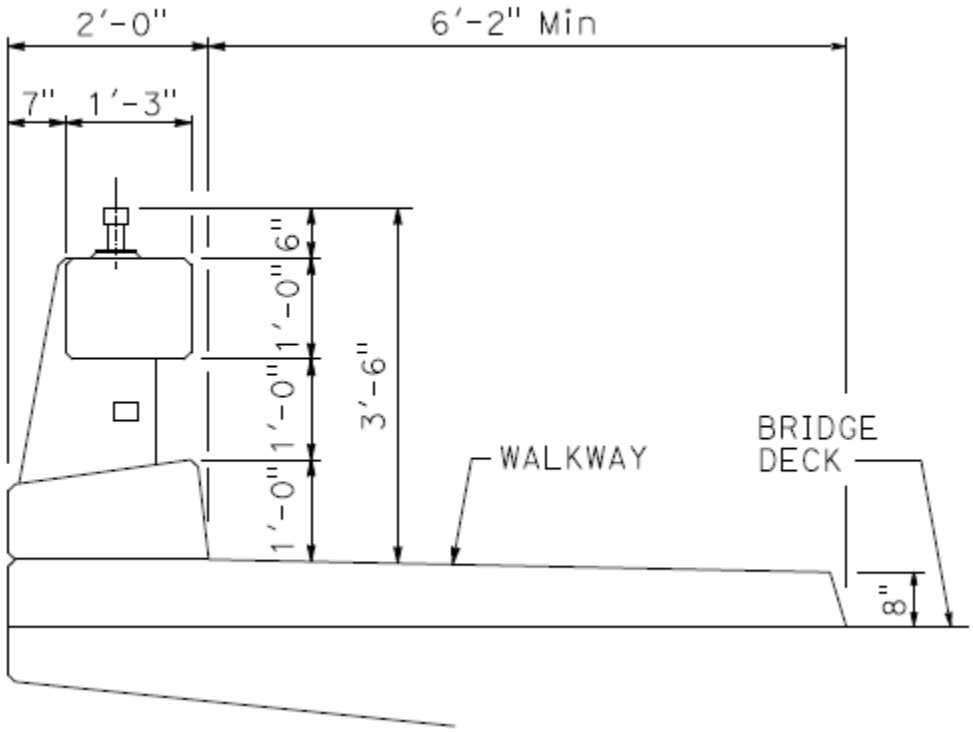
Section 16 – Barriers and Railings
Concrete Barrier Type 85SW

XS Sheet Numbers

xs16-118-1, xs16-118-2, xs16-118-3, xs16-118-4, and xs16-118-5

Description of Component



Concrete Barrier Type 85SW bridge railing (Type 85SW)

The MASH-compliant TL-2 rated Concrete Barrier -Type 85SW bridge rail replaces the NCHRP Report 350-compliant TL-2 rated Concrete Barrier 80SW bridge rail.

Approved per MASH 2016 (AASHTO Manual for Assessing Safety Hardware) and approved for TL-2 low-speed locations only (regulatory speed limits of 45 mph or less). Concrete Post & Beam see-thru Combination Railing (vehicular and pedestrian) is a post and beam style concrete barrier on concrete lower beam (curb over integral concrete sidewalk) that is connected to reinforced concrete box girder bridge deck, wingwall, or retaining wall as shown on the plans. It can be specially designed to connect to concrete barrier moment slab, structure approach slab, or top slab of concrete box culvert where the top slab acts as the vehicular riding surface. This Type 85SW is connected to the structure it is mounted on with reinforcing steel.

Section 16 – Barriers and Railings
Concrete Barrier Type 85SW

Geometric data from bottom of concrete lower beam (curb) and above for parapet portion of the Concrete Barrier Type 85SW matches the Concrete Barrier Type 85 (the new added feature is the integral raised concrete sidewalk). Vehicular rail 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.

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.

Overall barrier width 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 five of the Bridge Standard Detail Sheets must be included in the contract plans:

Sheet Number: xs16-118-1

Includes elevation and plan views for typical railing system with approach and departure concrete transition end blocks, a typical section, and concrete barrier reinforcement with additional transverse deck rebar needed at post locations.

Sheet Number: xs16-118-2

Includes railing system details on top of a wall or retaining wall, a longitudinal section for reinforcement details, transition end block reinforcement details, and expansion joint details.

Sheet Number: xs16-118-3

Includes elevation view, upper beam & lower beam (curb) reinforcement, an isometric view, and details for end block and adjacent post transition.

Section 16 – Barriers and Railings
Concrete Barrier Type 85SW

Sheet Number: xs16-118-4

Includes details for tubular pedestrian railing, lower pedestrian railings, HSS steel tube standard splice, and HSS steel tube expansion splice.

Sheet Number: xs16-118-5

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 end of the approach end block tapers down in height to 35” above top of integral concrete sidewalk.

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

- f_y = 60 ksi (ASTM A706/706M, Grade 60)
- f'_c = 3.6 ksi
- n = 8

Steel Components for pedestrian handrailing

- Carbon steel structural rail, and post tubing (HSS): ASTM A500/A500M, Grade B.
- Carbon steel plate and splice sleeves: ASTM A36/A36M
- Bolts: ASTM F3125, Grade A325/A325M, Type 1

- Threaded rods: ASTM A449, Type 1
- Nuts for bolts and threaded rods: ASTM A563/A563M
- Washers for bolts and threaded rods: ASTM F436/F436M

Designers must ensure that any supporting structures, such as the bridge deck, wing wall, retaining wall or bridge deck overhang, meet the requirements in the AASHTO LRFD Bridge Design Specifications, Appendix in Section 13, Railing, as amended by Caltrans California Amendments (AASHTO-CA-BDS-8 – Section 13).

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 lower beam (curb) 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 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:

Concrete Barrier Type 85SW was designed and checked as a new MASH-compliant bridge railing; its crashworthiness is based on the Concrete Barrier Type 85 Crash Test.

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 for Concete Barrier Type 85 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 when available. An FHWA Letter of Eligibility is no longer required by FHWA, but one may be requested after approval and posting to get this concrete barrier added on the FHWA list of approved MASH bridge railings to aid in its implementation by other state DOTs. More information regarding MASH Implementation by Caltrans can be found at the Implementation of the Manual for Assessing Safety Hardware (MASH).

Pedestrian Accessibility:

Concrete Barrier Type 85SW 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 Rating is more than 2 inches, contact the Caltrans Bridge Joints and Bearings Specialist or email at DESdesign@dot.ca.gov with “Attention: Caltrans Bridge Joints and Bearings Specialist”.

Utilities and Overlays:

Only two 1 ½ inches diameter conduits are permitted in the taller half of the concrete curb of the concrete barrier parapet on the raised integral sidewalk (front-to-back curb height of parapet from 12 inches to 9 inches).

Section 16 – Barriers and Railings
Concrete Barrier Type 85SW

Conduits are permitted in the integral raised sidewalk of the bridge rail as noted on the Bridge Standard Detail Sheets. As a minimum, provide two 4-inch round openings, ducts, or conduits for future use as shown on the plans. In regard to conduits at the end of bridge or wingwall see Standard Plans B14-3, ES-9A, and ES-9B.

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 be a minimum 8 inches above the top of the Finish Grade of the deck overlay). Designers shall also consider 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 concrete barrier per the Bridge Standard Detail Sheets for the Concrete Barrier Type 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 Concrete Barrier Type 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 concrete barrier 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 parapet on the integral raised sidewalk will measure 3 feet – 0 inches above the top of the sidewalk.

If a deck overlay is planned for an existing bridge deck with an existing Concrete Barrier Type 85SW, 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 Concrete Barrier Type 85SW.

- 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 to the a depth of 2” or less so that the height of the sidewalk curb at the traffic face is no less than 6” height above the top of the overlay Finish Grade. If this is not possible, then you may have to replace the existing Type 85SW in conjunction with an overlay placed all the way to the toe of the sidewalk curb in which case the overlay depth would be added to the height of the raised integral concrete sidewalk of Type 85SW so that the integral sidewalk curb height above the top of the overlay Finish Grade is 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 depth of 2 inches or less in order to preserve a minimum of 6 inches of sidewalk curb height for the existing Concrete Barrier Type 85SW.

Additional Drawings Needed to Complete PS&E

If the Type 85SW 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.

The height of the tubular hand railing can be increased to 48 inches, If the tubular hand railing is needed to be taller than 48 inches in height, then special designed detail drawings will be required.

Additional detail drawings will be required if there is going to be any architectural texture on the back side and/or traffic side of Type 85SW.

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, Section 91 Paint, and if a special design is done to add chain link railing to Type 85SW (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 the need for chain link railing) then also Section 83-1.021 Chain Link Railing.

Section 16 – Barriers and Railings
Concrete Barrier Type 85SW

Restrictions on Use of Standard Drawings

- A special design is required if Concrete Barrier Type 85SW is mounted on an Earth Retaining System (ERS) such as solider pile wall, tie-back wall, or soil nail wall. For MSE walls, which are one type of ERS. A Type 86H would have to be mounted on concrete barrier moment slab over the top of the MSE wall (see xs12-090, xs13-020-05, and xs13-020-6).
- Sound walls cannot be mounted on the Concrete Barrier Type 85SW.
- A special design is required to mount a chain link railing to the Concrete Barrier Type 85SW. Chain link railing should only be added to Type 85SW 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 concrete barrier with integral raised sidewalk onto an existing bridge deck, existing retaining wall, existing approach slab, top slab of existing concrete box culvert 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 concrete barrier cannot be considered for 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 long hooks and reinforcement. If Concrete Barrier Type 85SW is desired as a concrete barrier 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 concrete barrier 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 concrete barrier 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.

In regards to aesthetics:

- Aesthetic lower tubular handrailing design can be added in between the upper beam & lower beam (curb) 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 height above Finish Grade for at completion of construction contract cannot be less than the heights shown on the Bridge Standard Detail Sheets for Concrete Barrier Type 85SW.

- All pedestrian hand railing components require a galvanized coating, galvanized railing can be painted after galvanization. There are no restrictions on the 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), 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 pedestrian hand railing, then a special design could be done. 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.
- Type 85SW 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 Type 85SW, 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 Type 85SW, the lower 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 Type 85SW at the completion of construction contract cannot be less than the heights shown on the Bridge Standard Detail sheets for Type 85SW (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. If pedestrian hand railing is modified from the standard details shown on the Type 85 SW Bridge Standard Detail sheets, then a specially designed details will be required and will be placed in the same location shown on the plans for the 6-inch height pedestrian hand railing.

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.