WSDOT Ferry Terminal at Colman Dock Pedestrian Bridge Utilizing Innovative Materials for Accelerated Bridge Erection

Geoff Swett, PE, SE, WSDOT Bridge and Structures Office, 360-705-7157, SwettG@wsdot.wa.gov

EXTENDED ABSTRACT

The Washington State Department of Transportation's, Washington State Ferries Division, is upgrading the aging and seismically vulnerable Colman Dock Ferry Terminal in downtown Seattle. The terminal is the largest in Washington State and serves more than 9 million riders including more than 5.5 million foot passengers. Construction will be completed in stages and is scheduled to last until 2023 in order to preserve current levels of ferry service, while under construction. As part of the upgrade, a major portion of the pile supported trestle, the Terminal Building, the Passenger-only Ferry Facility, a passenger overhead loading to the ferries, and a vehicle transfer span will be replaced. Along with these upgrades a new pedestrian bridge 157'-4" long will be constructed between the new Terminal Building and the Passenger-only Ferry Facility. This pedestrian bridge will be the focus of this paper.

The project is WSDOT's first use of the GC/CM delivery method and the prime contractors are Hoffman Construction Co. and Pacific Pile and Marine. The design was completed using a combination of in-house and a team of consultant designers and architects.

Given the multiple construction stages for the project, it was desirable to construct and erect the pedestrian bridge in the shortest timeframe to minimize disturbance to ferry users and to reduce site construction. The pedestrian bridge consists of a steel pony truss constructed with HSS tubes and has a 12 foot wide walking surface. The bridge was originally planned to have a 5.5 inch cast-in-pace concrete deck. During the design phase it was decided to utilize an Implemented Advanced Technology comprising of Prefabricated Sandwich Plate System (SPS) bridge deck panels to form the new decking on the bridge. By utilizing the SPS panels for the bridge deck, a 60% reduction in deck weight was realized over an equivalent concrete deck.

The SPS panels consist of two thin outer steel plates that sandwich a polyurethane elastomer core. Steel edge plates are welded around the perimeter of the thin steel plates to create a sealed void between the outer two plates. The polyurethane elastomer is then pressure injected between the plates, which bond to the properly prepared plates forming a composite SPS panel. Bond between the plate and polyurethane is critical in the performance of the system and is verified during fabrication of the panels. The design requires a minimum bond strength of 1200 psi and testing for this project resulted in an average of 1700 psi being achieved. Depending on the span of the deck panels and design loads, the steel plates and thickness of the polyurethane core can vary. For this project the top and bottom plates were ¼ inch thick and the polyurethane core was 1 inch thick for a total section of 1.5 inches. The design of the panels includes a check on steel stresses, core stresses at the interface with the steel plates, and deflections. Deflections typically control and are limited to span length L/300. See Figure 1 for a typical section of the SPS deck panel.

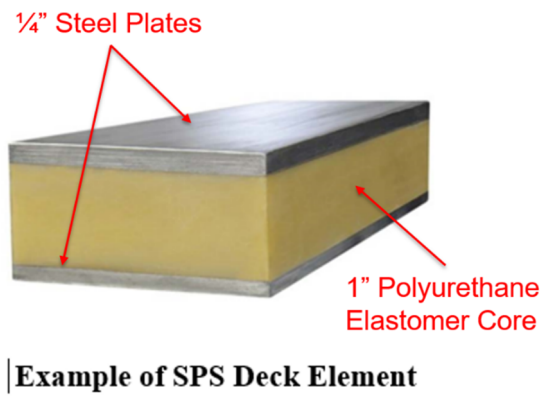

FIGURE 1 – Typical Section of SPS Deck Panel

The 157'-4" long bridge was fabricated in the shop as a single structure with no field splice connections required. Jesse Engineering, in Tacoma, WA, fabricated the structure. The SPS deck panels were fabricated on the East coast under the supervision of SPS Technologies and were shipped to Tacoma as completed units. After fabrication of the steel pony truss was completed, the SPS panels were bolted to the structure using countersunk high strength bolts at each truss floor beam. The floor beams consisted of an HSS member with a plate welded to the top providing a flange to facilitate bolting of the deck panels. A thin 1/4 inch wearing course consisting of methyl methacrylate and silica aggregate for surface roughness was applied to the top of the deck panels. See Figure 2 for a photo of the steel truss with the deck panels pre-erected onto the structure to verify fit, prior to removal for painting. The preassembled bridge was painted with WSDOT's 4-coat paint system, loaded onto a barge, and then floated to the construction site.

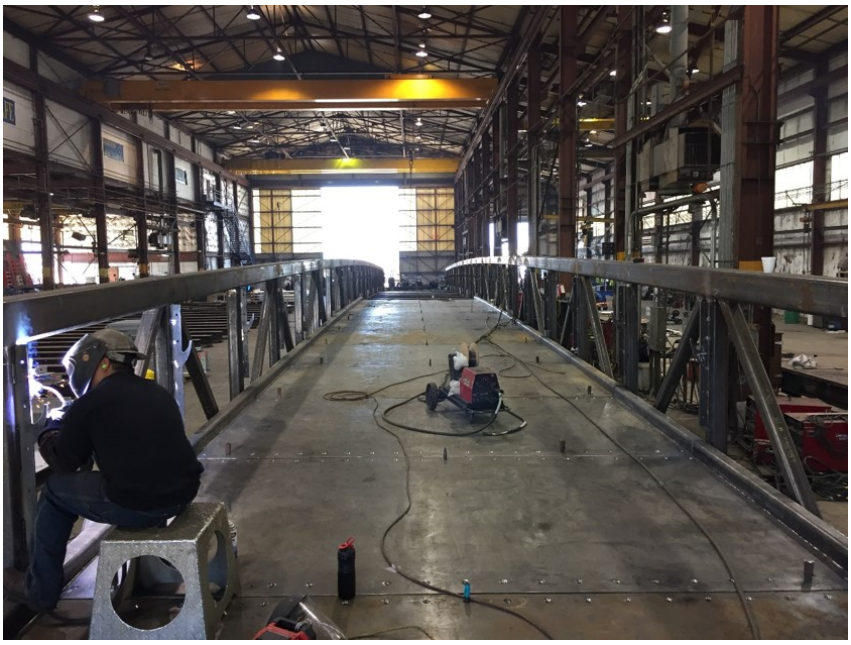

FIGURE 2 – Dry fitting SPS panels on bridge prior to painting operations.

Once arriving on site, the truss was erected using a derrick crane, the “Pacific Lifter”, and placed on previously constructed cast-in-place concrete piers with steel disc bearings. The total pick weight of the structure was 170 kips, down from 250 kips if erected with a concrete deck. The reduced pick weight allowed the Pacific Lifter to pick and erect the span at a significant radius, which couldn’t have been achieved at the higher 250 kip load. The erection and connection of the bridge to the bearings was completed in a few hours. See Figure 3 for a photo of the bridge erection. The bridge had immediate load carrying capacity as the SPS deck is an all steel construction with no site work required. Hand rail and expansion joints were installed at a later date but the structure was accessible and usable the same day. This lead to a simpler, safer and more predictable schedule for the contractor, thereby reducing construction schedule and cost. This bridge is being utilized during the staged construction as egress for passengers arriving at the terminal and provides access to the recently completed Passenger-only Ferry Facility owned and operated by King County. The pedestrian bridge utilizing SPS deck panels was fabricated and erected in Phase I of the multi-stage construction project, allowing the contractor to maintain schedule and move to the next phase of construction.

FIGURE 3 – Erection of steel pedestrian bridge with SPS panels.