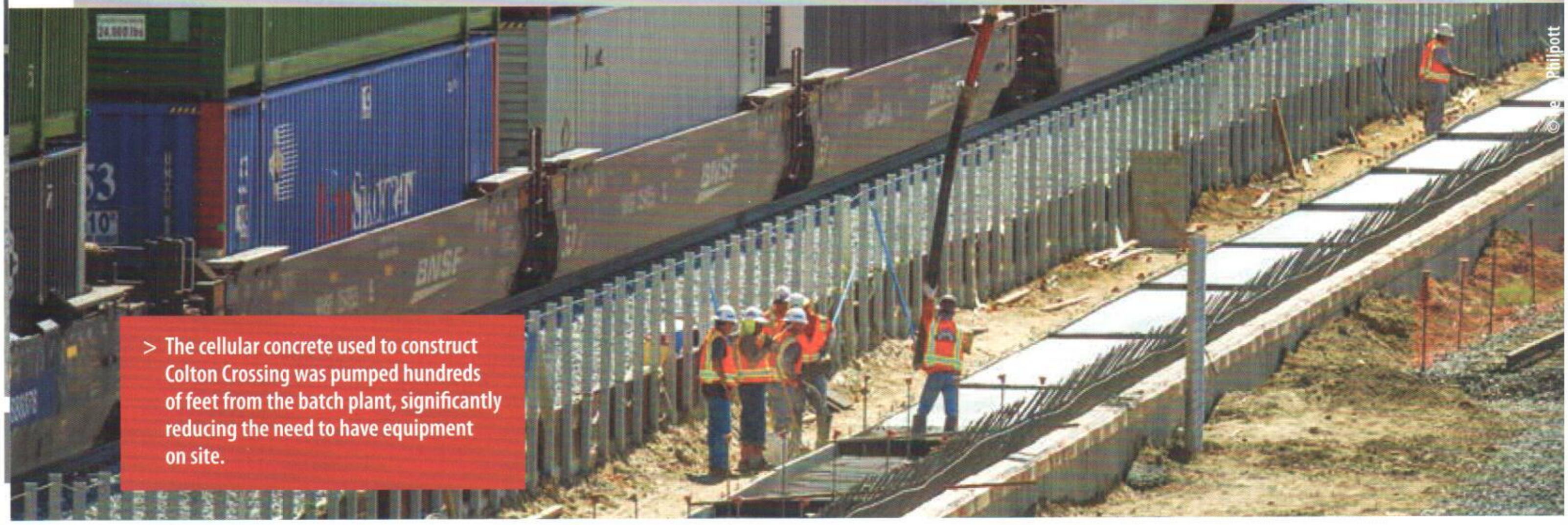
The use of cellular concrete also led to substantial time savings. The contractors could place the material much more quickly than in traditional retaining structure construction, allowing them to deliver the project eight months ahead of schedule.

There are considerable economic and community benefits associated with this project. The Colton Crossing Flyover generated a positive public perception by substantially mitigating delays that impacted freight and passenger operations as well as vehicular traffic. The grade separation is projected to save $241 million in travel time annually and reduce idling time for locomotives and vehicles, improving air quality within the surrounding community.

The Colton Crossing Flyover also significantly reduced noise levels in Colton. Trains on the UPRR mainline are no longer required to sound their horns as they enter the crossing. The project established quiet zones in Colton, with new train gates and an electronic signal system so trains do not have to sound their horns at other crossings. Horn use at the crossing is expected to decrease by 50 percent immediately, followed by additional decreases as the quiet zones are finalized. Eliminating the crossing diamond, which made a loud impact sound with every wheel set of the train that passed, further reduces noise levels.

The Colton Crossing Flyover was completed in August 2013. The project team is confident even Virgil Earp would have approved. ->

For more information, contact Jeff.Teig@hdrinc.com



> The cellular concrete used to construct Colton Crossing was pumped hundreds of feet from the batch plant, significantly reducing the need to have equipment on site.