Building a Bridge Widening above Finish Grade and Lowering it with Jacks

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Summary

The California Department of Transportation (Caltrans) regularly widens cast in place post tensioned bridges in order to increase capacity on the State Highway System. Site restriction sometimes requires innovative use of building formwork and falsework in order to achieve the desired widening. One such method when a bridge site has a vertical restriction is to build the bridge widening or bridge above finish grade, then lower it with hydraulic jacks into its final finish grade. Using this technique of lowering the superstructure of the bridge to a final finish grade has design and construction challenges that must be overcome. This paper will discuss some of the challenges faced by the design, field bridge engineers, and contractor personnel in order to achieve the desired outcome.

Keywords: Bridges, Decks, Cast in Place, Post Tensioning, Hydraulic Jacks, Falsework

1. Introduction

When adding vehicle lanes to the transportation network, the bridges that are part of the transportation system must also be widened. This paper will discuss the design, construction, and lessons learned of building a bridge widening superstructure high, then lowering it to finish grade with the use of hydraulic jacks.

One such area that requires immediate attention, where the Department has taken steps to address the issues, is on Interstate 101 between the cities of Ventura and Santa Barbara. A series of projects have been ongoing for years in order to increase the capacity in this corridor. A project that has begun and has an innovative way to widen a bridge in a vertically restricted area is the US 101 Carpool Lane Improvement Project from Mobil Pier Undercrossing to Casitas Pass Road. The objectives of the project are: to widen the highway from two lanes in each direction to three (converting it from a highway to a freeway with the additional lane being for the exclusive use of High Occupancy Vehicles) HOV, to add a pedestrian undercrossing at La Conchita to connect the residents to the beach, and to improve the bike lane between Casitas Pass road and Seacliff. The new HOV lane in each direction will encourage the travelling public to have multiple passengers and use different modes of transportation when they make the trip from the City of Ventura to the City of Santa Barbara. The 6 mile long project is designed in four stages but it will not be built in four stages. The contractor has elected to combine stage 1 and 4 into one stage in order to shorten the contract time and maximize efficiency of their resources. The bridge that must be widened for this project is Bates Rd. Undercrossing.

2. Overview of Design and Construction of Bates Rd Undercrossing

Bates Rd. Undercrossing (Br. No. 52-0279), built in 1972, is being widen to allow for an additional lane in each direction. The existing bridges consist of 2 cast-in-place post tensioned box girder bridges sitting on diaphragm abutments on top of steel H-piles with a skew of 37˚53'51". The challenge lies in the right side widening of the bridge. The clearance between the roadway underneath and the soffit is only 15'-3" in this location. The other two sides will be

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built at grade and will use conventional falsework construction for cast-in-place box girders. A closure pours between the abutments and deck will be done at all widenings. This means that although the bridge will look like one continuous bridge, in actually, for seismic purposes, will act as 5 independent brides. Each bridge is designed to stay intact after a seismic event and be serviceable after the event.

The contractor waited 60 days before the closure pour was placed between the widening and the existing bridge. In the meantime the contractor was allowed to jack the bridge to its final grade before they begin forming for the closure pour. The contractor has elected to use Hydraulic Jack RLN 2002 made by Simplex. The plan was to lower the bridge widening 6 inches at a time; therefore the contractor had to reset the system 4 times. The contractor removed the falsework and transferred the load from the steel pads that the abutments sat on to the 8 hydraulic jacks (4 on each abutment) first. Steel beams were placed in inserts in the recesses and the jacks placed at each end of the beam to support the bridge. A redundancy system consisting of 1" steel plates were set up between the beams in the recess and the footing at all jack locations (figure 7). The plates were removed one at a time as the lowering took place. A stability system was set up to prevent the bridge from moving in the transverse and longitudinal direction. The system consisted of beams anchored each abutment footing to brace it against loads assumed to be 2% of the dead loads in the longitudinal direction; and 2% of the dead load in the transverse direction. Once the system was checked that there was no more than a 1 inch deviation in the transverse and longitudinal direction of the bridge, then the bridge was lowered. The 1 inch tolerance for deviation along the bridge deck is to minimize any bending stresses that may occur due to the lowering of the bridge. As soon as the 60 days wait period was over the closure pour was placed and the bridge may be opened to traffic.

3. Conclusion

This project will help ameliorate some of that congestion by improving mobility and encouraging commuters to take alternative modes of transportation. Community and State goals will be reached with the completion of this project. Building the bridge above grade brought challenges for the design and field bridge engineers. One of those challenges was with the grades that the widening and existing bridges had. In the left and right widening a string line was strung in order to determine if the bridge deck would line up between the existing and the new one. Unfortunately that was not possible on the right widening since the bridge deck was elevated by 1.44 ft. Therefore the engineers were conservative in the grades and back checked by using a level and steel tapes from the top of the deck to the top of the footings. One of the designer's challenges was assessing how to build the bridge with the vertical restriction. Options that are available include: using precast girders, precast segmental construction, steel girders, or receiving a design exception to lower the vertical clearance. Hydraulic jacking ultimately proved to be the most economical way.