# New Mount Vernon Viaduct—Third Time's the Charm

by Claus Frederiksen, COWI, and Benjamin Turner, Dan Brown and Associates

The new Mount Vernon Viaduct is a vital project currently under construction, with an expected completion date in late 2025. This new structure over 3rd Street and a large rail yard operated by Burlington Northern Santa Fe (BNSF) Railroad in San Bernadino, Calif., will replace the existing bridge, which has been deemed structurally deficient and functionally obsolete. The City of San Bernardino, the owner, in collaboration with co-owner San Bernardino County Transportation Authority (SBCTA), awarded a design-build contract in 2020.

## Background

The history of the original bridge and the challenges it faced over the years provide crucial context for the current viaduct project. When the original structure was built in 1934 as a replacement for a 1907 steel viaduct, the project team attempted to salvage much of the existing steel from the original structure. While this reuse of materials seemed resourceful at the time, it contributed significantly to the structural issues that led to the viaduct's deterioration and poor safety ratings.

By 2004, the viaduct showed clear signs of distress, with cracks appearing in the steel girders that necessitated immediate intervention. After temporary shoring was installed to support the compromised steel bents, the bridge remained operational for passenger vehicles and pedestrians. However, the restrictions placed on larger vehicles, such as buses and trailer trucks, highlighted the structure's changing functionality.

## New Bridge

The new bridge is designed for a 75-year design life and in accordance with the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications*,[1] the California Department of Transportation's (Caltrans') *California Amendments to the AASHTO LRFD Bridge Design Specifications*,[2] and American Railway Engineering and Maintenance-of-Way Association's *Manual for Railway Engineering*,[3] including seismic, roadway, and railway specifications. Moreover, the design incorporates features that accommodate bicycles, pedestrians, and accessibility requirements of the Americans with Disabilities Act, significantly enriching the experience for all users of the bridge. Critical project objectives are to improve the alignment

After cracks appeared in the steel bents of the existing bridge, temporary shoring was needed and only passenger vehicles and pedestrians could be accommodated. Photo: San Bernadino County Transit Authority.

profile

**MOUNT VERNON VIADUCT, SAN BERNADINO, CALIFORNIA**

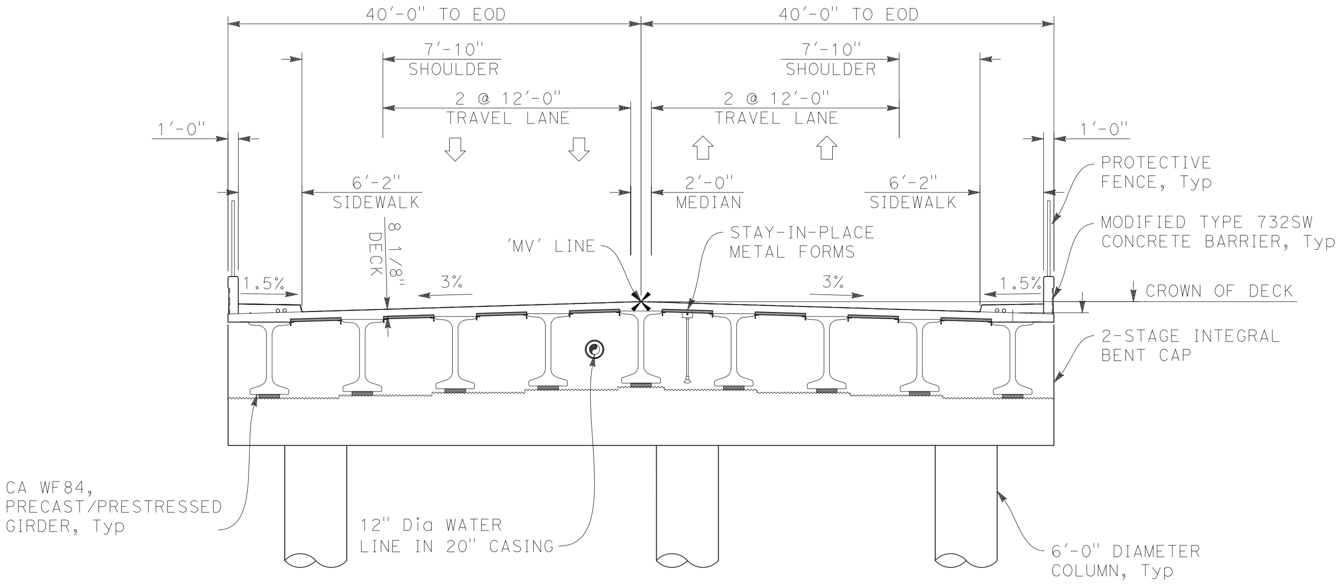
**BRIDGE DESIGN ENGINEER:** COWI North America, Oakland, Calif.

**OTHER CONSULTANTS:** Foundation designer: Dan Brown & Associates, Knoxville, Tenn.; civil engineer: Hernandez Kroone & Associates, San Bernadino, Calif.

**PRIME CONTRACTOR:** Traylor-Granite Joint Venture, Long Beach and Watsonville, Calif.

**CONCRETE SUPPLIER:** Robertson Ready Mix, San Bernadino, Calif.

**PRECASTER:** Girders and partial-depth panels: Con-Fab California LLC, Shafter, Calif.—a PCI-certified producer




New bridge cross section for spans 1 and 2 of the Mount Vernon Viaduct. Figure: COWI.

at the southern end of the bridge and to raise the vertical clearance by approximately 2 ft, thereby meeting the standard minimum vertical clearance of 24 ft for BNSF railways, 24 ft 6 in. for Metrolink regional rail lines, and 15 ft for local roads at the 3rd Street overcrossing. To achieve this increased clearance without drastically deviating from the profile of the existing bridge, the project team chose precast, prestressed concrete girders based on their efficiency and an outstanding span-to-depth ratio of roughly 25:1.

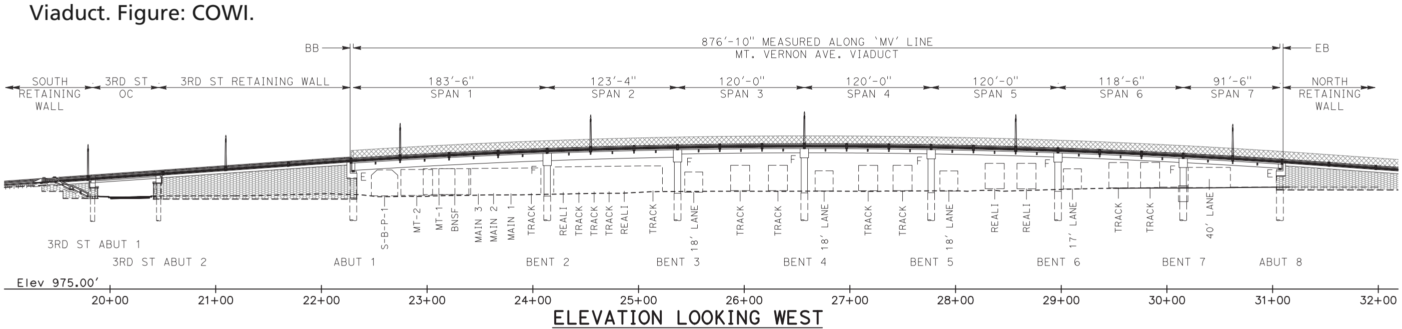
The seven spans of the Mount Vernon Viaduct cross over four Metrolink regional rail lines and 18 BNSF lines. The BNSF lines consist of three mainline tracks, six storage tracks, and nine intermodal tracks that are constantly active, with trains being assembled around the clock. Ensuring minimal disruption to the ongoing operations of both Metrolink and BNSF was a key requirement for the project, and precast, prestressed concrete girders were the ideal solution because they could be erected without the use of falsework in the busy rail yard.

The existing bridge consisted of four 10-ft travel lanes with no median or shoulder, and 3.5-ft-wide sidewalks on both sides. In contrast, the new Mount Vernon Viaduct will feature four 12-ft travel lanes, a 2-ft median, 7-ft 10-in. shoulders, and 6-ft 2-in. sidewalks in each direction. This upgrade will enhance vehicular movement and significantly improve pedestrian safety and accessibility.

## Innovative Solutions

The design-build team introduced several Alternative Technical Concepts (ATCs) during the proposal phase, one of which involved replacing approximately 185 ft of the overall bridge length with an earth-filled precast concrete retaining-wall system from the 3rd Street overcrossing to the Metrolink right-of-way. The addition of the wall effectively split the viaduct

Profile of the new structure shows the one-span 3rd Street crossing, the retaining-wall system, and the seven-span Mount Vernon Viaduct. Figure: COWI.




## CITY OF SAN BERNADINO AND SAN BERNADINO COUNTY TRANSPORTATION AUTHORITY, OWNERS

**BRIDGE DESCRIPTION:** 3rd Street overcrossing: 62-ft 6-in. single-span precast, prestressed concrete girders with cast-in-place concrete deck. Mount Vernon viaduct: seven-span bridge with spans ranging from 91 ft 6 in. to 183 ft 6 in. (center-to-center of piers); precast, prestressed concrete girders; and cast-in-place concrete deck.

**STRUCTURAL COMPONENTS:** 3rd Street overcrossing: eight 63-ft 10-in.-long, 28-in.-deep NEXT E girders with a 4½-in.-thick cast-in-place concrete deck. Mount Vernon Viaduct: spans 1 and 2: eighteen CA WF84 precast, prestressed concrete girders decked with stay-in-place metal deck forms and 8⅛-in.-thick cast-in-place concrete deck; spans 3–7: thirty-five CA WF48 precast, prestressed concrete girders with 258 partial-depth precast concrete panels and 9-in.-thick cast-in-place concrete deck.

**BRIDGE CONSTRUCTION COST:** $105 million (approx. $1400/ft$^2$)

Setting of a prestressed concrete Northeast Extreme Tee (NEXT) girder at the 3rd Street overcrossing. The shallow 28-in.-deep NEXT girder is used to provide the 15-ft minimum vertical clearance. Photo: Dany Schimpf Photography.

into two distinct structures: the single-span 3rd Street overcrossing and the seven-span Mount Vernon Viaduct. This ATC improved project aesthetics with a landscape buffer replacing rundown areas that were frequently targeted by graffiti. The reduction in total elevated structure reduced the project's initial cost and minimized future maintenance.

## Foundation Design Challenges

The location of the bridge presents geotechnical challenges. Situated near both the San Andreas and San Jacinto fault lines, the structure must be designed for very high seismic demands, including a peak ground acceleration of approximately 0.9 *g*, a peak spectral acceleration close to 2.0 *g* at 0.3 seconds, and a spectral acceleration of about 1.7 *g* at 1.0 second.

The design uses Caltrans Type I column-to-pile connections,[4] which are less common than Type II shafts using an oversized foundation. This choice enabled maximum design efficiency, but it also involved substantial analysis and design efforts to meet the desired seismic performance. The design also required special attention to the detailing of the shaft-to-column steel reinforcing cage splice. Notably, the Type I detail eliminated the need for a separate column cage, which would have been cast into the pile and required temporary bracing/guying. With the Type I detail, the pile reinforcement was simply spliced to the column bars using couplers at the same time the forms were installed, thereby minimizing disruption in the rail yard.

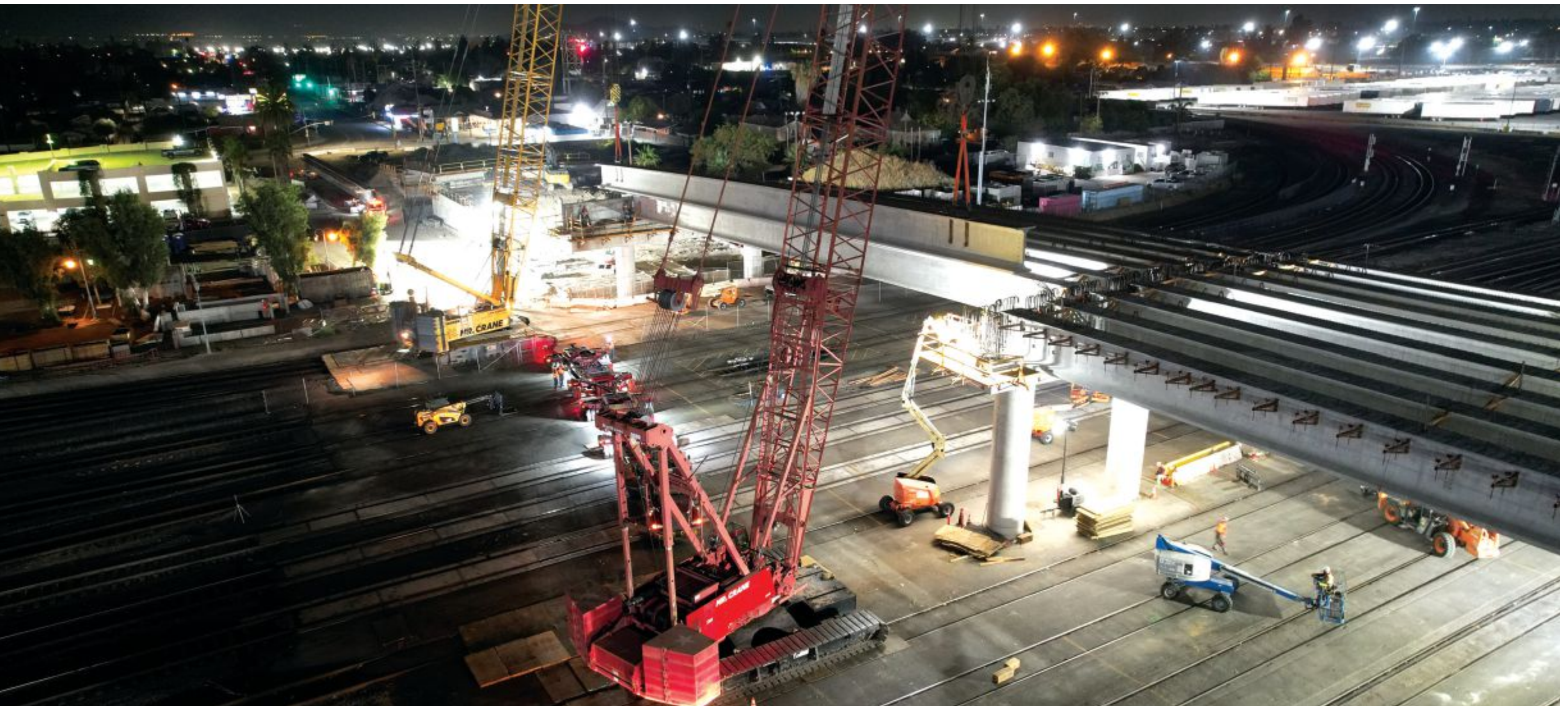
The design-build team opted to use drilled shafts instead of the cast-in-steel-shell piles (driven pipe piles filled with reinforced concrete) specified in the final report of the project. This decision was critical for both safety and practicality, as it allowed for construction work to be conducted close to operational rail lines while minimizing unnecessary vibrations. Specifically, the team used full-depth temporary casings advanced and withdrawn by an oscillator to facilitate the installation of the shafts with minimal impact to adjacent rail lines. This methodology enhanced safety and expedited the foundation installation process.

A significant challenge arose with the design of bent 7, the last interior bent on the northern end of the bridge, which was considerably shorter than the other interior bents due to the bridge profile's fall. This height differential led to high seismic demands on the short, stiff columns. To address this, the effective column length was increased by using a below-grade isolation casing, which reduced the bent stiffness to align more closely with the other bents and lowered the seismic design load on the shorter columns.

## Superstructure Design

As noted previously, the use of the ATC to replace a portion of the bridge with a precast concrete retaining-wall system

Setting of a California WF84 (CA WF84) girder on span 1 of the new Mount Vernon Viaduct. The longest CA WF84 girders measure 182 ft 6 in., making them the longest precast, prestressed concrete girders erected in California to date. Photo: Dany Schimpf Photography.




Detail of an original steel corbel on the old bridge at the sidewalk (left) and a rendering of the precast concrete corbel detail for the new viaduct (right). Photo (left): San Bernadino County Transit Authority. Figure (right): COWI.

resulted in a superstructure design that is for two distinct bridges. The design for the 3rd Street overcrossing uses low-profile Northeast Extreme Tee (NEXT) girders, the first implementation of such precast, prestressed concrete sections in California. The NEXT E girders selected are only 28 in. deep and double as the formwork for the 4½-in. cast-in-place topping slab. Using these low-profile girders was critical to provide the 15-ft vertical clearance without requiring significant changes to the existing profile that would alter the southern roadway tie-in.

Of the seven spans in the Mount Vernon Viaduct, the two longest spans use California WF84 (CA WF84) girder sections with forty-eight 0.6-in.-diameter straight strands. The longest single span measures 182 ft 6 in., making it the longest single precast, prestressed concrete girder erected in the state to date. Another distinctive aspect of the long girders was the use of a secondary pour on the top flange, which followed a parabolic profile from ½ in. at the ends to 4 in. at midspan. The secondary pour was completed in the casting yard with the girders shored, which prevented any deflection from the added concrete of the secondary pour at the time of placement, mitigated differential camber, enhanced the section properties of the girders, and reduced deflection from the

The new seven-span Mount Vernon Viaduct bridge and the one-span 3rd Street crossing use precast, prestressed concrete girders. Photo: Dany Schimpf Photography.


The California WF84 girders are transported to the site using specialized hauling equipment to accommodate the weight and length of the large girders. Photo: Dany Schimpf Photography.

cast-in-place deck. The remaining five spans of the viaduct, ranging in length from 91 ft 6 in. to 120 ft, use CA WF84 girders with eighteen 0.6-in.-diameter harped strands. These shallower girders did not incorporate a secondary pour.

To achieve the low depth-to-span ratios chosen to maximize clearance, the girder designs used a 28-day concrete strength of 10,000 psi. Fabrication occurred at a precast concrete facility in Shafter, Calif., and the girders were transported to the site using specialized hauling equipment during nighttime hours to minimize disruption to rail service. The design-build team also erected all the girders during nighttime closures to avoid disruption of Metrolink and BNSF operations. In total, girder erection took approximately two months: the 3rd Street girders were set in a single 10-hour shift and the girders for the viaduct were all set within one month.

The spans with CA WF84 precast, prestressed concrete girders use stay-in-place metal deck forms and an 8⅛-in.-thick cast-in-place concrete deck. The spans with CA WF48 precast, prestressed concrete girders use partial-depth precast concrete panels and a 9-in.-thick cast-in-place concrete deck. The stay-in-place forms and partial-depth precast concrete panels significantly minimize the amount of forming required over the rail yard and resulted in a reduced schedule as compared to traditional forming for cast-in-place concrete decks. Because the girder ends were cast integrally into the bent caps, the design eliminated the need for bearings within the rail yard. This drastically reduced the need for future access for inspections in the rail yard—a significant step to minimize the scale of ongoing maintenance efforts.

## Aesthetic Considerations

As the new viaduct was designed, the project team and stakeholders carefully considered the historical significance and aesthetics of the structure being replaced. Caltrans and the California State Historic Preservation Office established a memorandum of agreement emphasizing the importance of preserving the character-defining features of the original structure. This collaborative effort aimed to ensure that the new viaduct would be visually compatible with the adjacent Santa Fe Depot and would incorporate several aesthetic elements of the original structure. Features such as the existing stairwell on the south side of the bridge, along with specific lighting and railing details, were identified as critical components worthy of preservation.

## Conclusion

The new Mount Vernon Viaduct represents the third generation of this critical transportation link. Because the project team seamlessly blended lessons learned from the original structures with state-of-the-art engineering and design practices that address current seismic and safety codes, this new crossing is poised to serve the San Bernardino area for decades to come. As the construction progresses toward completion, the new Mount Vernon Viaduct is set to fulfill its role as a vital connector between two significant areas of San Bernardino, facilitating safe and efficient transportation routes for both vehicles and pedestrians alike. Achieved through careful planning, innovative design, and proactive engagement with historic preservation efforts, the project symbolizes a forward-thinking approach to infrastructure development that honors the past while looking toward a sustainable future.

## References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4. Caltrans. 2019. *Seismic Design Criteria*. Version 2.0. Sacramento, CA: Caltrans.


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