Concrete Barrier Type 85SW Bridge Railing

XS Sheet Numbers
xs16-118-1, xs16-118-2, and xs16-118-3

Description of Component

Figure 1 Typical Section of Concrete Barrier Type 85SW

The MASH-compliant TL-2 rated California ST-85SW Bridge Rail replaces the NCHRP Report 350-compliant TL-2 rated California ST-80SW Bridge Rail. Approved per MASH 2016 (AASHTO Manual for Assessing Safety Hardware)

Concrete Post & Beam see-thru 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 concrete bridge railing on concrete curb over integral 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 railing is connected to the structure it is mounted on with reinforcing steel.
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Geometric data from bottom of concrete curb and above for parapet portion of the Concrete Barrier Type 85SW matches the Concrete Barrier Type 85 (the new feature is the integral raised concrete sidewalk). Vehicular height is 3 feet – 0 inches above top of integral raised concrete sidewalk. Pedestrian railing height is 3 feet – 6 inches above the top of integral raised concrete 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 Concrete Barrier Type 85SW 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 three of the Bridge Standard Detail Sheets must be included in the contract plans:

Sheet Number: xs16-118-1

Includes typical railing system, expansion joint details, bridge railing reinforcement, and additional transverse deck rebar needed at post locations. Typical section of the concrete railing on concrete curb on sidewalk with approach and departure concrete transition end blocks

Sheet Number: xs16-118-2

Includes elevation view, typical section, section for Concrete Barrier Type 85SWB on trench footing, and top & bottom beam reinforcement.

Sheet Number: xs16-118-3

Includes details for sleeve tube splice joint at expansion joint, tubular railing details and lower railing detail for the bridge railing.
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

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, Railing, 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 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.

Concrete Barrier Type 85SW Bridge Railing was designed and checked as a new MASH-compliant bridge railing 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:

A link to the site for Vehicular Crash Tests of the Concrete Barrier Type 85 Bridge Railing Research Results will be updated after the crash test report is posted online. The Final Crash Test Report 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 by January 2022. An FHWA Letter of Eligibility is no longer required by FHWA, but one will be requested after approval and posting as a matter of formality and to get this bridge railing added on the FHWA list of approved MASH bridge railings. More information regarding MASH Implementation by Caltrans can be found at the Caltrans Division of Safety Programs webpage for Implementation of the Manual for Assessing Safety Hardware (MASH)

Pedestrian Accessibility:

Concrete Barrier Type 85SW 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:

Only two 1 ½ inches diameter conduits are permitted in the taller half of the concrete curb (front-to-back from 12 inches to 9 inches).

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 Concrete Barrier Type 85SW 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 Type 85SW, 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-85SW, 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-85SW. 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 railing on the integral raised sidewalk will measure 3 feet – 0 inches above the top of the sidewalk.
User Guide to Bridge Standard Detail Sheets

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If a deck overlay is planned for an existing bridge deck with an existing Concrete Barrier Type 85SW Bridge Railing, 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 Concrete Barrier Type 85SW.
- 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 Type 85W so that the Type 85SW'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 Concrete Barrier Type 85SW sidewalk curb.

Additional Drawings Needed to Complete PS&E

Connection of Concrete Barrier Type 85SW bridge railing concrete transition end block to guardrail transitions at approach and departure ends: Standard Plans A78F1 & A78F2 for Three 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
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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 railing (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, 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 Railing 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 Concrete Barrier Type 85SW is mounted on an earth retaining system.
- Sound walls cannot be mounted on the Concrete Barrier Type 85SW.
- Concrete Barrier Type 85SW cannot be used in locations where the regulatory speed limit of the vehicular traffic lanes next to the bridge is greater than 45 miles per hour (MPH).
- A special design is required to mount a chain link railing to the Concrete Barrier Type 85SW.
- A special design is required for retrofitting this bridge railing with integral raised sidewalk onto an existing bridge deck, existing retaining wall, or existing barrier moment slab. Due to the need for long hooks as well as the additional transverse
deck bars at each post location, this bridge railing would require a detailed finite element analysis in order to determine if it’s possible to consider placement onto an existing bridge without removal and replacement 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 should be considered if the Concrete Barrier Type 85SW is desired to be added to an existing bridge. The Concrete Barrier Type 85SW 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 extra hooks and reinforcement. If Concrete Barrier Type 85SW is desired as a bridge railing at the top of an existing retaining wall that was not designed for the transfer of vehicular impact loading, then either the Concrete Barrier Type 85SW 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 8 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 Concrete Barrier Type 85SW 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:

- Aesthetic metal bar design can be added in between the top & bottom beam if a custom artistic design is desired. This could be done to match a design of a custom feature railing on the bridge or to match or complement some feature on or near the bridge.
the bridge 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.

- 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.

- The height above Finish Grade for bridge railing at completion of construction contract cannot be less than the heights shown on the Bridge Standard Detail Sheets for Concrete Barrier Type 85SW.

- Any architectural texture added to the Type 85SW parapet or the concrete end blocks on the raised integral sidewalk must be added to the outside of the standard size cross section which would make the parapet wider than 2 feet-0 inches and, in turn, make the overall bridge rail from backside of parapet at the Edge of Deck to the toe of the raised integral sidewalk an equivalent amount wider. This could affect the total bridge width.

Fixed objects, such as lighting standards or bridge-mounted signs, must be placed on a corbel or pedestal at the barrier post locations or on an outcropped portion of the deck overhang on the back side of the bridge railing 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 Concrete Barrier Type 85SW 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.