Perpetual Pavement Saves Caltrans $19M in Initial Project Costs

With the completion of Interstate 5 in Sacramento, CA, an 8th Caltrans long-life/perpetual pavement (L-L/PP) project, it is worthwhile to highlight the value engineering applied to this project and the derived benefits. In short, value engineering is an option for the contractor to suggest improvements to the project design, specifications, and plans and if accepted, share the savings with the owner.

This $270 Million project, constructed in a joint venture by Granite Construction and Teichert, is the renovation of a 15.3 mile stretch of aged concrete pavement in Sacramento County, CA. The section runs from downtown Sacramento (American River Bridge) to 1.1 miles south of Elk Grove. Besides converting the existing pavement to a L-L/PP, other aspects, such as widened lanes, added HOV lanes, bridge work, median barrier, pedestrian crossing, and information systems were part of the contract. Both full-depth (FD) and the crack, seat, and overlay (CS&O) were utilized to create perpetual pavements.

In a typical FD perpetual pavement structure, the lowest bound (asphalt) layer is a 2-3 inch “rich bottom” layer which has 0.5% increased binder content above the optimum binder content (OBC) of the middle layer. The rich bottom layer is typically followed by a middle layer containing recycled asphalt pavement, and then a polymer modified asphalt (PMA) surface layer. The pavement structure is designed so that the stresses and strains in the “rich bottom” layer remain below the fatigue endurance limit. This avoids the initiation of “bottom-up cracking” of the pavement structure.

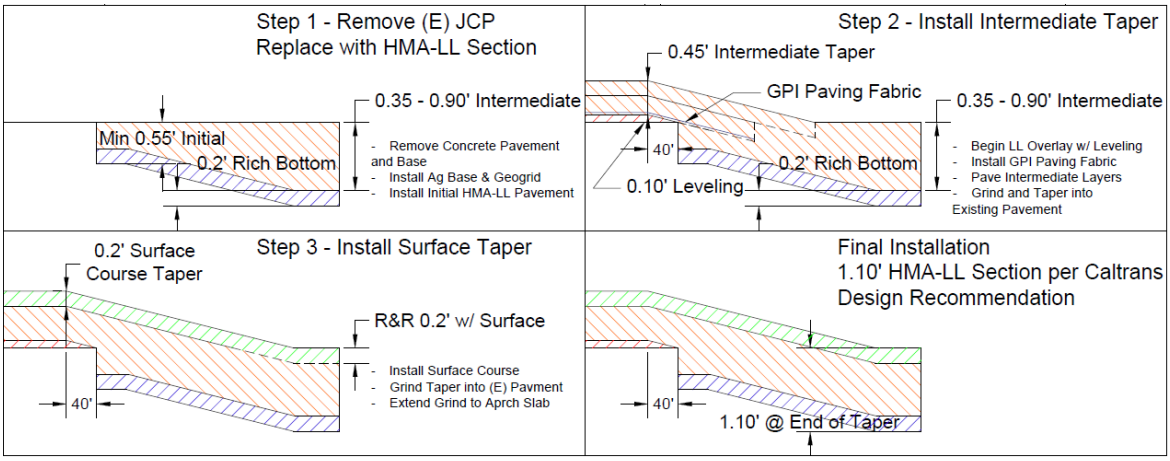
At 14 overpasses of the I-5 project, the new pavement had to be tapered down to keep the required clearances resulting in temporary 400:1 HMA tapers at each bridge location. In the contract plans, after completion of the perpetual pavement at the CS&O areas, the temporary HMA tapers were to be removed along with the underlying jointed plain concrete pavement (JPCP) and replaced with pre-cast joint concrete pavement panels (PJCP). The two contractors had concerns regarding the maximum 1/8” tolerances of the concrete panels’ dimensions, the distant off-site fabrication of the panels, the transportation and traffic congestion associated with installing the panels, and possible project delays if the panels didn’t fit. This is where value engineering allowed the contractors to use innovation and propose a better solution, resulting in significant time and cost savings to Caltrans and ultimately the taxpayers of California.

The value engineering proposal restaged and redesigned the work at all 14 overpasses. A test pit was opened at the overpass with the lowest area (in close proximity to the adjacent river), to determine the subgrade strength for the pavement’s structural design. The PJCP panels would

be replaced with an FD perpetual pavement section similar in character to sections utilized elsewhere on the project.

Instead of a sequence with the pavement overlay staged prior to panel installation requiring temporary pavement transitions, the pavement would be reconstructed at the bridges first, allowing the HMA transitions paved during the L-L/PP overlay to be permanent. This eliminated the cost of installing and removing the temporary tapers.

The tapered pavement sections were constructed with the following sequence:



The work to install the L-L/PP sections was performed over a total of (13) 55-hour weekend-long, partial freeway closures. During each weekend, lane closures occured at multiple locations in both directions of travel reducing four lanes to two in each freeway direction. In the two closed lanes, all work to remove existing pavement and base, recompact subgrade, place new geogrid and aggregate base (AB), and pave HMA back to its original grade was accomplished. On a typical weekend, the quantities of work completed were 7,000 CY of roadway excavation, 7,000 tons of aggregate base, and 6,500 tons of HMA.

As night falls on the 3rd of thirteen 55-hour weekend closures, the two Contractors (each on opposite sides of the I-5 freeway) are removing the deteriorated concrete under the overpasses and paving the L-L/PP structure two lanes at a time to keep the required clearance. The next weekend, the adjacent two old concrete lanes come out, and asphalt paving is matched in height. The Contractors each with three paving crews are taking on three of the 14 underpass locations each weekend closure in a mirrored operation.

The original plan would have required the demolition and removal of 43,700 CY of existing PJCP and base. Removal of this existing plain joined concrete pavement and HMA tapers, including the installation of the new pavement structure, used approximately 6,500 pre-cast panels (a total of 131,600 SY) and was bid at $45,500,000. The total net dollar amount that was saved by allowing the value engineering change from pre-cast concrete panels to a full-depth asphalt perpetual pavement was $19,365,000. The value engineering allowed for installation of all roadway pavements ahead of schedule. As is customary on major Caltrans projects, the final pavement was capped with 0.1 foot of rubberized open-graded HMA (RHMA-O). This last lift was placed a full season later. In all, a total of 630,000 tons of asphalt mixes were placed on the job.

The final FD perpetual pavement structure under the bridges is (From the top down):

- 0.1 of a foot of RHMA-O
- 0.2 of a foot of HMA-A (long-life) surface mix
- 0.7 of a foot of HMA-A (long-life) intermediate mix with up to 25% RAP
- 0.2 of a foot of HMA-A (long-life) rich bottom mix
- 1.0 foot of new aggregate base (Class 2 AB), and
- At the bottom of it all, the Tensar geogrid/geotextile composite

Each layer of HMA-A had a different set of laboratory performance requirements to accommodate the stresses and strains it would encounter in the structure under traffic. For the mixes with RAP, the binder grade was the contractor's decision as long as the mixes met the stringent performance test requirements. During construction, the customary QC/QA test criteria were required to be met, while shadow performance QA tests were performed by UC-Davis Pavement Research Center (UC-PRC).

With infrequent "mill-and-fill" renewal of the top two to three inches, this pavement structure was recalculated to carry the design traffic for *at least 65 years*. This example of value engineering on this recently completed Caltrans I-5 project is a demonstration of contractor ingenuity and innovation and agency partnering resulting in substantial project cost savings, reduced construction time, and a Long-Life/Perpetual Pavement project.