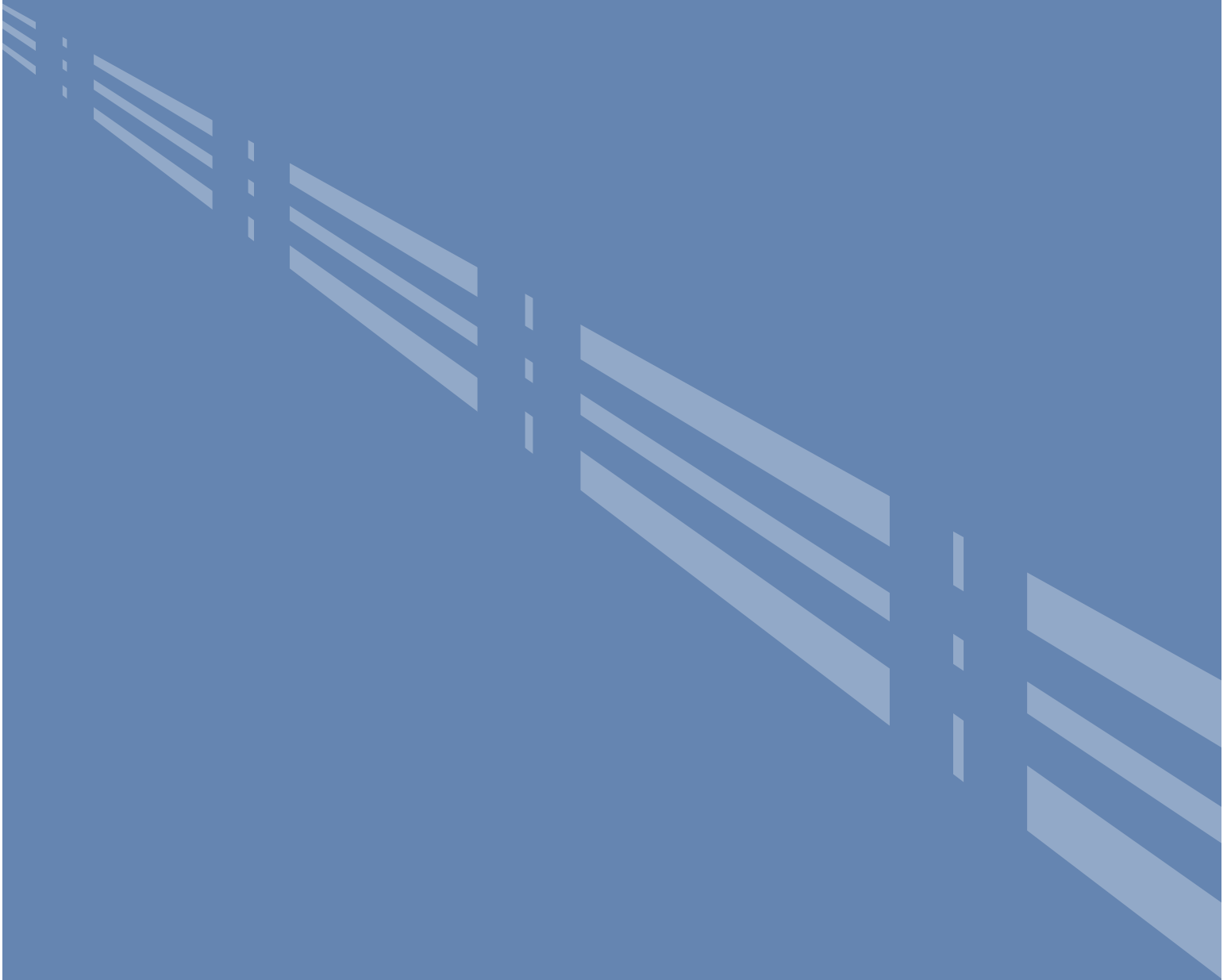


Bridge Rails and Barriers

A Reference Guide for Transportation Projects in the Coastal Zone



Introduction



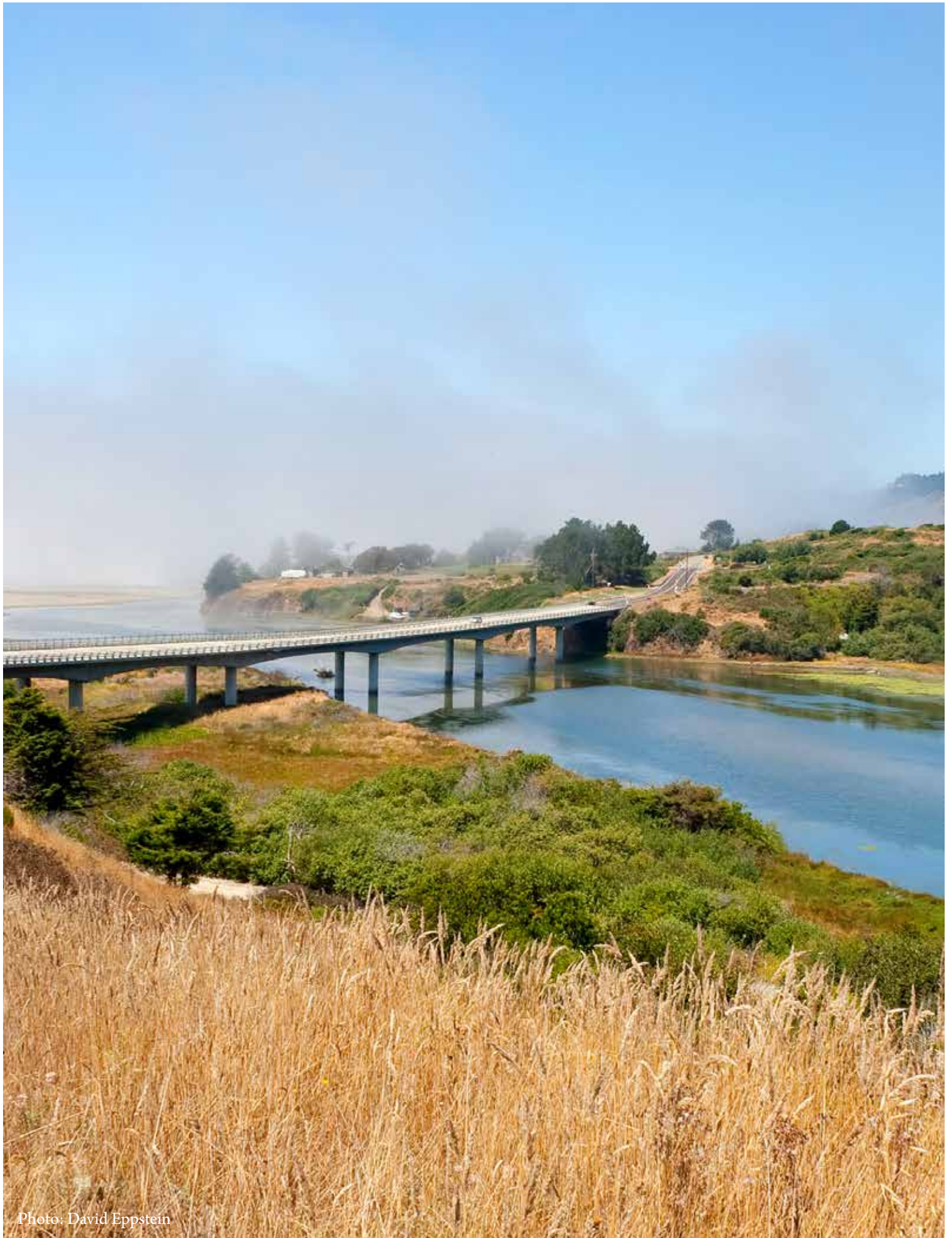


Photo: David Eppstein

Background

The mission of the California Department of Transportation (Caltrans) is to improve mobility across California. To that end, Caltrans is responsible for the design, construction, operation, and maintenance of the state transportation network. The Caltrans Strategic Plan sets goals of providing the safest transportation system in the nation for the traveling public and Caltrans workers, maximizing transportation system performance and accessibility, efficiently delivering quality transportation projects and services, preserving and enhancing California's resources and assets, and promoting quality service through an excellent workforce. Caltrans pursues these goals in accordance with current engineering, environmental, and economic regulations and policies.

The mission of the California Coastal Commission (Commission) is to protect, conserve, restore, and enhance environmental and human-based resources of the California coast and ocean for environmentally sustainable and prudent use by current and future generations. The Commission, in partnership with coastal cities and counties, plans and regulates the use of land and water in the coastal zone. The terrestrial component of the coastal zone varies in width from several hundred feet in urban areas to more than 5 miles in some rural areas. Development projects (including transportation projects) in the coastal zone generally require a coastal permit from either the Commission or a local jurisdiction with a Commission-certified local coastal program (LCP). In addition, projects must meet the requirements of the federal Coastal Zone Management Act of 1972.

As the state department responsible for the transportation infrastructure in California, Caltrans is often involved in projects in the coastal zone. Consequently, such projects must satisfy the requirements of Caltrans' mission and regulations, as well as the policies of the Coastal Act. In designing projects, Caltrans is guided by a rigorous and comprehensive body of specifications set forth in the *Highway Design Manual*, which is supplemented by an array of documents published by the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA).

The Commission's review of plans and development proposals is guided by the provisions set forth in the California Coastal Act of 1976 (Coastal Act), which are implemented through the Coastal Commission's planning and regulatory programs. Local government review of transportation projects in the coastal zone is guided by the pertinent Commission-certified LCP policies, together with the public coastal access policies of the Coastal Act.

The design process is the meeting place of engineering, resource protection, and aesthetic considerations that must be evaluated by both Caltrans and the Commission. Consequently, an effective working partnership between the two entities is important for both to meet their common mandate of serving the people of California. Successful collaboration early in the design process can assist both entities not only in meeting their statutory responsibilities, but also in fostering the creation of a modern multimodal transportation network that complements the spectacular resources—natural, cultural, and visual—of the state.

Bridge railings and barriers in the coastal zone have presented a distinct set of challenges, largely because the visual protections established by the Coastal Act reach beyond the structural considerations that have traditionally driven Caltrans design practices. To help address these challenges, the Commission appointed a Road's Edge Subcommittee of two members to work with Caltrans and Commission staff in providing input on selected bridge railings and related features prior to the permit approval stage. The Subcommittee's review normally occurs after the development of substantial information, primarily through the development of environmental documents and related technical reports, and after Caltrans and Commission staff have worked

together to sort out more basic project considerations such as the bridge/roadway alignment and structural alternatives. Although the Subcommittee cannot bind a future decision of the Commission, the Commission carefully weighs the Subcommittee's input when projects reach the permit approval stage. But perhaps more importantly, the Subcommittee functions as a resource for design review—facilitating collaboration, efficiency, and resolution of potential conflict at earlier phases of project development.

To support this process, Caltrans, in collaboration with the Commission, has developed a number of railing and barrier designs that have met or exceeded Caltrans' standards; several have received coastal development permit approvals. With the application of each new railing, Caltrans and Commission staff continue to learn more about the positive and negative features of the various designs in different settings. This reference guide presents, in a single, user-friendly format, a digest of the currently available palette of railing and barrier types that may be suitable for adapted use in future projects in the coastal zone. Not all of the railing and barrier types contained in this guide would be appropriate for all types of projects in all locations. The ultimate choice of railing or barrier type for any particular project must be sensitive to the regional and site-specific context. Ensuring a general sense of visual cohesion and compatibility within regional corridors is another important factor in the selection of railing types. Early consultation between Caltrans and Commission staff is recommended to determine a subset of railing and barrier types contained in this reference guide that might be appropriate to consider for any given project.

How to Use this Guide

This guide has been prepared as a tool to help stakeholders and participants in bridge and railing design to better understand options available for potentially successful application in future projects. Hopefully, this information will help to streamline the processes of rail selection and coastal development permitting. Part II, Rails and Barriers, presents fundamental design standards as well as a wide array of rail examples of (both preliminary designs and final selections) exhibiting site-specific features; aesthetic designs and treatments; and design features to ensure safety, ease of maintenance, and versatility. The successful combination of these characteristics supports compatibility and compliance with both Caltrans standards and Coastal Act/LCP policies. Several examples in this document reflect projects that have been approved, and in some cases already constructed, in the coastal zone. As noted above, not all of the railing and barrier types contained in this guide would be appropriate for every project. Furthermore, some of the built examples provide useful guidance for potentially improving railing designs in future applications. Again, while the use of railings depicted in this document does not guarantee coastal development permit approval for any given project, since each project must be evaluated within its specific context, this compilation represents the currently available palette of railing types that may be successfully tailored for upcoming projects. Part III, Reference Material, is a list of sources and links that provide additional in-depth information for more detailed study and project development.

Most of the railings and barriers shown here are standard railings—or variations of standard railings—already in use by Caltrans. This palette is not meant to be viewed as an exhaustive list; other designs, appropriate to project-specific contexts, are encouraged for future projects, so long as they meet the applicable design standards of both Caltrans and the Commission. To ensure context-sensitive compatibility, final rail selection should consider applicable Coastal Act/LCP policies, site-specific features, and aesthetics of the structure.

It is anticipated that the range of available railing and barrier options will continue to increase as additional designs that meet the criteria of the two entities are developed and implemented, and as the relative success of new and different approaches can be evaluated over time. Moreover, it is anticipated that this compilation will ultimately be updated to include a palette of railings and barriers (including median barriers) for off-bridge use in the coastal zone, and possibly evolve into a guide that addresses a broader spectrum of road edge treatments in the coastal zone.

To create successful design options, it is important that Caltrans project teams familiarize themselves with the appropriate Coastal Act/LCP policy provisions specific to the project location as early as possible in the project development process. Close collaboration with Commission and LCP staff and, as appropriate, the Road's Edge Subcommittee, at key stages in the process promotes understanding of these policies and facilitates development of approvable bridge railing design and selection of options. Caltrans district offices often work with design review committees at the local level, and it is likewise important that those efforts to develop context-sensitive designs are well informed of the LCP and Coastal Act policies that will be the standards of review for coastal development permit proposals. Throughout the design development process, it is important to incorporate the coastal policy guidance as Caltrans' project teams develop safe and creative options that adhere to the Department's structural and design parameters for coastal zone settings.

Bridge Railing Design Considerations

The determination of a bridge project's form and function is driven by its location and the character of the use to which it will be subject. The science of developing a project's form and function is the product of years of expertise in varied geographies and adherence to the most current standards and practices in the relevant engineering fields. This aspect of project development is common to all bridge projects wherever they may occur. Beyond the essential form and function, the visual and aesthetic effects of the bridge on its surroundings are of singular concern to the designer.

Bridge projects in the coastal zone, as discussed earlier, must be consistent with state and local coastal program policies to receive the necessary regulatory approvals. Accordingly, the Commission's policy context is addressed first below, with the understanding that the aesthetic accommodations must be compatible with the engineering standards to which Caltrans is required to conform. A discussion of Caltrans' design standards and policies follow.

Coastal Commission

The California Coastal Act of 1976 established specific policies for guiding the Commission's planning and regulatory responsibilities. Section 30251 of the Act, in particular, addresses the design and aesthetics of bridge railings and barriers. It specifies that "the scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance." Provisions of the Act give clear policy direction for siting and designing development to achieve the aesthetic objectives listed below.

- Views both of and from the shoreline and scenic areas should be protected.
- The alteration of natural landforms should be minimized.
- Development should be designed and sited to ensure compatibility with the context of the surrounding area.
- Visual qualities in visually degraded areas should be enhanced.
- Development in highly scenic areas should be subordinate to the character of its setting.

In general, there are several guiding principles that can be followed to help meet Coastal Act and LCP scenic and visual quality policies as they pertain to bridge designs. Some of these are briefly summarized below.

- Visibility for users of the bridge may be the single most important consideration. Where the primary scenic resource is the public view from the bridge deck, the railing should be designed to minimize impairment of such views. Rail elements should be as thin as possible and should avoid “blocky” forms. In addition to keeping the railing as unobtrusive as possible, the design and materials should be selected to harmonize with the surroundings (while meeting all essential safety requirements).
- The lowest possible railing heights should be applied, consistent with the minimum allowable height for the class of anticipated users (i.e., motor vehicle, bicycle, or pedestrian).
- Appropriate color and texture can assist in visually blending railings with their surroundings. Metal railings can be treated to create a weatherized look; concrete elements can be stamped and colored to match the surrounding landscape or to simulate appropriate materials (e.g., wood grain, stone).
- Curved and arched elements, where appropriate, can create a graceful and pleasing structure.
- Views of bridges from public areas are also important considerations. Ensuring the architectural and visual compatibility of railings with the underlying bridge structure is essential. Within the parameters of engineering and safety requirements, the scale and style of all bridge elements should be subordinate to and harmonious with the character of the surrounding area.
- Because of the loss of many historic and attractive bridges throughout California, railing designs should seek to incorporate elements of historic bridges where such an approach is consistent with modern safety standards. As appropriate, scale, materials, and other factors that evoke traditional bridge forms in California should be explored.
- A coherent and unified railing design that incorporates the elements necessary for pedestrian and bicycle safety is preferable to simply adding decorative elements onto existing vehicle barrier designs.

Caltrans

Bridge railings serve both safety and aesthetic functions in bridge projects. They are designed to safely redirect vehicles to minimize injury and damage in the case of accidents, as well as to retain pedestrians and bicyclists. There are four classes of bridge railings, each intended to perform a different function.

- Vehicular barrier railings. The primary function of these railings is to retain and redirect errant vehicles.
- Combination vehicular barrier and pedestrian railings. These railings perform the dual function of retaining both vehicles and pedestrians on the bridge. They comprise a concrete parapet barrier (generally with a sidewalk) and a metal hand railing or fence-type barrier.
- Pedestrian railings. These railings prevent pedestrians from accidentally falling from the structure; in the case of fence-type barriers, they reduce the risk of objects being dropped on the roadway below.

- Bicycle railings. These railings retain bicycles and riders on the structure. They may be specifically designed for bicycles; alternatively, they can consist of a vehicular barrier topped by a fence or metal handrail.

After determining the function of the bridge railing, the designer must prepare a preliminary design that considers a series of parameters such as the vehicular design speed, railing height and width requirements, structural materials (generally either concrete or steel), constructability, ease of maintenance, and overall cost. With these preliminary parameters as a baseline, aesthetics and the context of the bridge site must be factored into the design process.

Caltrans' *Context Sensitive Solutions* policy informs quality transportation design by implementing a philosophy of integrating the transportation system into the place that it serves. Whether a project is in an urban, rural, or natural setting, it must be in harmony with both community goals and the local environment. To that end, Caltrans policies, practices, and mandatory design standards help designers provide for the needs of all users in balance with the needs of the local community and the project's context. Similarly, it is important that Caltrans coordinate effectively with all stakeholders, including local LCP jurisdictions and the Commission, to ensure that the various parties' objectives are being considered, that the project budget reflects agreed-upon aesthetic features, and that the necessary regulatory approvals can be obtained.

After determining the railing function and preparing a preliminary design for the railing form, the designer must ensure that the facility will meet the structural integrity and safety requirements set forth in the *AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications with California Amendments* and the *Highway Design Manual*. For example, these and other documents, in compliance with the Americans with Disabilities Act, establish very precise specifications dictating the size and placement of clear space openings in bridge railings.

In addition to complying with the structural standards outlined above, bridge railings must also meet crash test requirements. FHWA requires that all roadside safety hardware (including bridge railings) installed on National Highway System facilities after October 1, 1998, comply with crash-testing criteria. These criteria are outlined in various documents, including the *AASHTO Bridge Design Specifications*; National Cooperative Highway Research Program (NCHRP) Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features*; and the *Manual for Assessing Safety Hardware* (AASHTO MASH).

Caltrans has developed various kinds of railings and barriers for use on bridges to satisfy different requirements. Typically, railings are steel and barriers are concrete. These structures are classified by their test level (TL) performance, which in turn is based on criteria set forth in NCHRP Report 350. Designs approved subsequent to January 1, 2011, will be required to satisfy the newer AASHTO MASH criteria. TL-4 facilities are approved for use on bridges with posted speed limits greater than 45 mph. TL-2 facilities are approved for use on bridges with posted speed limits up to 45 mph. Accordingly, TL-4 facilities can be used on bridges suitable for TL-2 facilities, but the reverse is not true. TL-3 facilities, approved only for use as median barriers on bridges, are solid because no standards have been approved for "see-through" facilities in that application.

The structural requirements for bridge railings are provided in the *AASHTO Bridge Design Specifications* and the *Highway Design Manual*. For more detailed information regarding these standards, the reader is directed to sources listed in Part III, *Reference Material*.

Rail & Barrier Palette

Note that these examples include conceptual renderings of some options that were considered for application, but have not yet been incorporated into specific projects.



TL-4 Rails and Barriers

TL-4 railings and barriers are required on bridges with posted speed limits higher than 45 mph, though they may be used on bridges with lower speed limits. Examples of the facility types listed below are shown in this section.

-
- ▶ **CA ST-10 Bridge Rail**See-through 2-bar steel bridge rail on concrete curb
 - ▶ **CA ST-20S Bridge Rail**See-through 5-bar steel bridge rail on concrete curb
 - ▶ **CA ST-30 Bridge Rail**See-through 2-bar steel bridge rail on concrete curb
 - ▶ **CA ST-70 Bridge Rail**See-through 4-bar steel bridge rail on concrete curb
 - ▶ **Concrete Barrier Type 80**See-through concrete barrier on concrete curb
 - ▶ **Concrete Barrier Type 90**See-through concrete barrier with 1-bar steel bridge rail
-

California ST-10 Bridge Rail



Description

See-through two-bar steel bridge rail.

Dimensions

33 inches above bridge deck (27 inches plus 6-inch curb).

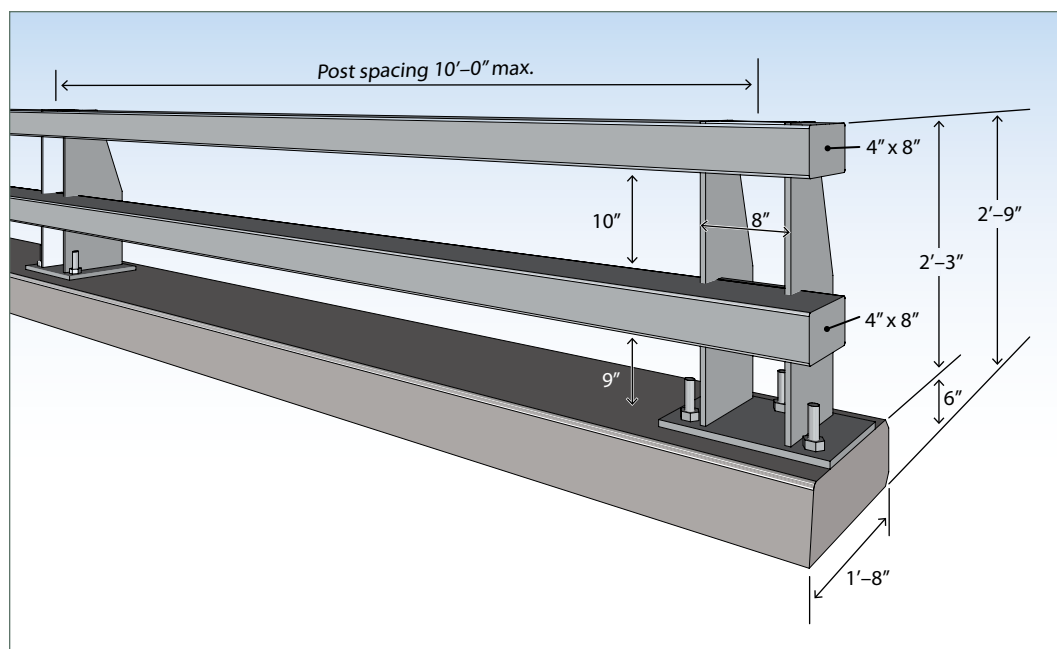
Comments

For use as a pedestrian/bicycle rail, the ST-10 requires addition of a steel rail behind the vehicular rail to increase height to a minimum of 42 inches, as well as modification of the clear openings. Addition of pedestrian/bicycle rail structures can create aesthetic issues.

Reference

Standard Plans / Bridge Metal Rail Barriers

 Approved for past projects in the Coastal Zone.





Rendering of 42-inch-high California ST-10 Bicycle Rail on Mad River Bridge in Humboldt County. (01-HUM-101-PM 090.8)



Rendering of Ten Mile River Bridge in Mendocino County with California ST-10 Bridge Rail with a pedestrian walkway and 42-inch-high handrail on the coastal side of bridge and 42-inch-high bicycle rail on the inland side. (01-MEN-001-PM 069.7)



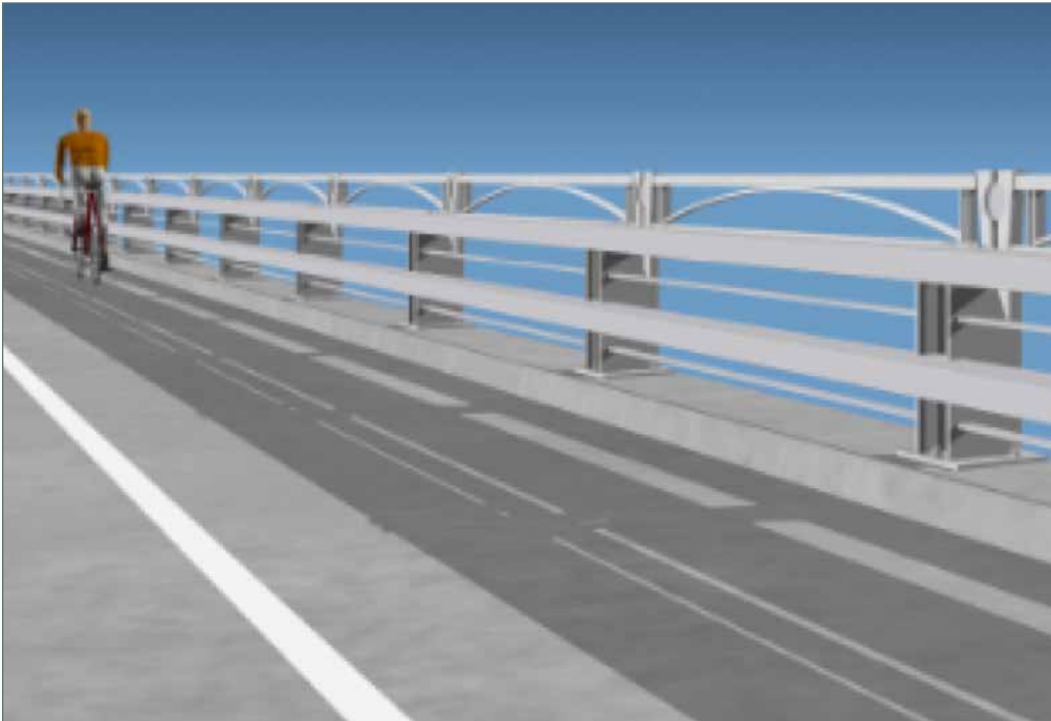
Rendering of 54-inch-high California ST-10 Bicycle Rail with arch bicycle rail.



Rendering of 54-inch-high California ST-10 Bicycle Rail with wave bicycle rail.



Rendering of 42-inch-high California ST-10 Bicycle Rail with decorative double arch option. Note cables added to reduce clear openings between ST-10 rails as required when bicycle traffic is expected. This is the bicycle rail alternative design that was ultimately chosen for the Ten Mile River Bridge in Mendocino County. (01-MEN-001-PM 069.7)



Rendering of 42-inch-high California ST-10 Bicycle Rail with decorative single arch option. Note cables added to reduce clear openings between ST-10 rails as required when bicycle traffic is expected. This is one of the bicycle rail alternative designs that was considered for the Ten Mile River Bridge in Mendocino County.



Rendering of California ST-10 Bridge Rail with sidewalk and steel pedestrian handrail at Noyo River Bridge on State Route 1 at Fort Bragg in Mendocino County. This is the barrier rail and pedestrian railing alternative that was ultimately chosen for the Noyo River Bridge. (01-MEN-001-PM 060.2)



Rendering of California ST-10 Bridge Rail with sidewalk and steel pedestrian handrail at Noyo River Bridge on State Route 1 at Fort Bragg in Mendocino County. (01-MEN-001-PM 060.2)



Rendering of 42-inch-high California ST-10 Bicycle Rail on the right and ST-10 / pedestrian walkway / 42-inch-high pedestrian rail on the left at Greenwood Creek Bridge in Mendocino County. (01-MEN-001-PM 033.7)



Renderings of decorative pedestrian rail for use on outside of bridge (top) and 42-inch-high vehicular/bicycle rail for use between sidewalk and roadway (bottom).



Looking east from ocean toward U.S. 101 in Ventura County. Rendering of 48-inch-high pedestrian rail / walkway-bikeway / California ST-10 Bridge Rail with 54-inch-high access control rail. La Conchita project (07-VEN/SB-101).



Looking south along combination walkway-bikeway (ocean side of U.S. 101 in Ventura County). Rendering of 48-inch-high pedestrian-bicycle rail on the right and California ST-10 Bridge Rail with 54-inch-high access control rail on the left. La Conchita Project (07-VEN/SB-101).

California ST-20S Bridge Rail

Description

See-through 5-bar curb-mounted steel bridge rail.

Dimensions

54 inches above bridge deck (48-inch steel rail plus 6-inch curb).

Comments

The 54-inch-high California ST-20S Bridge Rail is 12 inches higher than the minimum required bicycle rail or pedestrian rail height of 42 inches. Clear openings are in conformance for bicycle rail.

Reference

Bridge Standard Detail Sheets (XS Sheets) / Section 16, Barriers and Railings

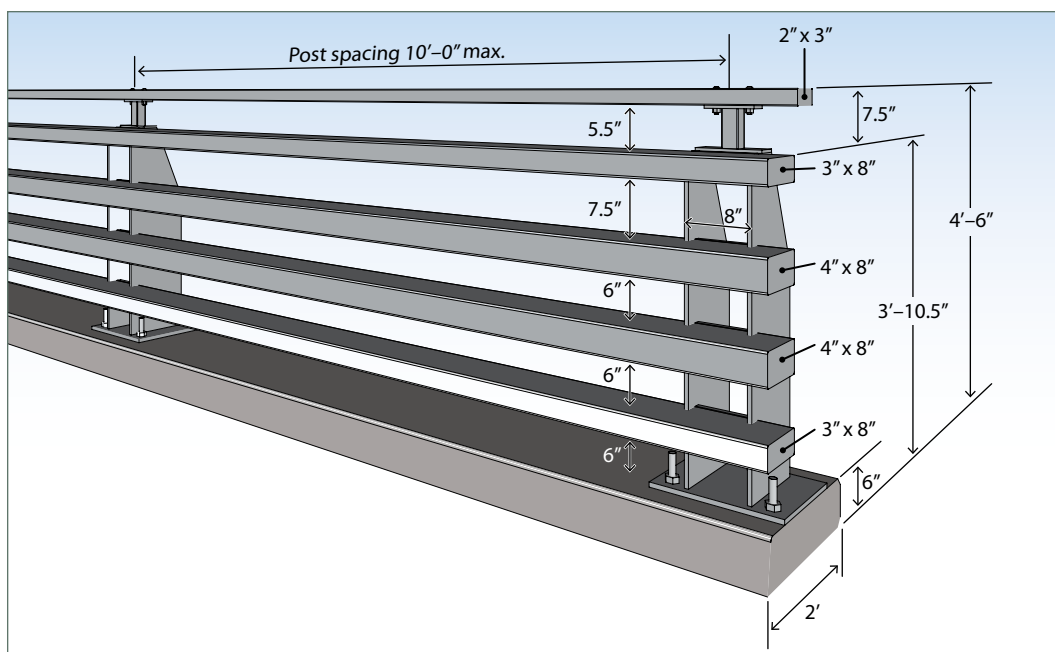
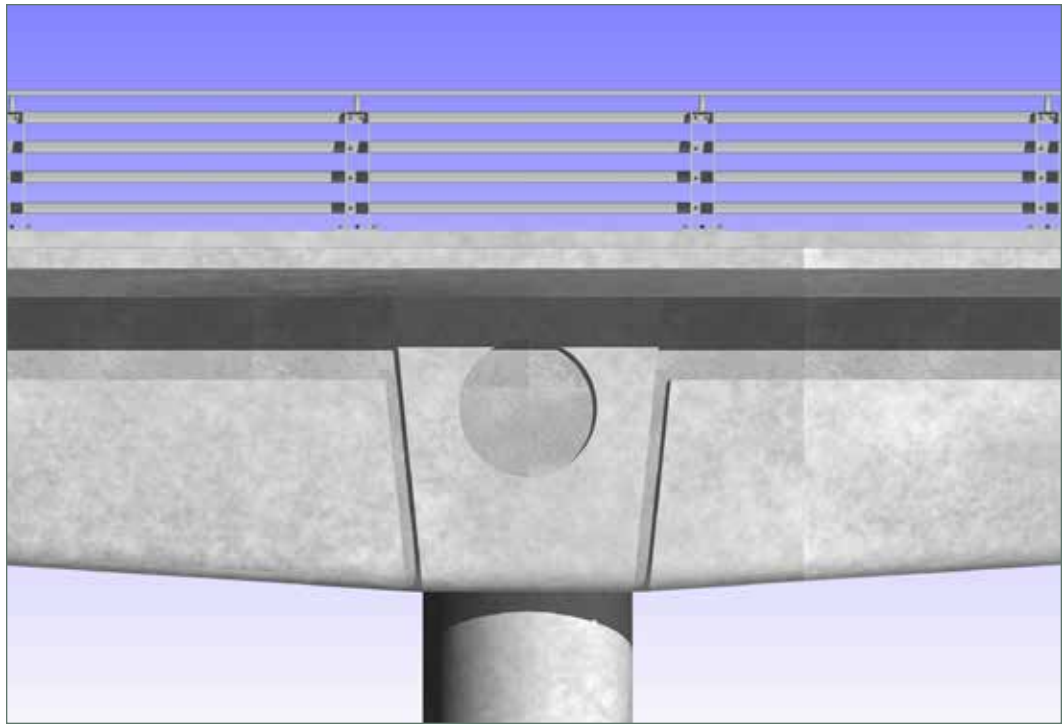




Photo of California ST-20S Bridge Rail painted green at Van Duzen River Bridge in Humboldt County. (01-HUM-101-PM 056.8)



Exterior view of above.



Exterior concept rendering of a proposed alternative California ST-20S Bridge Rail, Ten Mile River Bridge in Mendocino County. (01-MEN-001-PM R069.7)

California ST-30 Bridge Rail

Description

See-through two-bar curb-mounted steel bridge rail.

Dimensions

32 inches above bridge deck (25-inch steel rail plus 7-inch curb).

Comments

For use as a pedestrian/bicycle rail, the ST-30 requires addition of a steel rail behind the vehicular rail to increase height to a minimum of 42 inches, as well as modification of the clear openings. Addition of pedestrian/bicycle rail structures can create aesthetic issues.

Reference

Standard Plans / Bridge Metal Rail Barriers

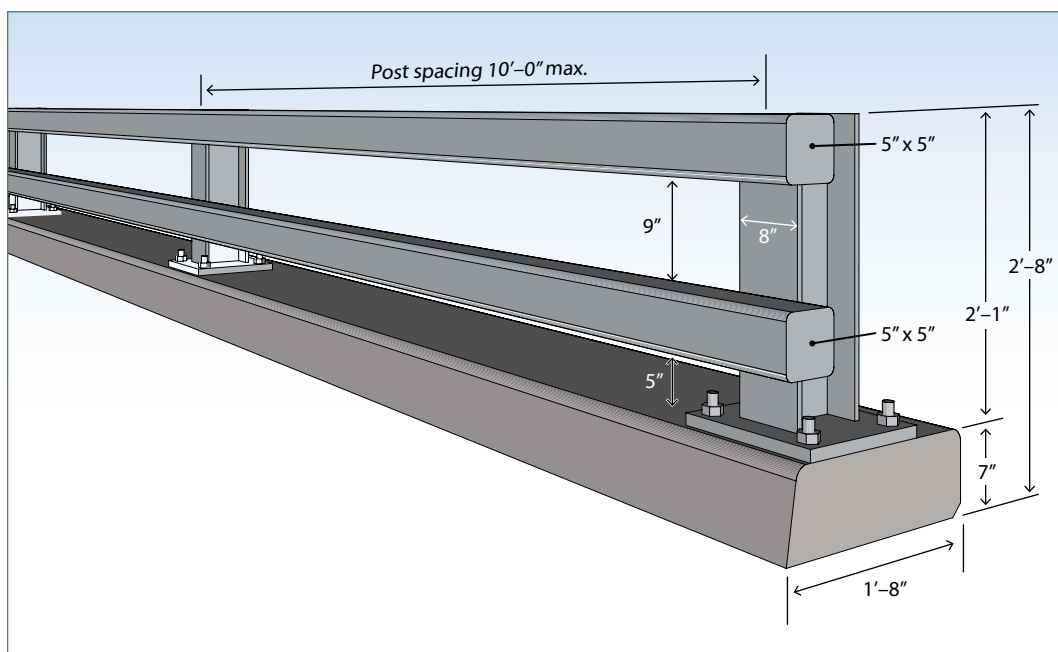




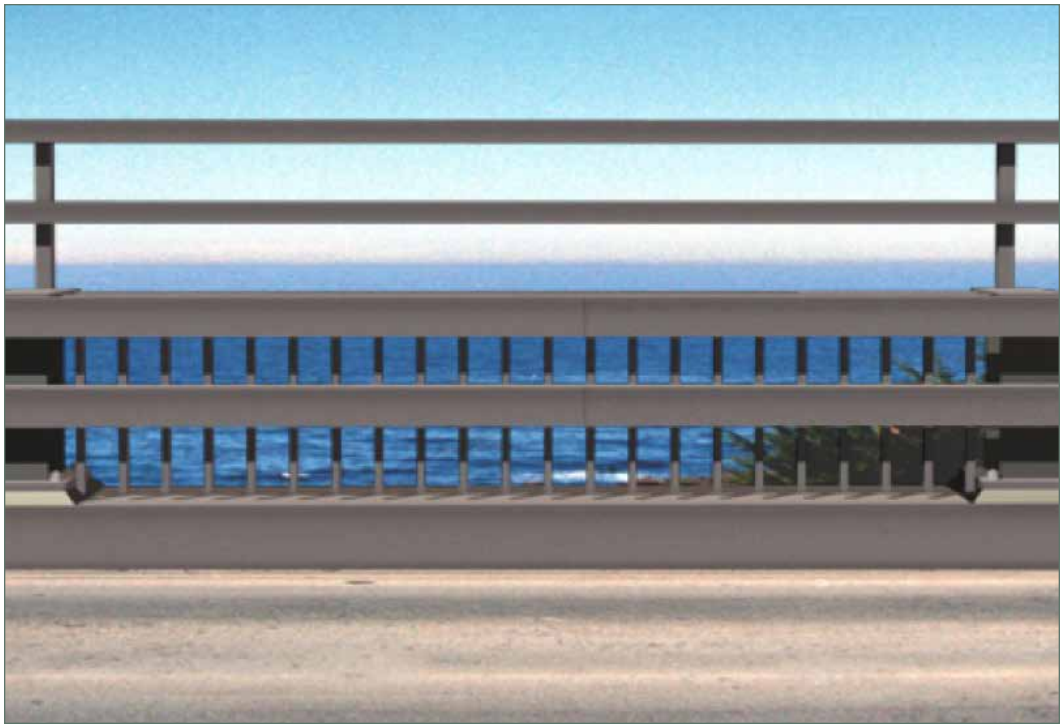
Photo of interior view of California ST-30 Bridge Rail at the South Fork Dibble Creek Bridge in Tehama County. (02-TEH-036-PM 39.0)



Photo of interior view of California ST-30 Bridge Rail at the South Fork Dibble Creek Bridge in Tehama County. (02-TEH-036-PM 39.0)



Photo of exterior view of California ST-30 Bridge Rail at the South Fork Dibble Creek Bridge in Tehama County. (02-TEH-036-PM 39.0)



Rendering of 54-inch-high California ST-30 Bicycle Rail--a proposed alternative for Noyo River Bridge in Mendocino County. (01-MEN-001-PM 060.2)

California ST-70 Bridge Rail

Description

See-through 4-bar curb-mounted steel bridge rail.

Dimensions

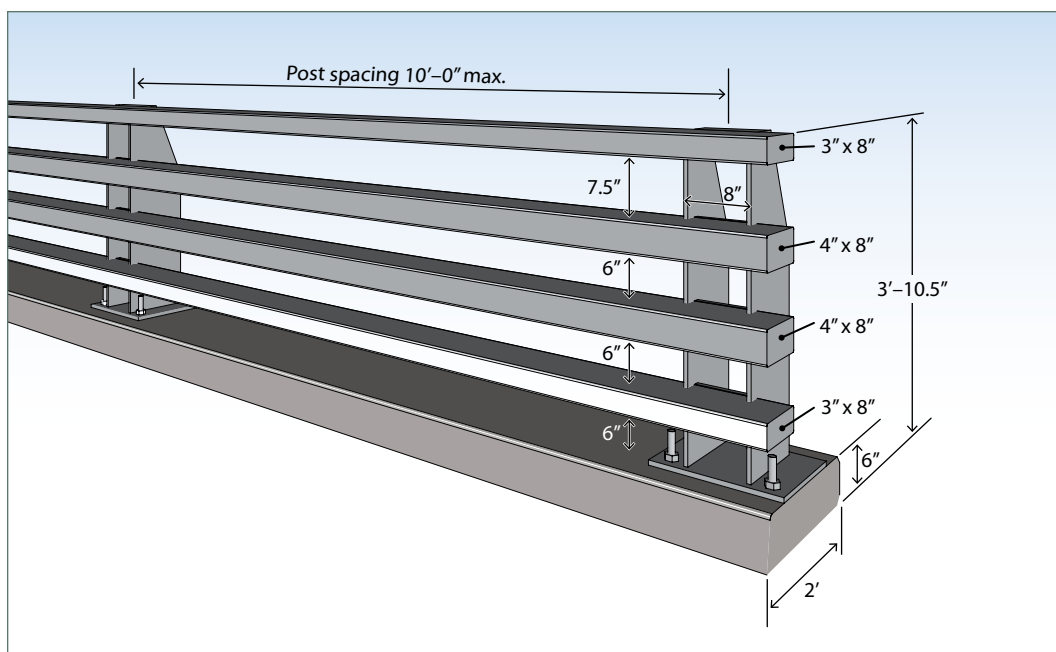
46.6 inches above bridge deck (40.5 inch steel rail plus 6 inch curb).

Comments

The 46.5-inch-high California ST-70 Bridge Rail is 4.5 inches higher than the minimum required bicycle rail or pedestrian rail height of 42 inches. Clear openings are in conformance for bicycle rail.

Reference

Bridge Standard Detail Sheets (XS Sheets) / Section 16, Barriers and Railings



Concrete Barrier Type 80



Description

See-through concrete barrier.

Dimensions

32 inches above bridge deck.

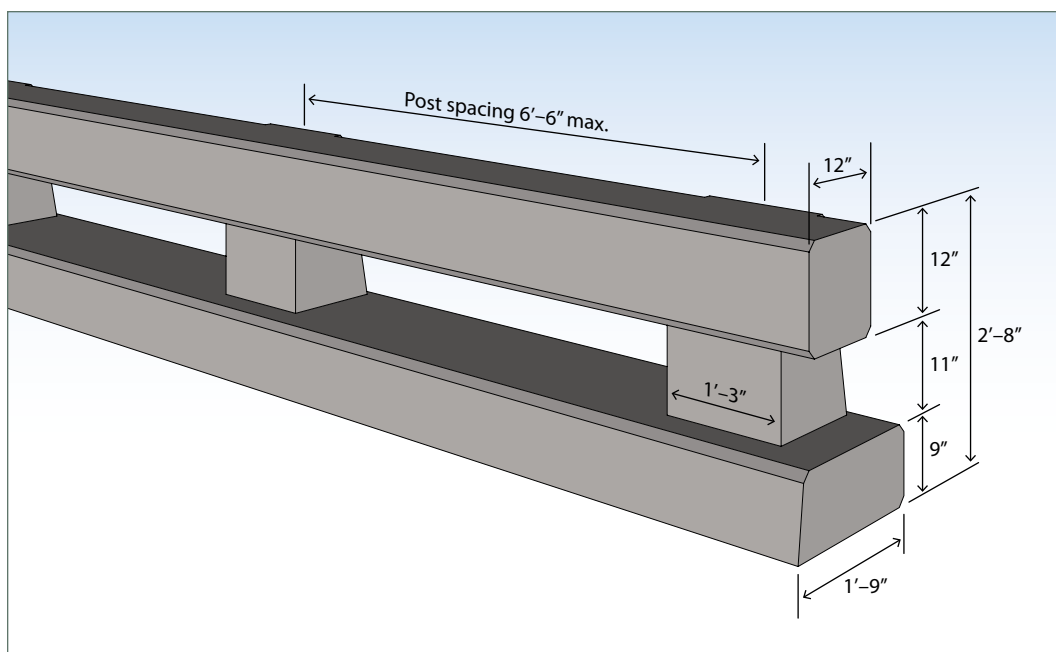
Comments

For use as a pedestrian/bicycle rail, the Concrete Barrier Type 80 requires addition of a steel rail attached to the back of the concrete posts to increase height to 42 inches, as well as modification of the clear opening. Addition of pedestrian/bicycle rail structures can create aesthetic issues.

Reference

Standard Plans / Bridge Concrete Barriers

 Approved for past projects in the Coastal Zone.





Rendering of Concrete Barrier Type 80 modified with architectural treatment.



Photo of Concrete Barrier Type 80 modified with color treatment. Sheffield Drive Bridge, Santa Barbara County. (05-SB-101-PM 009.0)



Photo of Concrete Barrier Type 80 with architectural color treatment. Sheffield Drive Bridge Demonstration Project, Santa Barbara County. (05-SB-101-PM 009.0)



Exterior view of Concrete Barrier Type 80 with architectural treatment and modified bicycle railing at Canal Street Bridge at Highway 49/50 junction in Placerville, El Dorado County. (03-ED-050-PM 017.52)



Photo of Concrete Barrier Type 80 with 54-inch-high bicycle rail offset 15" from rail face on the completed Devil's Slide Bridge at North end of Devil's Slide Tunnel in San Mateo County. (04-SM-001-PM 39.66)



Photo of Concrete Barrier Type 80 with architectural treatment and bicycle rail offset 15 inches from rail face on the Bear River Bridge at the Placer/Nevada County line. (03-PLA-049-PM 011.35)



Photo of exterior view of Concrete Barrier Type 80 modified with architectural treatment at Myrtle Creek Sidehill Viaduct in Del Norte County. (01-DN-199-PM 007.32)



Photo of Concrete Barrier Type 80 on barrier moment slab over retaining wall with tribal design architectural texture in Humboldt County. (01-HUM-096)



Concrete Barrier Type 80 on barrier moment slab over retaining wall with tribal design architectural texture in Humboldt County. (01-HUM-096)



View from bridge approach slab of Concrete Barrier Type 80 with architectural treatment and 54-inch-high bicycle rail offset 15 inches from barrier rail face on the Bear River Bridge on the Placer/Nevada County line. (03-PLA-049-PM 011.35)



View from sidehill viaduct bridge deck of Concrete Barrier Type 80 with architectural texture and color at the Myrtle Creek SideHill Viaduct in Del Norte County. (01-DN-199-PM 007.32)



Photo of Concrete Barrier Type 80 modified with color, 54-inch-high bicycle rail, and lower clear opening size reduced for bicycle traffic on the Forest Boundary Viaduct in Monterey County. (05-MON-001-PM 001.49)



Photo of Concrete Barrier Type 80 modified with architectural treatment and 54-inch-high bicycle rail offset 15 inches from barrier rail face on the Bear River Bridge on the Placer/Nevada County line. (03-PLA-049-PM 011.35)



Exterior view of Concrete Barrier Type 80 with custom 54-inch-high bicycle rail on the Devil's Slide Bridges on the north end of the Devil's Slide Tunnel. (04-SM-001-PM 39.66)



Rendering of Concrete Barrier Type 80 in an unspecified location with an alternative 54-inch-high bicycle rail and alternative design for reducing lower clear opening in concrete to conform to bicycle requirements.

Concrete Barrier Type 90

Description

Concrete barrier with see-through steel rail on top.

Dimensions

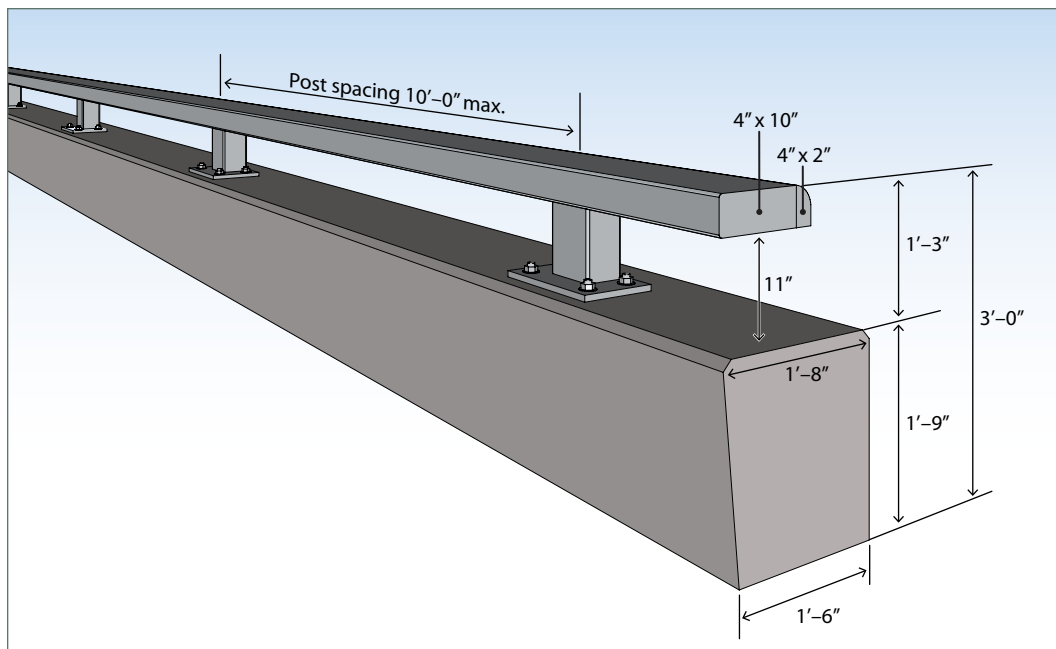
32 inches above bridge deck.

Comments

For use as a pedestrian/bicycle rail, the Concrete Barrier Type 90 requires addition of a steel rail behind the vehicular rail to increase the height to a minimum of 42 inches, as well as modification of the clear openings. Solid lower barrier may create light/visibility or wildlife connectivity issues.

Reference

Bridge Standard Detail Sheets (XS Sheets) / Section 16, Barriers and Railings





Concrete Barrier Type 90.



Concrete Barrier Type 90.



Concrete Barrier Type 90. As of June 2011, this new bridge barrier type had not been used on a bridge. Photos are from the crash test site; consequently, there are no full-height concrete anchor blocks at the ends of the barrier.

TL-2 Rails and Barriers

TL-2 railings and barriers are required on bridges with posted speed limits equal to or less than 45 mph. Examples of the facility types listed below are shown in this section.

- ▶ **California ST-40 Bridge Rail**.....See-through four-bar steel bridge rail with integral raised concrete sidewalk
 - ▶ **Concrete Barrier Type 80SW**.....See-through concrete barrier with integral raised concrete sidewalk
-

California ST-40 Bridge Rail

Description

See-through four-bar sidewalk-mounted steel bridge rail.

Dimensions

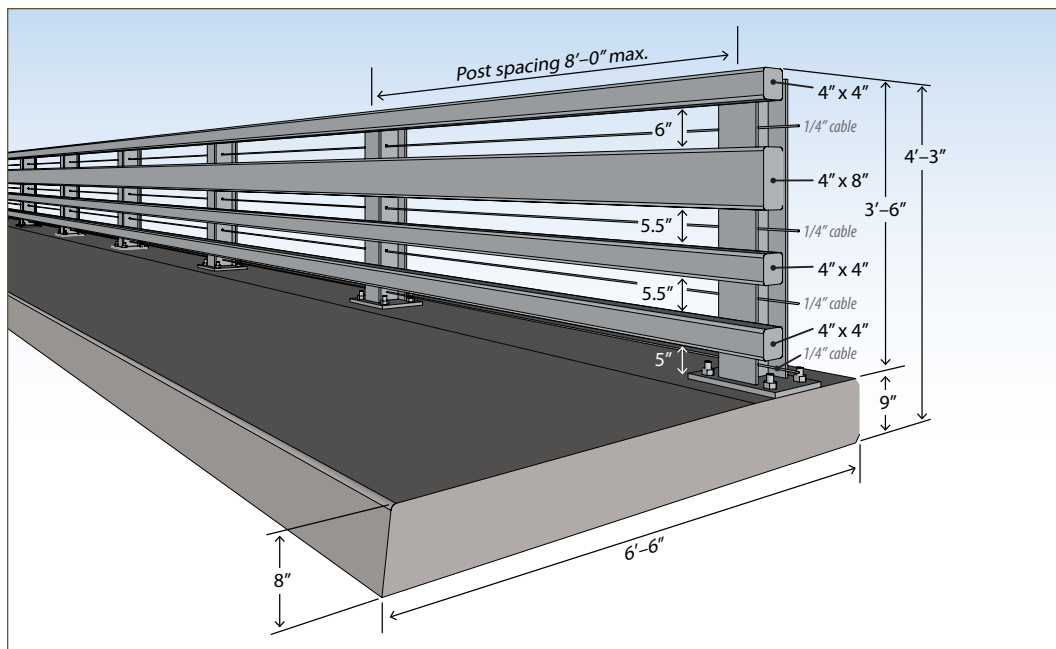
42 inches above sidewalk. 8-inch-high sidewalk/curb next to traffic (9 inches at edge of deck).

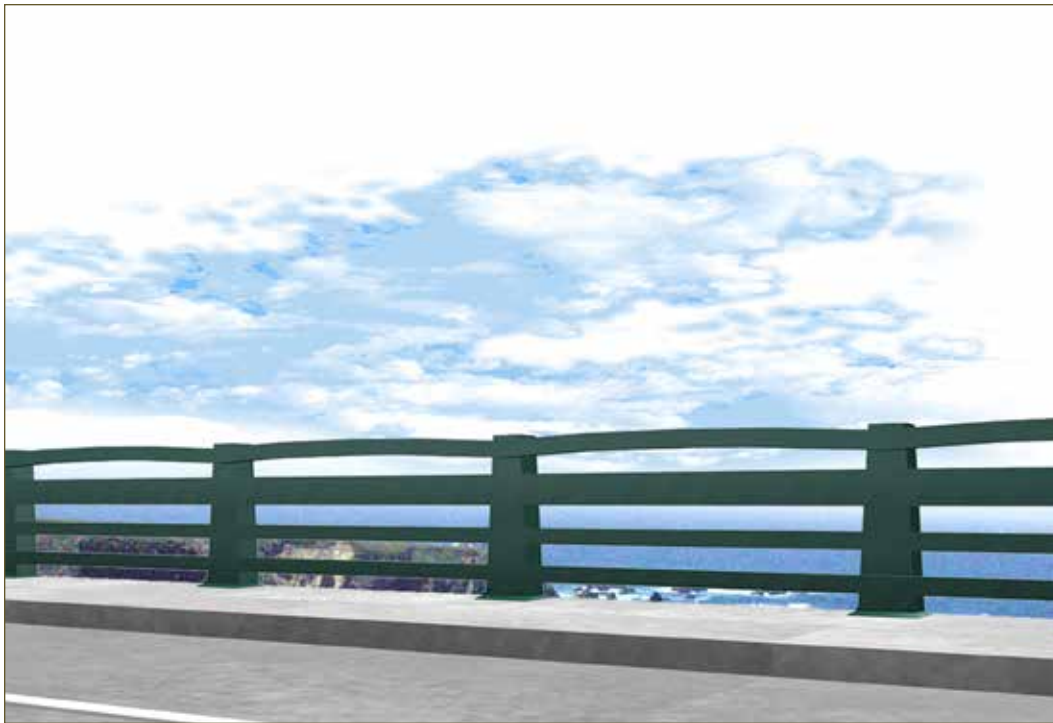
Comments

Cannot be used on bridge decks with vehicular traffic signed for more than 45 mph. For use as a pedestrian rail, the California ST-40 Bridge Rail requires modification of clear openings with cables (shown below) or bars.

Reference

Standard Plans / Bridge Metal Rail Barriers





Rendering of California ST-40 Bridge Rail modified with arched top bar and vertical posts that flare from top to bottom. This was one of the alternatives proposed, but not chosen, for the coastal side of the Noyo River Bridge in Mendocino County. (01-MEN-001-PM 060.2)



Rendering of California ST-40 Bridge Rail modified with arched top bar and vertical posts that flare from top to bottom. This is one of the bridge rail alternatives that was considered for the Noyo River Bridge in Mendocino County. (01-MEN-001-PM 060.2)

Concrete Barrier Type 80SW

Description

See-through concrete barrier with a raised sidewalk.

Dimensions

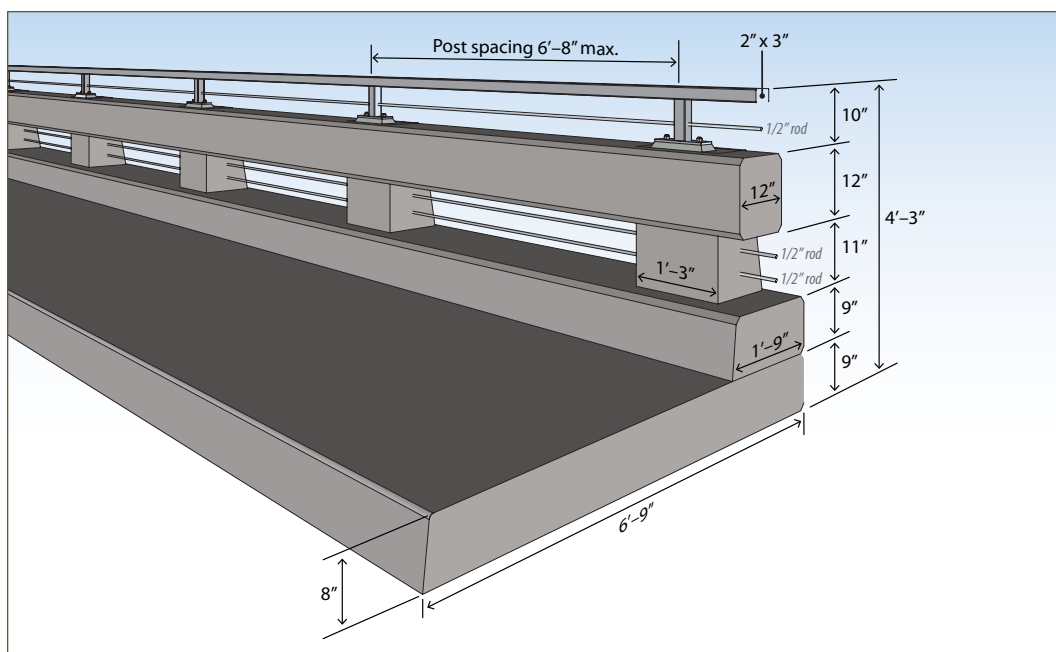
42 inches above sidewalk (32-inch-see-through concrete barrier plus 10 inches of handrail).
8-inch-high sidewalk/curb next to traffic (9 inches at edge of deck).

Comments

Cannot be used on bridge decks with vehicular traffic signed for more than 45 mph. Pedestrian rail is mounted directly on concrete barrier.

Reference

Standard Plans / Bridge Concrete Barriers





Rendering of a proposed alternative Concrete Barrier Type 80SW on the Noyo River Bridge in Mendocino County. (01-MEN-001-PM 60.2)

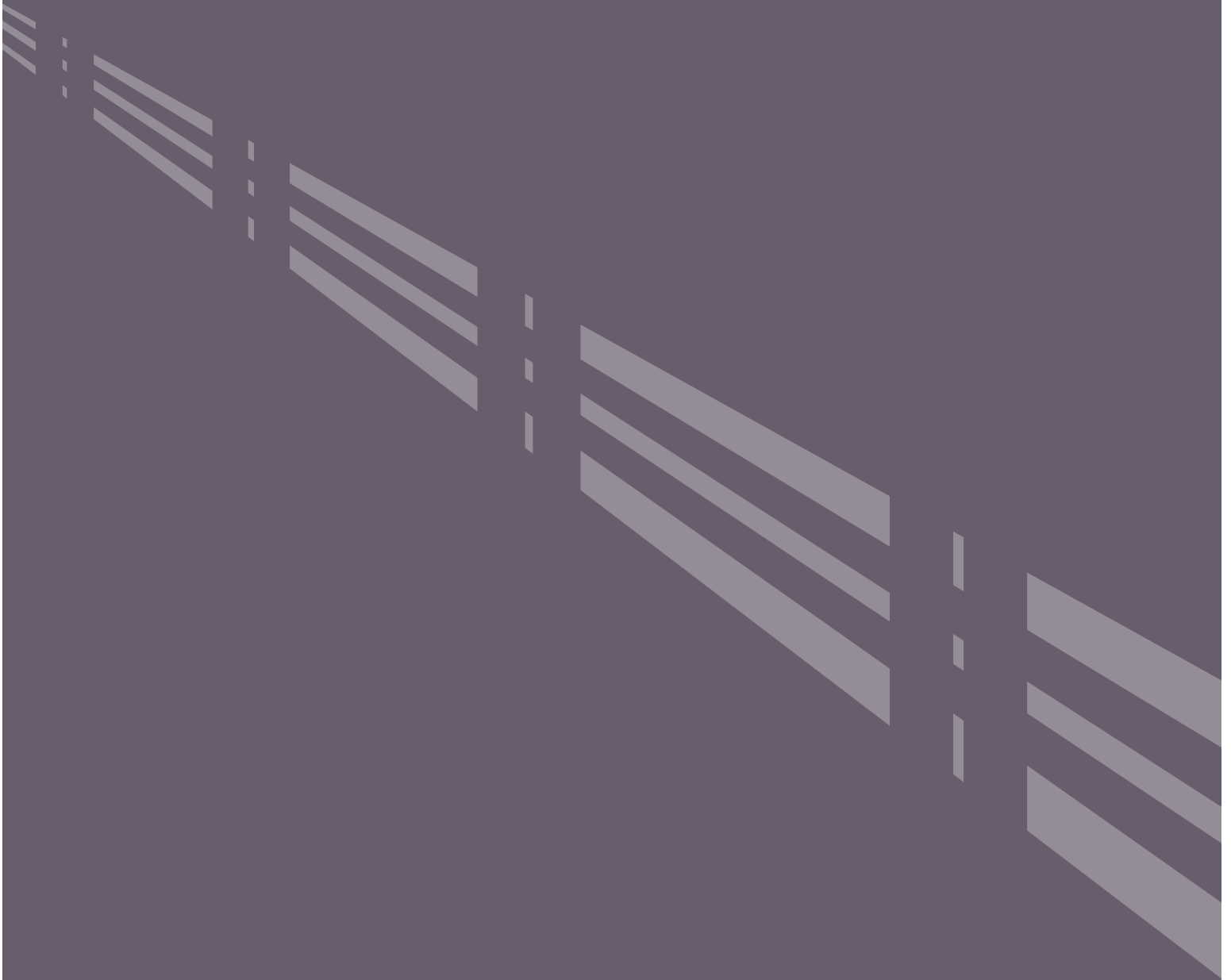


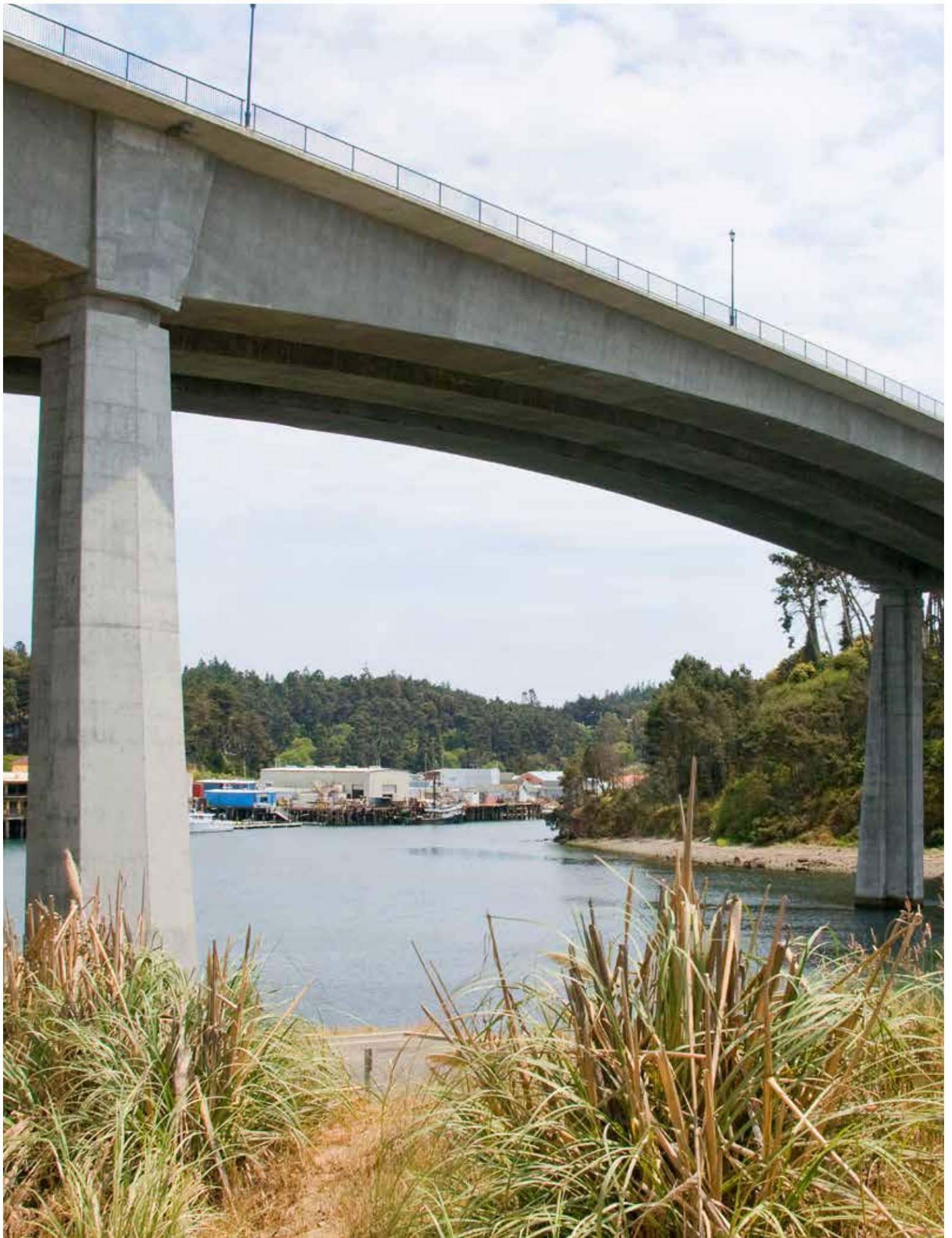
Interior view of Concrete Barrier Type 80SW with architectural treatment and modified pedestrian railing at the Canal Street Bridge at the Highway 49/50 Junction in Placerville, El Dorado County. (03-ED-050-PM 017.52)



Exterior view of Concrete Barrier Type 80SW with architectural treatment and modified pedestrian railing at the Canal Street Bridge at the Highway 49/50 Junction in Placerville, El Dorado County. (03-ED-050-PM 017.52)

Reference Material





Reference Material

1. FHWA, AASHTO and Other

1A. AASHTO LRFD Bridge Design Specifications, 4th Edition [US Customary Units], Section 13 –Railings (with CA Amendments, Section 13 -Railings, see reference 2C below)

1B. MASH (Manual for Assessing Safety Hardware, 1st Edition, by AASHTO, 2009):
(https://bookstore.transportation.org/Item_details.aspx?id=1539)

1C. NCHRP Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features (by FHWA/TRB, published by National Academy Press, 1993):
(http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_350-a.pdf)

2. Caltrans (<http://www.dot.ca.gov>)

2A. Construction Contract Standards: (<http://www.dot.ca.gov/hq/esc/oe/standards.php>)

- Standard Plans.
 - Bridge/ Chain Link, Cable and Tubular Hand Railings
 - Bridge/ Bridge Concrete Barriers
 - Bridge/ Bridge Metal Rail Barriers
- Standard Specifications.
 - Sec. 83 Railings and Barriers
- SSPs.

2B. Highway/Roadway Design:

- Highway Design Manual (HDM):
(<http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm>)
 - Chapter 200 –Geometric Design and Structure Standards
 - Ch.200/ 208.10 –Bridge Barriers and Railings
- Design Information Bulletins (DIBs):
(<http://www.dot.ca.gov/hq/oppd/dib/dibprg.htm>)
 - DIB 82-04, Pedestrian Accessibility Guidelines for Highway Projects (12/01/2010)
- Highway Barrier Aesthetics:
(http://www.dot.ca.gov/hq/LandArch/barrier_aesthetics/index.htm)
- Context Sensitive Solutions: (<http://www.dot.ca.gov/hq/oppd/context/index.htm>)

2C. Caltrans Bridge Design: (<http://dot.ca.gov/hq/esc/techpubs/#design>)

- CA Amendments to AASHTO LRFD Bridge Design Specifications. 4th Edition:
(http://www.dot.ca.gov/hq/esc/techpubs/manual/bridgemanuals/ca-to-aashto-lrfd-bds/caalbds_v4.html)
- Bridge Design Details Sheets (aka XS Sheets):
(<http://www.dot.ca.gov/hq/esc/techpubs/manual/bridgemanuals/bridge-standard-detail-sheets/>)
 - Section 16 –Barriers and Railings
 - Section 15 –Sound Walls (some details with sound walls on barrier rail)
 - Section 14 –Retaining Walls with Sound Walls (some details with sound walls on barrier rail on retaining walls)
 - Section 13 –Mechanically Stabilized Embankment Walls (some details with barrier rail [with & without sound wall mounted on top] on a barrier moment slab over a wall)
- Memos-To-Designers/ Section 14 -Railings and Barriers:
(<http://www.dot.ca.gov/hq/esc/techpubs/manual/bridgemanuals/bridge-memo-to-designer/bmd.html>)

3. California Coastal Commission: (<http://www.coastal.ca.gov>)

