# Revised Standard Plans Numbers

ST-75SW Standard Plan sheets: RSP B11-215, RSP B11-216, and RSP B11-217

Common sheets shared by ST-75, ST-75SW, ST-76, and ST-76SW:

RSP B11-220, RSP B11-221, and RSP B11-222

# Implementation

New Revised Standard Plans are to be implemented in January 2024.

# Description of Component



**CALIFORNIA ST-76SW BRIDGE RAIL**

The MASH-compliant TL-2 rated California ST-76SW Bridge Rail replaces the NCHRP Report 350-compliant TL-2 rated California ST-40 Bridge Rail just as the CA ST-75SW did, but the CA ST-76SW adds a 42-inch vehicular parapet height above the bridge rail’s integral raised sidewalk to complement and add another option to the 36-inch vehicular parapet height of the CA ST-75SW.

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 for 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 bars.

Geometric data from bottom of concrete curb and above for parapet portion of the ST-76SW matches the ST-76 (the new feature is the integral raised concrete sidewalk). Vehicular rail height is 3 feet – 6 inches above the top of integral raised sidewalk. Pedestrian hand railing height is 4 feet – 0 inches above the top of integral raised sidewalk to meet or exceed the 42-inch minimum height requirement for pedestrians. The traffic-face of 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-76SW does not exceed the maximum cross slope of 2% per ADA law and accessibility guidelines and policies.

Width of the bridge rail parapet on the integral raised sidewalk is 2 feet – 0 inches.

Post spacing is 10 feet – 0 inches maximum. Post spacing between BB and EB should be equal spacing. Post spacing on wing walls may be different than on bridge deck.

Aesthetic see-through railing.

# Standard Drawing Features

All six Revised Standard Plan sheets of ST-76SW Bridge Rail must be included in the contract plans:

RSP B11-215

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

RSP B11-216

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

RSP B11-217

Includes MASH compliant details for approach end block details and features the vertical slotted holes to aid with constructability of the thrie beam rail. Caltrans is adapting bridge approach end block per the crash tested and approved details developed by the Midwest Roadside Safety Facility (MwRSF) at the University of Nebraska (TRP 03-367-19-R1) for the MwRSF Pooled Fund of which Caltrans is a member State DOT.

The attachment of guardrail end cap and thrie beam guardrail shall be placed so that the top is at 34” above top of sidewalk. The end of the approach end block tapers down in height to 35” above top of sidewalk.

Common Standard Plans sheets for ST-75, ST-75SW, ST-76, and ST-76SW:

RSP B11-220

Includes steel post elevation view and side view, base plate detail, shim plate details, rail end cap, and bicycle railing connection details.

RSP B11-221

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

RSP B11-222

# Indicates elevation view of parapet shoe and other sections and views that explain parapet shoe details. Isometric view of parapet shoe is also indicated. The parapet shoe is the welded steel assembly that provides a tapered surface between the clear openings of the steel bridge rail where the HSS steel rail tubes meet the concrete end blocks. The parapet shoe ensures that any portion of an impacting vehicle that has crushed into the clear openings will be smoothly redirected back out to the traffic face of the bridge rail/concrete end block. Design/General Notes

Design Criteria:

AASHTO LRFD Bridge Design Specifications 8th edition with California Amendments:

Live Loading

* HL 93 and permit design load

Vehicular Collision Force

* MASH 2016, Test Level 2

Concrete

* fy = 60 ksi (ASTM A706/706M, Grade 60)
* f’c = 3.6 ksi
* -n = 8

Structural Steel

* Posts & Plates: fy = 36 ksi min (ASTM A709/A709M, Grade 36 or Grade 50, ASTM A36/A36M, or ASTM A572/A572M, Grade 42 or Grade 50)
* Rails (HSS tubes): fy = 46 ksi min (ASTM A500/A500M Grade B, or ASTM A1085/A1085M)
* Anchor Bolts: ASTM 1554, Grade 105
* Parapet shoe plates: fy = 50 ksi (ASTM A709/A709M, Grade 50 or ASTM A572/A572M, Grade 50)
* 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 bridge deck, wingwall, retaining wall, or bridge deck 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

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 2 inches on the top, and in the integral raised concrete sidewalk the clearance is 2 inches at the traffic-face and the back-face of the sidewalk and 2 inches below the top of the sidewalk. The clearance to reinforcement in the concrete transition end blocks at the approach and departure ends is 2 inches 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 5.10 for using epoxy coated rebar and Standard Specifications 2018 section 52-2.

California ST-76SW 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. Refer to TYPE H CURB detail on Std. Plan A87A “CURBS AND DRIVEWAYS”.

**Crashworthiness:**

Crashworthiness of California ST-76SW Bridge Rail was based on the successful MASH crash testing of the California ST-75 Bridge Rail. Refer to the following site for Vehicular Crash Tests of the [California ST-75 Bridge Rail Research Results](https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/research-results/task3033-rrs-6-20-a11y.pdf).

The Final Crash Test Report for the California ST-75 Bridge Rail and other general information will be posted to the Division of Research and Innovation and Systems Information webpage for [Research Final Reports in the Geotechnical and Structures subsection](https://dot.ca.gov/programs/research-innovation-system-information/research-final-reports) pending final ADA remediation and publication. More information regarding MASH Implementation by Caltrans can be found at the Caltrans/Division of Safety Programs [Implementation of the Manual for Assessing Safety Hardware (MASH)](https://dot.ca.gov/programs/safety-programs/mash) webpage.

**Pedestrian Accessibility:**

California ST-76SW Bridge Rail complies with the pedestrian accessibility guidelines in [Design Information Bulletin 82 (DIB 82)](https://dot.ca.gov/-/media/dot-media/programs/design/documents/dib82-06-a11y.pdf)

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](https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/bridgestandarddetails/chap-8/201810-xs8-050-a11y.pdf) and the [Bridge Standard Details, xs8-050 User Guide](https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/bridgestandarddetails/chap-8/201607-xs8-050-ug-a11y.pdf).

If the Maximum Movement Rating is more than 2 inches, contact the [Caltrans Bridge Joints and Bearings Specialist](https://des.onramp.dot.ca.gov/structure-policy-innovation/joints-bearings) or email at DESdesign@dot.ca.gov with “Attention: Caltrans Bridge Joints and Bearings Specialist”.

**Utilities and Overlays:**

No conduits are permitted in the 12-inch height of the concrete curb of the bridge rail parapet or in the deck overhang directly below the concrete curb of the bridge rail parapet, but conduits are permitted in the integral raised sidewalk of the bridge rail as noted and as shown 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-76SW 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), the minimum distance that conduits must be clear of the sidewalk curb face per the Revised Standard Plans for the ST-76SW, the minimum distance that conduits must be clear of the traffic face of the vertical parapet portion of the bridge rail per the Bridge Revised Standard Plans for the ST-76SW, 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 Revised Standard Plans for the ST-76SW. 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 (not to exceed 2 inches in additional curb height), 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 – 6 inches above the top 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-76SW bridge rail.

If a deck overlay is planned for an existing bridge deck with an existing California ST-76SW Bridge Rail, then consider the following options:

* No deck overlay.
* Taper the deck overlay down to the minimum depth permissible 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-76SW.
* If need deck overlay to extend all the way to the existing 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 CA ST-76SW so that the CA ST-76SW’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 California ST-76SW Bridge Rail sidewalk curb.

# Additional Drawings Needed to Complete PS&E

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 59 Structural Steel Coatings**,** Section 75 Miscellaneous Metal, Section 83 Railings and Barriers, , Section 91 Paint, and if a special design is done to add chain link railing to the ST-76SW (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-76SW is mounted on an earth retaining system.
* Sound walls cannot be mounted on the CA ST-76SW.
* California ST-76SW 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-76SW. Chain link railing should only be added to CA ST-75SW for specific lengths where required over railroad tracks or where over or adjacent to locations with security concerns.
* 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 carbon-fiber-reinforced polymers (CFRP) near surface deck strengthening may be required if the CA ST-76SW is desired to be added to an existing bridge. The CA ST-76SW 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-76SW 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-76SW 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 is based on the successful crash testing of the CA ST-75 which was crash tested with the bicycle/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

Should use a 42-inch vehicular parapet height above the top of the integral raised sidewalk such as the CA ST-76SW in these instances:

* On the high side of a bridge deck (or high side of a roadway where bridge rail at the outside edge is mounted on a retaining wall or concrete barrier moment slab or trench footing) when super-elevation is 6% or greater.
* Where end of bridge rail transitions to meet up with Type 60M (42-inch height) on a sidewalk along outside edge of roadway.
* Whenever designer or stakeholders desire a 42-inch height vehicular parapet above top of integral raised sidewalk of the bridge rail, for any reason, instead of any shorter bridge rail parapet (32 inches is the minimum parapet height above top of integral raised sidewalk required for MASH TL-2 bridge rails).
* Whenever designer or stakeholders desire a vehicular combination bridge rail that already meets the minimum pedestrian parapet railing height of 42 inches above the top of integral raised sidewalk without a separate pedestrian railing added to the top of the vehicular parapet portion of the bridge rail. If the CA ST-76SW requires a special design to use chain link railing, then the chain link railing would be required for the full chain link railing standard height above the top of the integral raised sidewalk even though the bridge rail vehicular parapet is already 42 inches height above the top of the integral raised sidewalk.
* If one side of the bridge has a CA ST-76SW, then the opposite side (if opposite side of bridge does not have a sidewalk) should either have a CA ST-76 or a CA ST-75 to match the aesthetics.
* If the existing bridge has a 42-inch or greater height see-through aesthetic bridge rail, and the new project is either replacing the bridge rail or replacing the bridge, and -to address any context sensitive issues- it is desired to replace the bridge rail with a new 42-inch vehicular parapet height see-through aesthetic bridge rail that meets current standards … then the see-through aesthetic CA ST-76SW would be a good option.

Issues to consider to be able to determine when a taller-than-minimum pedestrian hand railing should be used (in most cases, consider taller-than-minimum height when more than one of these cases exist, but if a single case is at the more extreme end, then only need that one case to justify taller-than-minimum):

* Bridge/highway located on small radius curve (where small radius is relative to the posted regulatory speed limit)
* High super-elevation of bridge/highway (6% or more)
* Narrower-than-standard shoulders
* Sustained profile grade of 3% or more (for 300 feet or more, that includes the approach up to the bridge)
* Located where daytime visibility is frequently obscured (due to fog, dust/sandstorms, etc.)
* Located at bottom of T-intersections (if have downhill grade of 3% or more into a T-intersection with a bridge rail/bicycle rail at opposite side of T-intersection, then the bicycle railing height should 54 inches)
* If project stakeholders and Caltrans District or local agency have agreed on a taller-than-minimum bicycle railing height for any reason (this is not uncommon)

Aesthetics:

Aesthetic see-through bridge railings such as the CA ST-76SW 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:

* All the steel railing components require a galvanized coating, galvanized steel railings can be painted. There are no restrictions on choice of paint color for the steel elements, except that yellow cannot be used because the MUTCD reserves that color for the median striping (cannot have a yellow-colored bridge rail at outside edge of structure/roadway). 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.
* If a Context Sensitive Solution is desired for the bicycle railing, then a special design could be done for the bicycle railing itself. If so, the special design railing must comply with the design capacity and clear opening requirements shown in Section 13 RAILINGS of the AASHTO LRFD Bridge Design Specifications with California Amendments.
* 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.
* Concrete curb of the CA ST-76SW bridge railing can have color added by either staining the concrete surface or adding dye to the concrete mix, or both. When adding color to concrete barrier surface, stain should be used. Stain penetrates into the surface so if the concrete surface is lightly impacted the color will still remain, whereas paint is only adhered to the surface and will scrape off even if lightly impacted. Paint peels over time and more rapidly in harsh environments.
* Architectural texture can be added to the surface of concrete curb of the CA ST-76SW, but the depth of texture must be added to the outside of the cross section of the standard details for the concrete barrier (so a textured barrier will be wider than the standard barrier and this may affect the bridge width). If texture is planned for the traffic side of a steel post-and-beam bridge rail the lower concrete beam/curb portion of the rail can only have very little texture depth, and if it has any texture it needs to also be a smooth texture design so that tires will not climb the face of the rail. If architectural texture is desired, contact the Bridge Railing Technical Specialist.

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 Bridge Standard Details sheets for CA ST-76SW (42 inch vehicular rail height and 48-inch pedestrian railing height which exceeds the 42-inch minimum pedestrian railing height), but the tubular pedestrian hand railing can be taller than 48-inches if desired or if required as noted above in the Special Considerations section (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.

Scuppers cannot be used with bridge rail that integral raised sidewalk. Note that deck drainage can only be allowed to drop off from the deck by means down-drains if the Environmental Document allows it, and if there is no vehicular lanes/railroad tracks/bicycle path/walkway/or boating waterway directly below.

All project-specific modifications to the CA ST-76SW 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.