Section B – Bridge Metal Rail Barriers
California ST-75SW Bridge Rail

Bridge Standard Detail Sheet Numbers
xs16-119-1, xs16-119-2, xs16-119-3, and xs16-119-4

Implementation
New Bridge Standard Detail Sheets for the mid-January 2021 Quarterly Posting.

Description of Component

CALIFORNIA ST-75SW BRIDGE RAIL
The MASH-compliant TL-2 rated California ST-75SW Bridge Rail replaces the NCHRP Report 350-compliant TL-2 rated California ST-40 Bridge Rail.
Approved per MASH 2016 (AASHTO Manual for Assessing Safety Hardware)
3 Hollow Structural Steel (HSS) tubes for vehicular rail
Combination Railing (vehicular and pedestrian)
Approved to TL-2 low speed locations only (regulatory speed limits of 45 mph or less).

Post and Beam style steel bridge rail on concrete curb over integral raised concrete sidewalk that is connected to bridge deck, wingwall, retaining wall, concrete barrier moment slab, structure approach slab, or special designed top slab of concrete box culvert where the top slab acts as the vehicular riding surface. This bridge rail is connected to the structure it is mounted on with reinforcing bars, anchor bolts, and anchor plates.

Geometric data from bottom of concrete curb and above for parapet portion of the ST-75SW matches the ST-75 (the new feature is the integral raised concrete sidewalk). Vehicular rail height is 3 feet – 0 inches above the top of integral raised sidewalk. Bicycle railing height is 3 feet – 6 inches above the top of integral raised sidewalk to meet the 42-inch minimum height requirement for pedestrians.

The sidewalk curb is 8-inches above the Finish Grade of either the bridge deck or the deck overlay if an overlay is to be placed on the same contract. From the traffic face of the sidewalk curb, the top of the sidewalk slopes up at 1.5% toward the edge of deck (EOD). The 1.5% cross slope of the top surface of the sidewalk gives 0.5% construction tolerance to ensure that the constructed integral raised sidewalk of the ST-75SW does not exceed the maximum cross slope of 2% per ADA law and accessibility guidelines and policies.

Bridge rail parapet width is 2 feet – 0 inches.

Post spacing is 10 feet – 0 inches maximum.

Aesthetic see-through railing.

Standard Drawing Features

All four of the Bridge Standard Detail Sheets must be included in the contract plans:

Sheet Number: xs16-116-1

Includes typical rail system, anchor plates, base plate, shim plate details, and additional transverse deck rebar needed at post locations.

Sheet Number: xs16-116-2

Includes steel post and end block side view and Plan view. Elevation view of steel rail on concrete curb with approach and departure concrete transition end blocks. And rail end cap details.

Sheet Number: xs16-116-3
Section B – Bridge Metal Rail Barriers
California ST-75SW Bridge Rail

Includes steel post elevation view and side view, and bicycle railing connection details.

Sheet Number: xs16-116-4

Includes details for standard sleeves and expansion sleeves, and Elevation view of standard splices and expansion splices and open joint in curb for the bridge rail.

Design/General Notes

Design Criteria:
AASHTO LRFD Bridge Design Specifications 6th edition with California Amendments:

Live Loading
- HL 93 and permit design load

Vehicular Collision Force
- MASH 2016, Test Level 2

Concrete
- $f_y = 60$ ksi (ASTM A706/706M, Grade 60)
- $f_c = 3.6$ ksi
- $N = 8$

Structural Steel
- Posts & Plates: $f_y = 36$ ksi (ASTM A709/A709M, Grade 50)
- Rails: $f_y = 46$ ksi (ASTM A500/A500M Grade B)
- Anchor Bolts: ASTM 1554, Grade 55
- Structural steel bridge rail elements, anchor bolts, and associated hardware must be galvanized per Standard Specifications 75-1.02B Galvanizing.

Designers must ensure that any supporting structures, such as the deck or overhang, meet the requirements in the AASHTO LRFD Bridge Design Specifications, Appendix in Section 13, Railings, as amended by Caltrans California Amendments.

Supporting elements, such as the deck and overhang, must be designed to three applicable load cases:
- Case 1: Extreme Event II (transverse and longitudinal forces)
- Case 2: Extreme Event II (vertical forces)
- Case 3: Strength I
Section B – Bridge Metal Rail Barriers
California ST-75SW Bridge Rail

The clearance to reinforcement in the concrete curb of the post-and-beam bridge rail parapet is 2 inches at the traffic face and back face, and 1 inch on the top. Clearance to reinforcement in the integral raised concrete sidewalk is 2 inches. The clearance to reinforcement in the concrete transition end blocks at the approach and departure ends is 1 inch at the traffic face, the back face, and the top.

For projects located in a corrosive environment, refer to the AASHTO LRFD Bridge Design Specification Section 5.12 for using epoxy coated rebar and Standard Specifications 2018 section 52-2.

California ST-75SW Bridge Rail was designed and checked as a new MASH-compliant bridge rail design including Finite Element Analysis.

Sidewalk Design:
Per the Caltrans Highway Design Manual (HDM), Section 208.4 Bridge Sidewalks:
“Sidewalks on bridges should be provided wherever there are sidewalks or other pedestrian facilities that follow the highway. The minimum width of a bridge sidewalk shall be 6 feet. The recommended width should be 8 feet for pedestrian comfort. Bridge sidewalks in area types (see Index 81.2) with high levels of pedestrian activity may need to be greater than 8 feet.”

The 6 feet minimum width of bridge sidewalk noted in Section 208.4 of the Highway Design Manual refers to the walking surface at the top of the sidewalk and does not include the 2-inch width for the slope of the sidewalk curb face next to the roadway shoulder. Similarly, the recommended 8 feet sidewalk width noted in Section 208.4 of the Highway Design Manual refers to the walking surface at the top of the sidewalk and does not include the 2-inch width for the slope of the sidewalk curb face next to the roadway shoulder.

Crashworthiness:
Refer to the following site for Vehicular Crash Tests of the California ST-75 Bridge Rail Research Results. (the ST-75 crash testing was used as the basis for the ST-75SW). The Final Crash Test Report for the ST-75 and other general information (including crash test videos, and Compliance Crash Testing records of the ST-75) was posted to the Division of Research and Innovation and Systems Information webpage for Research Final Reports in the Geotechnical and Structures subsection by July 2020. An FHWA Letter of Eligibility is no longer required by FHWA since FHWA now allows State DOTs to self-certify. More information regarding MASH Implementation by Caltrans can be found at the Caltrans HQ Division of Safety Programs webpage for Implementation of the Manual for Assessing Safety Hardware (MASH)
Section B – Bridge Metal Rail Barriers
California ST-75SW Bridge Rail

Pedestrian Accessibility:
California ST-75SW Bridge Rail complies with the pedestrian accessibility guidelines in Design Information Bulletin 82 (DIB 82).

Bridge deck joints shall continue through the barrier and must be armored to comply with the requirements in DIB 82 for allowable change in horizontal and vertical elevations in pedestrian walkways. See, “Joint Armor for Pedestrian Walkways” detail on Bridge Standard Details, xs8-050 sheet and the Bridge Standard Details, xs8-050 User Guide.

If the Maximum Movement Range is more than 2 inches, contact the Caltrans Bridge Joints and Bearings Specialist by email at DESdesign@dot.ca.gov with “Attention: Caltrans Bridge Joints and Bearings Specialist”.

Utilities and Future Overlays:
No conduits are permitted in the 6-inch height of the concrete curb of the bridge rail parapet, but conduits are permitted in the integral raised sidewalk of the bridge rail as noted on the Bridge Standard Detail Sheets. Provide two 4-inch conduits for future use as shown on the plans.

Designers shall consider cross-slope of the sidewalk, super elevation of the bridge deck, whether an overlay is going to be placed on the bridge deck in front of the ST-75SW integral raised sidewalk (in which case the sidewalk must be constructed deeper so that the height of the sidewalk curb will still be 8 inches above the top of the Finish Grade of the deck overlay). Also, the minimum distance that conduits must be clear of the sidewalk curb face per the Bridge Standard Detail Sheets for the ST-75SW, the minimum distance that conduits must be clear of the traffic face of the vertical parapet portion of the bridge rail per the Bridge Standard Detail Sheets for the ST-75SW, the minimum 2 inches of clear space required between the outside edges of adjacent conduits, and other factors to ensure that there is adequate cover over and adequate spacing of planned or future conduits. Due to these considerations, designers may have to reduce the size and or number of conduits from the maximum allowable number and size of conduits shown in the NOTES on the Bridge Standard Detail Sheets for the ST-75SW. For each additional foot of sidewalk width above the minimum sidewalk width noted on the Bridge Standard Detail Sheets, one additional 4-inch nominal diameter (or smaller) conduit can be added.

If a deck overlay is being added to the bridge deck or approach slab on the same contract that the bridge rail is being constructed, then the concrete sidewalk curb should be constructed to an additional height equal to the depth of the overlay so that, after the overlay is placed, the height of the concrete curb is 8 inches above the Finish Grade (FG) of the deck overlay instead of the concrete bridge deck, and the height of the vehicular rail parapet on the integral raised sidewalk will measure 3 feet – 0 inches above the top.
Section B – Bridge Metal Rail Barriers
California ST-75SW Bridge Rail

of the sidewalk. It's important to note that the anchor bolts will need to be lengthened in this case by an amount equivalent to the depth of the overlay placed against the sidewalk curb face of the ST-75SW bridge rail.

If a deck overlay is planned for an existing bridge deck with an existing California ST-75SW Bridge Rail, then consider the following options:

- No deck overlay.
- Taper the deck overlay down to zero or to its minimum depth and stop at least 3 feet – 0 inches away measured transversely from the traffic side toe of the integral raised concrete sidewalk curb of the ST-75SW.
- If need deck overlay to extend all the way to the curb face such as in a marine environment or in snow country where it is needed to seal the deck surface, then taper down the depth of the overlay starting at the Edge of Travelled Way down so that it is 2 inches depth or less in order for the remaining sidewalk curb height to be 6 inches or more. If this is not possible, then may have to replace the existing bridge rail in conjunction with an overlay placed all the way to the toe of the bridge rail in which case the overlay depth would be added to the height of the raised integral concrete sidewalk of the ST-75SW so that the ST-75SW’s integral sidewalk curb height above the top of the overlay Finish Grade was 8 inches (make sure to take into consideration how this additional weight affects the superstructure/substructure design).
- If the shoulder is narrow which leaves little or no distance to taper down the deck overlay depth, then choose an overlay material that can be applied in a 2 inch or less depth against the toe of the bridge rail’s integral raised sidewalk in order to preserve a minimum of 6 inches in height of the existing CA ST-75SW sidewalk curb.

Additional Drawings Needed to Complete PS&E

Connection of CA ST-75SW bridge rail concrete transition end block to guardrail transitions at approach and departure ends: Standard Plans A78F1 & A78F2 for Thrie Beam Barrier guardrail or Standard Plans A77V1 & A77V2 for Midwest Guardrail System (MGS).

If the guardrail leading up to each end of the bridge rail is thrie beam barrier guardrail instead of MGS guardrail, then use Standard Plans A78F1 or A78F2, but they’ll need to be modified slightly for a bridge rail that has integral raised sidewalk. Standard Plan A77V1 is used if one end of the bridge rail with integral raised sidewalk is an approach end (connected to an MGS guardrail transition from MGS WB-31 to thrie beam barrier guardrail) and the other end of the bridge rail is the departure end [connected to MGS...
guardrail WB-31]. Use Standard Plan A77V1 if (a) all of the vehicular lanes are travelling in the same direction, or (b) there is a median barrier separating opposing directions of vehicular traffic, or (c) there is no median barrier between opposing directions of vehicular traffic but traffic in the opposing direction is outside of the Clear Recovery Zone CRZ (traffic face of bridge rail is greater than 20 feet transverse to opposing direction traffic lane for conventional highways, or traffic face of bridge rail is greater than 30 feet transverse to opposing direction traffic lane for access-controlled freeways and expressways). Standard Plan A77V2 is used if both ends of the bridge rail with integral raised sidewalk are effectively approach ends. Use Standard Plan A77V2 if opposing direction of vehicular traffic is within the Clear Recovery Zone CRZ (traffic face of bridge rail is within 20 feet or less transverse to opposing direction traffic lane for conventional highways, or traffic face of bridge rail is within 30 feet or less transverse to opposing direction traffic lane for access-controlled freeways and expressways).

If the bridge rail (with integral raised sidewalk) concrete transition end blocks for a project are going to connect to something other than the guardrail transition Standard Plans for either Thrie Beam Barrier guardrail or Midwest Guardrail System (MGS) guardrail, then special designed detail drawings will be required.

**Contract Specifications**

Caltrans Standard Specifications: Section 51 Concrete Structures, Section 52 Reinforcement, Section 55 Steel Structures, Section 75 Miscellaneous Metal, Section 83 Railings and Barriers, and if a special design is done to add chain link railing to the ST-75SW (such as, if the bridge goes over railroad tracks or if bridge is in an urban area or where a large volume of pedestrian traffic is anticipated, or other factors that may determine need for chain link railing) then also Section 83-1.021 Chain Link Railing.

**Restrictions on Use of Standard Drawings**

- A special design is required if CA ST-75SW is mounted on an earth retaining system.
- Sound walls cannot be mounted on the CA ST-75SW.
- California ST-75SW cannot be used in locations where the regulatory speed limit of the vehicular traffic lanes next to the bridge rail is greater than 45 miles per hour (MPH).
- A special design is required to mount a chain link railing to the CA ST-75SW.
- A special design is required for retrofitting this bridge rail with integral raised sidewalk onto an existing bridge deck, existing retaining wall, or existing barrier.
moment slab. Due to the need for the anchor bolts and anchor plates as well as the additional transverse deck bars at each post location, this bridge rail cannot be considered for placement onto an existing bridge without removal and replacement of all or a large portion of the existing bridge deck overhang. The additional transverse bridge deck bars at the post locations cannot reach the required minimum 2 feet – 0 inches inward from the exterior girder with a deck overhang removal and replacement, so near surface deck strengthening may be required if the CA ST-75SW is desired to be added to an existing bridge. The CA ST-75SW cannot be retrofitted onto the top of an existing retaining wall unless the existing retaining wall was designed for the transfer of vehicular impact loading, and -if so- the top of the existing wall will need to be removed and replaced due to the need for the anchor bolts and anchor plates. If CA ST-75SW is desired as a bridge rail at the top of an existing retaining wall that was not designed for the transfer of vehicular impact loading, then either the CA ST-75SW will have to be mounted on a concrete barrier moment slab that extends over the top of the existing retaining wall or be mounted on a structure approach slab that extends over the top of the existing retaining wall or wing wall.

- This bridge rail with integral raised sidewalk was designed with the pedestrian railing attached (offset 9 inches from the top of the traffic-side of the vertical vehicular parapet portion of this bridge rail with integral raised sidewalk).
- The clear openings for the vehicular rail and for the pedestrian railing are in conformance with the size limits set forth in Section 13 of the AASHTO LRFD Bridge Design Specifications along with Section 13 of the California Amendments.

Special Considerations

Aesthetics:

Aesthetic see-through bridge railings such as the CA ST-75SW are preferred by the California Coastal Commission for use within the Coastal Zone and may also be selected for any location where a Context Sensitive Solution is warranted or may be selected based on stakeholder input.

In regards to aesthetics:

- The tubular hand railing requires a galvanized coating. There are no restrictions on choice of coating color for the steel elements. Common choices are: the galvanized dull grey (unpainted but coated with copper sulfate solution), the galvanized chrome grey (unpainted), Natina Stain (rusty brown or mottled rusty
brown) over the galvanized steel railing, or white, light blue, green, black, brown or Golden Gate orange paint over the galvanized steel railing.

- Aesthetic metal bar design can be added in between the steel tubes if a custom artistic design is desired. This could be done to match a design of a custom pedestrian hand railing or bicycle railing on the bridge or to match or complement some feature on or near the bridge. If this is desired, it must be attached behind the traffic-side of the steel posts. When special or context sensitive solutions are desired for the pedestrian hand railing, a special design can be done as long as it complies with the design loading and clear openings per Section 13 of the AASHTO LRFD Bridge Design Specifications and Section 13 of the California Amendments.

- Any architectural texture added to the concrete end blocks on the raised integral sidewalk must be added to the outside of the standard size cross section which will make them wider than the cross section of the end blocks shown on the detail sheets so adjustments would need to be made to keep the new traffic face flush with the face of the HSS steel tubes of the steel bridge rail parapet.

The vehicular rail height and the pedestrian hand railing height above the top of integral raised sidewalk for the parapet portion of the bridge railing at completion of construction contract cannot be less than the heights shown on the Standard Plan sheets for CA ST-75SW (36 inch vehicular rail height and 42-inch minimum pedestrian railing height), but the tubular pedestrian hand railing can be taller than 42-inches if desired (which would require a special design.

Fixed objects, such as lighting standards or bridge-mounted signs, must be placed on a corbel or pedestal on an outcropped portion of the deck overhang on the back side of the steel bridge rail that will require a special designed detail. For special situations, contact both the Signs and Overhead Structures Technical Specialist and the Bridge Railing Technical Specialist in the Caltrans, Division of Engineering Services, Office of Design and Technical Services by email at DES Design and Technical Services.

All project-specific modifications to the CA ST-75SW must be reviewed by the Bridge Railing Technical Specialist in the Caltrans, Division of Engineering Services, Office of Design and Technical Services. Contact the Bridge Railing Technical Specialist by email at DES Design and Technical Services.