Attachment I

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California Department of Transportation

CALTRANS DISTRICT 5
50 HIGUERA STREET | SAN LUIS OBISPO, CA 93401-5415
(805) 549-3101 | FAX (805) 549-3329 TTY 711
www.dot.ca.gov

March 6, 2024

Mr. Craig Spencer
County of Monterey
Housing and Community Development
1441 Schilling Place South 2nd Floor Salinas, CA 93901

Dear Mr. Spencer:

Thank you for meeting with the Garrapata Creek Bridge Rail Replacement project development team (PDT), on February 7, 2024. At the meeting you requested a memo from the Department to provide clarification and address recurring questions from both the Monterey County Planning (MCP) and the California Coastal Commission (CCC). This memo serves to 1) highlight information that has previously been documented in the project's CEQA document and Coastal Development Permit Process and 2) further clarify details specific to the design of the bridge rail and the standards it must adhere to. The PDT has included CCC in all project meetings with MCP for the past several years, as well as meetings with the Aesthetic Design Advisory Committee (ADAC) which was developed by the Department for transparency and in the event that the Coastal Development Permit was denied by Board of Supervisors and appealed to CCC. The ADAC was comprised of local agency representatives and community citizens including an architectural historian, architects, business owners, residents, and Department project team members, and several 2-hour workshop meetings were held.

Finally, included with this memo are supporting documentation and letters of support for the Department's rail replacement project. The information provided below and documents attached are specific to several key points that have been discussed during the Coastal Development Permit process.

Design Exception Process – Not Applicable to Bridge Rail Replacement:
The County had asked Caltrans to summarize the design exception process. It should be noted, for bridge rail replacement types, a design exception could be granted by the State Bridge Engineer, but both the current and former State Bridge Engineer stated that they would not grant an exception to bridge design specifications for rail opening size or barrier shape that could provide snag points.

The Department processes design exceptions (or "Design Standard Decision Document" [DSDD]) only for non-standard features such as lane width, shoulder width, side slopes, sight distances, etc. When applicable, design exceptions are at the discretion of the Project Engineer based on project circumstances or needs. However, bridge rail type is *not* part of the DSDD process.

What the Department is proposing is a bridge railing that was custom designed for this location and was approved based on standardized crash tests and studies that meet State and Federal safety standards and specifications, including MASH compliance. The Manual for Assessing Safety Hardware (MASH) presents uniform guidelines for crash testing permanent and temporary highway safety features and recommends evaluation criteria to assess test results. Again, both the current and former State Bridge Engineers stated that the design exception would not be granted for this bridge rail replacement.

There have been comments regarding potential design exceptions in other states regarding bridge rail replacements. As noted, there are design exceptions for some non-standard features. The Department is not aware of any state that has replaced a MASH standard bridge rail *on a state highway* with a design that includes clear openings larger than 6 inches that does not include a bar through it (i.e. in the state of Oregon a bridge rail exists with two horizontal bar through the middle of window opening).

Crash Information:

Between 2013 and 2023 a total of eight crashes have been reported on and adjacent to the bridge. During this period, five crashes involved injury. In the same 10-year time period, 921 lane departure crashes occurred on Highway 1 (SLO County Line to Point Lobos) resulting in 407 fatal+injury crashes. A total of 24 people died and 532 people were injured for lane departure crashes. Lane departure crashes can be left or right of the traveled lane. Modern bridge rail design aims to redirect lane departures to keep vehicles on the highway as opposed to the road, creek, or canyon they are crossing over. Please see attached letters of support from CHP and State Parks.

Bridge Rail Window Dimension Requirements:

Bridges in California and in all of the United States are currently designed per AASHTO (American Association of State Highway and Transportation Officials) LRFD-BDS (Load and Resistance Factor Design - Bridge Design Specifications).

Section 13 of the AASHTO LRFD-BDS, Article 13.8.1 Pedestrian Railing "Geometry" and Article 13.9.2 Bicycle Railing "Geometry" states that clear openings cannot allow a 6-inch sphere to pass in the lower 27-inch of bridge rail height, and above 27-inch height clear openings must not allow an 8-inch sphere to pass. This clear opening requirement must be adhered to within a bridge rail, bicycle railing, or pedestrian railing wherever bicycle traffic and/or pedestrian traffic is present. Both the current and former State Bridge Engineers cite that no design exception would be granted for this bridge rail replacement.

Adherence to Industry Standards:

In addition to the proposed Type 86H rail (and the 10 design variation options based on Type 86H) meeting AASHTO LRFD-BDS standards and specifications, such as concrete cover spacing from steel reinforcement, spacing and placement of steel reinforcement elements from each other, the Type 86H rail was designed per AASHTO-CA BDS-8 including Finite Element Analysis, then crash tested per MASH 2016 Test Level 4 (TL-4). Reference: *User Guide to Bridge Standard Detail Sheets, Section 16 – Barriers and Railings Concrete Barrier Type 86H: <https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/bridgestandarddetails/chap-16/202401-xs-16-127-ug-a11y.pdf>.*

Character Defining Features:

The character-defining features of the historic Big Sur Arch Bridges that were identified in the determinations of eligibility for the National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR) are the following:

- Open spandrel arch rib design
- Use of reinforced concrete
- Concrete T-beam approach spans
- Bridge deck and cantilevered walkways
- Bents
- Abutments
- Concrete railings with arched window design

The proposed bridge rail was designed to meet safety standards but also maintain the character defining concrete railings with arched windows. With input from the ADAC, the PDT further refined the Type 86H rail to incorporate chamfered edges as requested by the ADAC after Division of Engineering Services (DES) Architecture presented artist renderings of different edge options.

The view in the current rail configuration is currently blocked by the existence of the temporary guardrail section attached to the bridge rail. The bridge rail view will not be restored until the bridge rail is replaced thus allowing for the removal of the attached guardrail section.

If you have any additional comments or would like to hold a meeting, please reach out to Lucas Marsalek, Environmental Manager at Lucas.Marsalek@dot.ca.gov Please also find FAQs, links to video and visual simulations of the Type 86H rail and design variations, maps, and more project information at <https://dot.ca.gov/caltrans-near-me/district-5/district-5-current-projects/05-1h800>.

Sincerely,

Peter Hendrix
District 5, Traffic Division Chief

Attachments:
Memo – Rich Foley, current State Bridge Engineer, Division of Engineering Services Chief
Memo – Tom Ostrom, former State Bridge Engineer, Division of Engineering Services Chief
Letter of support – CHP
Letter of support – State Parks
Comparison of steel and concrete volumes of bridge rails

CC:
Philip Angelo, County of Monterey, Associate Planner
Peter Allen, California Coastal Commission
Eric Stevens, California Coastal Commission
Glenn Church, Supervisor District 2
Richard Rosales, D5 Deputy District Director of Program, Project, and Asset Management
Sara von Schwind, D5 Deputy District Director of Maintenance and Operations
David Silberberger, Office Chief of Project Management North
Peter Hendrix, Office Chief of Traffic Safety and Traffic Operations
Kelly McClain, Office Chief of Maintenance, District Bridge Program Advisor
Carla Yu, Project Manager

Lucas Marsalek, Environmental Manager

State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

To: SCOTT EADES
Director
District 5

Date: February 13, 2024

File: 0516000163
05-1H8001
01-MON-63

From: RICHARD FOLEY, Chief *Richard Foley*
State Bridge Engineer
Division of Engineering Services

Subject: **GARRAPATA CREEK BRIDGE RAIL REPLACEMENT PROJECT**

This memorandum reiterates the response by Thomas A. Ostrom in the memorandum titled "Garrapata Creek Bridge Rail Replacement Project" dated March 21, 2023, regarding the question as to whether a design exception would be granted to allow for a larger clear opening in the bridge railings on Garrapata Creek Bridge. As set forth below and as previously stated, the Department of Transportation cannot construct bridge components that violate minimum safety standards set forth in federal and state law and policy, and as such, neither wider openings nor narrower railings than those proposed by the Department may be used in the Garrapata Creek Bridge Rail Replacement Project.

Bridges in the United States are designed in accordance with specifications published by the American Association of State Highway and Transportation Officials (AASHTO). These specifications include the AASHTO LRFD Bridge Design Specifications (AASHTO LRFD-BDS), which provide the **minimum standards** for highway bridge design according to the Code of Federal Regulations. Bridge rail designs must meet the requirements of AASHTO LRFD-BDS, Section 13, which specifies in part that the clear opening between elements shall be such that a 6-inch-diameter sphere shall not pass through the opening. Since this is a safety requirement, a design exception cannot be granted to increase the clear openings in the bridge railing: such exception would violate state and Federal standards and jeopardize public safety

Additionally, all new permanent and replacement bridge railing on the State Highway System must comply with the Manual for Assessing Safety Hardware (MASH). There is no design exception process to grant a waiver for a bridge rail to not comply with MASH criteria. Attached is the MASH implementation memorandum that requires all bridge rails to be MASH compliant.

For questions regarding this memorandum, please contact Joel Magana, Chief, Office of Design and Technical Services, at (916) 952-4345.

Attachment

"Garrapata Creek Bridge Rail Replacement Project" memorandum dated March 21, 2023

"Implementation of the Manual for Assessing Safety Hardware," dated December 23, 2016

c: Ruth Fernandes, Deputy Division Chief, Division of Engineering Services (DES)
Joel Magana, Chief, DES Office of Design & Technical Services (ODTS)
Aiman Malak, Technical Specialist, DES ODTS
Peter Hendrix, District Traffic Safety Engineer, Caltrans District 5
Kelly McClain, Chief, Maintenance Division, Caltrans District 5
Carla Yu, Project Manager, Senior Transportation Engineer, Caltrans District 5
Mitch Dallas, Senior Coastal Resources Specialist, Caltrans District 5

State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

Serious drought.
Help save water!

To: CHIEF DEPUTY DIRECTOR
DEPUTY DIRECTORS
DISTRICT DIRECTORS
DIVISION CHIEFS

Date: December 23, 2016

LHOncutt
From: for STEVE TAKIGAWA
Deputy Director
Maintenance and Operations

for KARLA SUTLIFF
Chief Engineer
Project Delivery

Subject: IMPLEMENTATION OF THE MANUAL FOR ASSESSING SAFETY HARDWARE

This memorandum establishes California Department of Transportation's (Caltrans) timeline for implementation of roadside safety hardware and evaluation of new products under the Manual for Assessing Safety Hardware (MASH), consistent with the Association of State Highway and Transportation Officials (AASHTO) and Federal Highway Administration (FHWA) Joint Implementation Agreement for MASH.

As a matter of practice, FHWA performs a crash worthiness review of roadside safety hardware and when found crash worthy issues a federal aid eligibility letter. Caltrans uses this letter as part of its internal product review process. After December 31, 2016, the FHWA will no longer issue eligibility letters for highway safety hardware not successfully crash tested to MASH. Modifications of eligible highway safety hardware must utilize criteria in the MASH for re-evaluation and/or retesting. Manufacturers must submit new products complying with MASH to Caltrans for review and approval. Caltrans has previously adopted MASH for crash testing internal designs of safety hardware and through this implementation will use only those guidelines to evaluate new products.

Caltrans is adopting the AASHTO/FHWA recommendation to implement MASH for evaluating all new permanent installations and full replacements of roadside safety hardware. Below is the Caltrans implementation schedule of MASH for projects that will be advertised on or after the following dates:

- June 30, 2017: inline w-beam terminals (earlier than AASHTO/FHWA letting date)
- October 31, 2017: w-beam barriers and cast-in-place concrete barriers
  - The Midwest Guardrail System, approved on July 9, 2013, is the Caltrans standard for w-beam barriers and is MASH approved.
- April 30, 2018: Flared w-beam terminals
- October 31, 2018: cable barriers, cable barrier terminals, and crash cushions

- October 31, 2019: bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and all other breakaway hardware.

For temporary work zone roadside safety hardware, including portable barriers, devices manufactured after December 31, 2019, must have been successfully tested to MASH. Such devices manufactured by this date, and successfully tested to NCHRP Report 350, may continue to be used throughout their normal service lives.

After December 31, 2016, Caltrans will no longer evaluate highway safety hardware that has not been successfully crash tested to MASH. Modifications of federal aid eligible highway safety hardware must utilize criteria in MASH for re-evaluating and/or retesting.

Implementation will include these actions:

- Projects on the State highway system with an advertising date on or after the above implementation schedule must use safety hardware that complies with the MASH criteria for all new permanent installations and full replacements.
- New products compliant with MASH must be submitted to the Caltrans New Products Coordinator. Then the Caltrans' Highway Safety Features New Products Committee will evaluate and make recommendations for approval of the new products.

The MASH approved safety hardware devices for Caltrans can be found at:
http://traffic.onramp.dot.ca.gov/safety-devices-approved-products

For questions regarding this process for highway safety features, please contact Duper Tong, Chief, Office of Traffic Engineering at (916) 654-5176 or by email at duper.tong@dot.ca.gov; or for bridge rails, transitions, sign supports and other breakaway hardware, Shannon Post, Chief, Office of Design and Technical Services at (916) 227-8070 or by email at shannon.post@dot.ca.gov.

c: Thomas P. Hallenbeck, Chief, Division of Traffic Operations
Tony Tavares, Chief, Division of Maintenance
Rachel Falsetti, Chief, Division of Construction
Janice Benton, Acting Chief, Division of Design
Michael Keever, Chief, Division of Engineering Services
Jim Appleton, Chief, Division of Research, Innovation and System Information

State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

To: SCOTT EADES
Director
District 5

Date: March 21, 2023

File: 0516000163
05-1H8001
01-MON-63

From: THOMAS A. OSTROM
State Bridge Engineer
Chief
Division of Engineering Services

Subject: **GARRAPATA CREEK BRIDGE RAIL REPLACEMENT PROJECT**

This memorandum is in response to a question as to whether a design exception would be granted to allow for a larger clear opening in the bridge railings on Garrapata Creek Bridge. As set forth below, the Department of Transportation cannot construct bridge components that violate minimum safety standards set forth in federal and state law and policy, and as such, neither wider openings nor narrower railings than those proposed by the Department may be used in the Garrapata Creek Bridge Rail Replacement Project.

Bridges in the United States are designed in accordance with specifications published by the American Association of State Highway and Transportation Officials (AASHTO). These specifications include the AASHTO LRFD Bridge Design Specifications (AASHTO LRFD-BDS), which provide the **minimum standards** for highway bridge design according to the Code of Federal Regulations. Bridge rail designs must meet the requirements of AASHTO LRFD-BDS, Section 13, which specifies in part that the clear opening between elements shall be such that a 6-inch-diameter sphere shall not pass through the opening. Since this is a safety requirement, a design exception cannot be granted to increase the clear openings in the bridge railing: such exception would violate state and Federal standards and jeopardize public safety.

Additionally, all new permanent and replacement bridge railing on the State Highway System must comply with the Manual for Assessing Safety Hardware (MASH). There is no design exception process to grant a waiver for a bridge rail to not comply with MASH criteria. Attached is the MASH implementation memorandum that requires all bridge rails to be MASH compliant.

For questions regarding this memorandum, please contact Joel Magana, Chief, Office of Design and Technical Services, at (916) 952-4345.

Attachment

"Implementation of the Manual for Assessing Safety Hardware," dated December 23, 2016

c: Ruth Fernandes, Deputy Division Chief, Division of Engineering Services (DES)
Joel Magana, Chief, DES Office of Design & Technical Services (ODTS)
Greg Kaderabek, Technical Specialist, DES ODTS
Peter Hendrix, District Traffic Safety Engineer, Caltrans District 5
Kelly McClain, Chief, Maintenance Division, Caltrans District 5
Carla Yu, Project Manager, Senior Transportation Engineer, Caltrans District 5
Mitch Dallas, Senior Coastal Resources Specialist, Caltrans District 5

State of California-Transportation Agency GAVIN NEWSOM, Governor

DEPARTMENT OF CALIFORNIA HIGHWAY PATROL
960 East Blanco Road
831-770-8000
(800) 735-2929 (TT/TDD)
(800) 735-2922 (Voice)

January 24, 2024

File No.: 730.015901

California Department of Transportation
District 5 Division
50 Higuera Street
San Luis Obispo, Ca. 93401

To whom it may concern:

The California Highway Patrol (CHP), Monterey Area, supports the proposed replacement of the Garrapata Bridge Rail, a crucial initiative aimed at ensuring the safety and reliability of Highway 1 travelers. The CHP understands the paramount importance of maintaining and upgrading infrastructure to meet current safety standards.

It has come to the CHP's attention that the reinforced concrete barrier rail posts on Garrapata Bridge have significantly deteriorated along 75% of the left and right barrier rail lengths. The Bridge Inspection Reports have documented severe cracking, unsound concrete, and exposed rusted rebar, raising serious concerns about the structural integrity of the existing railing. Considering these findings, the CHP commends the proactive approach taken by the California Department of Transportation (Caltrans) in proposing this project to upgrade the deteriorating, nonstandard bridge railing to current safety standards. Such initiatives are crucial in enhancing the overall safety and security of our roadways, particularly along the vital corridor of Highway 1.

Ensuring the safety of Highway 1 travelers is a shared responsibility, and collaborative efforts between law enforcement agencies and transportation authorities are instrumental in achieving this goal. The replacement of the Garrapata Bridge Rail aligns with our collective commitment to public safety, and the CHP is confident that this project will contribute significantly to the well-being of the community.

If you have any questions or concerns, contact me at itroxell@chp.ca.gov or (831) 770-8000.

Sincerely,

I. TROXELL, Captain
Monterey Area

Monterey District
2211 Garden Road
Monterey, CA 93940

February 5, 2024

California Department of Transportation
District 5
50 Higuera Street
San Luis Obispo, CA 93401

To whom it may concern:

California State Parks' Monterey District supports the proposed Garrapata Creek Bridge Rail Replacement Project to ensure the safety and reliability of the bridge, which provides vital access to the Big Sur coast. We recognize the importance of maintaining and improving infrastructure to meet current standards.

We understand that portions of the existing rails have developed severe cracking caused by deterioration of the concrete and reinforcing steel, which may pose a hazard to public health and safety. Due to the railing no longer meeting current traffic safety standards, this project is instrumental to ensuring the safety of travelers along the Big Sur coast.

This project aligns with our collective commitment to public safety, and we look forward to its successful completion. Please contact Dan Shaw if you have any questions at Daniel.Shaw@parks.ca.gov or 831-643-6326.

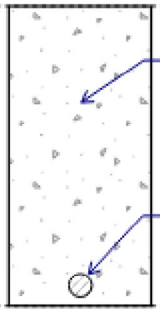
Sincerely,

DocuSigned by:
Brent C Marshall
149638D5E8B9487...

Brent C. Marshall
Monterey District Superintendent

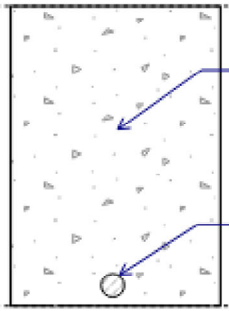
PROGRESSION OF CALTRANS BRIDGE RAIL SAFETY STANDARDS

EXISTING GARRAPATA CREEK BRIDGE
BALLUSTER RAIL



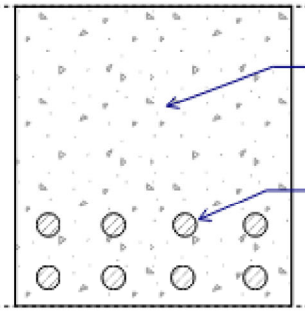
CONSTRUCTED 1931

OLD NOJOQUI CREEK BRIDGE
BALLUSTER RAIL



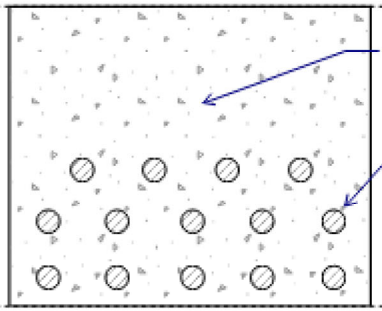
CONSTRUCTED 1956

UPGRADED NOJOQUI CREEK BRIDGE
TYPE 80 RAIL



CONSTRUCTED 2012

NEW STANDARD
TYPE 86H RAIL



TO REPLACE EXISTING GARRAPATA CREEK BRIDGE RAIL

DES
DIVISION OF ENGINEERING SERVICES

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

XS Sheet Numbers

xs16-127-1, xs16-127-2, xs16-127-3, xs16-127-4, xs16-127-5, and xs16-127-6

Description of Component

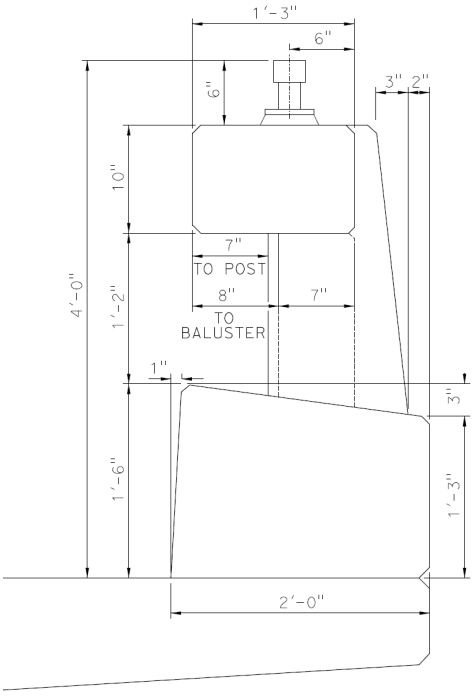


Figure 1 Typical Section of Concrete Barrier Type 86H

Concrete Barrier Type 86H bridge railing

New aesthetic Type 86H is required to comply with the National Historic Preservation Act and for use on projects that may require consultation with the State Historic Preservation Officer (SHPO) in the California Department of Parks and Recreation. Concrete Barrier Type 86H includes an aesthetic component between upper beam and lower beam (curb) composed of concrete balusters and clear openings between balusters that are visually compatible with the open concrete baluster rail seen on many historic bridges. The “H” in Type 86H stands for “Historic” because its most common use will be at locations where the existing structure has a historic designation, or the area is a historic district.

Approved per MASH 2016 (AASHTO Manual for Assessing Safety Hardware)

Concrete Post & Beam see-thru Combination Railing (vehicular/bicycle)

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

Approved for TL-4 high-speed locations (speed limits greater than 45 mph) and can therefore also be used in TL-2 low-speed locations (speed limits equal to or less than 45 mph).

Post and Beam style concrete bridge railing with concrete lower beam (curb) 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.

If a bicycle railing taller than 48 inches is desired (Type 86H is a 42-inch height vehicular rail plus an additional 6-inch height bicycle railing for a total bicycle railing height of 48-inch), then a design modification detail needs to be approved by Technical Specialist for a height up to 12-inches above the top of the concrete vehicular rail can be placed in the same location shown on the plans for the 6-inch height bicycle railing. If a bicycle railing total height taller than 54-inch above shoulder Finish Grade (FG) is desired, then a special designed bicycle railing will be required with a greater offset from the top of the traffic-face of the Type 86H upper beam than shown in the XS sheets. Such special design will need to be reviewed by the Bridge Railing Technical Specialist in the Caltrans, Division of Engineering Services, Office of Design and Technical Services.

Vehicular rail height is 3 feet – 6 inches above the bridge deck or Finish Grade (FG). Bicycle railing height is 4 feet – 0 inches above the bridge deck or Finish Grade (FG). For access-controlled freeways and expressways where bicycle traffic is prohibited by signage on the on-ramps, the bicycle railing mounted on top of the Type 86H vehicular rail may be omitted.

Overall barrier width is 2 feet – 0 inches.

Post spacing is 10 feet – 0 inches maximum.

Standard Drawing Features

All six of the Bridge Standard Detail Sheets must be reviewed by the PDT and any historical committees representing the community for applicability, then pertinent details may be edited as needed for a specific project by the Engineer of Record (EOR) and included in the contract plans:

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

Sheet Number: xs16-127-1

Includes typical railing system and concrete barrier reinforcement. Typical section of the concrete railing on concrete lower beam (curb) with approach and departure concrete transition end blocks

Sheet Number: xs16-127-2

Includes railing system details on top of a wall or trench footing, some transition end block details, and a perspective view.

Sheet Number: xs16-127-3

Includes reinforcement details in the elevation view, and plan views of upper beam and lower beam (curb), and at expansion joint locations.

Sheet Number: xs16-127-4

Includes basic baluster alignment & reinforcement details, plus architectural options for baluster shapes and for shapes at top of clear openings between balusters.

Sheet Number: xs16-127-5

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

Sheet Number: xs6-127-6

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 adopting 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 of shoulder FG.

Design/General Notes

Design Criteria:

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

AASHTO LRFD Bridge Design Specifications 8th edition with California Amendments (AASHTO-CA BDS-8):

Live Loading

- HL 93 and permit design load Vehicular Collision Force
- MASH Test Level 4

Concrete

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

Steel Components for tubular bicycle railing

- 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, retailing 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

For projects located in a corrosive environment, refer to AASHTO-CA BDS-8, Section (5.10) for using epoxy coated rebar and Standard Specifications section 52-2.

Concrete Barrier Type 86H was designed per AASHTO-CA BDS-8 including Finite Element Analysis, then crash tested per MASH 2016 Test Level 4 (TL-4).

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

Crashworthiness:

A link to the site for Vehicular Crash Tests of the Concrete Barrier Type 86H 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 . 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 concrete barrier added on the FHWA list of approved MASH concrete barriers. 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) webpage.

Utilities and Overlays:

Only two 1 ½ inch diameter conduits are permitted in the concrete lower beam (curb) in front of the concrete post reinforcing that extends through the lower beam (curb) as depicted in details. Regarding conduits at the end of bridge or wingwall, see Standard Plans B14-3, ES-9A, and ES-9B.

If an overlay is being added to the bridge deck or approach slab on the same contract that the Type 86H is being constructed, then the concrete lower beam (curb) should be constructed to an additional height equal to the depth of the overlay (not to exceed 2 inches in additional height) so that, after the overlay is placed, the height of the traffic face of the concrete lower beam (curb) is 18 inches above the Finish Grade of the overlay, and the height of the vehicular railing remains 3 feet – 6 inches above the Finish Grade which in this case is measured from the top of the overlay instead of the concrete bridge deck. Plan notes are needed for lengthening lower beam (curb) stirrups and post reinforcement when overlay considerations are required during design phase.

If an overlay is planned for an existing bridge deck with an existing Concrete Barrier Type 86H , then consider the following options:

- No overlay.
- Taper the overlay down to the minimum depth permissible for the specific type of overlay and stop at least 3 feet – 0 inches away measured transversely from the traffic side toe of the concrete lower beam (curb) of the Type 86H.
- If an overlay is needed to extend all the way to the lower beam (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 minimum depth that the type of overlay can be placed. Then at that point start to remove surface of the deck shoulder down to the equivalent of the minimum possible overlay depth (as thin as allowable, but not to exceed 1-inch) at the toe of the lower beam (curb) of the Concrete Barrier Type 86H so that that minimum depth of the overlay can be placed all the way to the toe without reducing the 3 feet – 6 inch height measured from the Finish Grade of the overlay. This will minimize the area of deck shoulder that needs some minimal depth of bridge deck surface removal. If this is not possible, then may have to replace the existing bridge railing in conjunction with an overlay placed all the way to the toe of the bridge railing.

- If the shoulder is narrow which leaves little or no distance to taper down the overlay depth, then choose an overlay material that can be applied in the thinnest possible depth section and only remove the minimum area and minimum depth of deck surface close to the toe of the Type 86H in order to preserve the 3 feet – 6 inch height of the existing Concrete Barrier Type 86H vehicular railing and the 4 feet – 0 inch height of the bicycle railing.

When the existing bridge condition does not permit removing a portion of the top of the bridge deck surface for any specified reason, then the overlay options are limited to either no overlay, or no overlay within 3 feet – 0 inches from the toe of the bridge railing, or overlay all the way to the toe of the bridge railing in conjunction with a bridge railing replacement where the height of the bridge rail lower beam (curb) is increased by the equivalent height of the overlay but not to exceed 2 inches whereby the height of the vehicular bridge rail will be the standard 3 feet – 6 inches above the top of the overlay.

Additional Drawings Needed to Complete PS&E

If the Type 86H 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.

If the bicycle railing is needed to be taller than 48-inch in height, then special designed detail drawings will be required and will be placed in the same location shown on the plans for the 6-inch height bicycle railings.

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

Section 16 – Barriers and Railings
Concrete Barrier Type 86H

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 Railing and Barriers, Section 91 Paint.

Restrictions on Use of Standard Drawings

- A special design is required if Concrete Barrier Type 86H is mounted directly to the top of 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, xs13-020-5, and xs13-020-6).
- Sound walls cannot be mounted on the Concrete Barrier Type 86H.
- A special design is required to mount a chain link railing to the Concrete Barrier Type 86H. Chain link railing should only be added to Type 86H 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 Type 85H 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 and due to the existing bridge deck design and deck overhang size, Type 86H may not work as a retrofitted concrete barrier onto an existing bridge without removal and replacement of the existing bridge deck overhang. If the Concrete Barrier Type 86H is desired to be added to an existing bridge and if the additional transverse bridge deck bars required 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, then carbon-fiber-reinforced-polymers (CFRP) near surface mounted deck strengthening needs to be considered. If finite element analysis indicates that the Concrete Barrier Type 86H can be retrofitted onto the existing deck/deck overhang, the analysis may show that CFRP near surface mounted deck strengthening will be required before placement of the concrete barrier. The Concrete Barrier Type 86H 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, or a full design check is done that shows the existing wall design will be adequate for the transfer of vehicular impact loading. The top of the existing wall will need to be removed and replaced with a haunch with adequate reinforcement when the existing wall design can handle the impact

load. If the existing retaining wall is incapable of handling the vehicular impact loading, then either the Concrete Barrier Type 86H will have to be mounted on a concrete barrier moment slab or be mounted on a structure approach slab that extends over the top of the existing retaining wall or wing wall.

- Type 86H was crash tested with the bicycle railing attached (offset 9 inches from the top of the traffic-side of the vehicular railing), and it passed, so per AASHTO-CA BDS-8 (13.9.2) Bicycle Railings, Geometry, the bicycle railing is acceptable without being offset by 15 inches from the top of the traffic-side of the vehicular railing.

Special Considerations

Should use the 42-inch height Type 86H concrete post and beam style (with concrete balusters between concrete posts) vehicular concrete barrier instead of a 36-inch height Type 85 concrete post and beam style (with concrete balusters between concrete posts) vehicular concrete barrier 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) when super-elevation is 6% or greater.
- Where end of bridge rail transitions to meet up with Type 60M (42-inch height) along outside edge of roadway. A special design is required for a transition from Type 86HA to a Type 60M.
- Where end of Concrete Barrier Type 86H on bridge/wingwall/structure approach slab/retaining wall meets up with Concrete Barrier Type 86HB (Concrete Barrier Type 86H on trench footing) beyond end of structure.
- Whenever owner, designer, or stakeholders desire a 42-inch height vehicular bridge rail, for any reason, instead of any shorter bridge rail (36 inches is the minimum height required for MASH TL-4 bridge rails). Whenever owner, designer, or stakeholders desire a vehicular combination bridge rail that already meets the minimum bicycle/pedestrian railing height of 42 inches without a separate bicycle railing added to the top of the vehicular bridge rail.
- If one side of the bridge has a Concrete Barrier Type 86HSW (with 42-inch vehicular rail height [above top of sidewalk] Type 86H parapet mounted on a sidewalk), then the opposite side (if opposite side of bridge does not have a sidewalk) should have a 42-inch vehicular rail height Concrete Barrier Type 86H to match the aesthetics.

- If the existing bridge has a 42-inch or greater height see-through aesthetic concrete baluster bridge rail (that does not meet current standards and/or is damaged or deteriorated), 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 see-through aesthetic concrete baluster bridge rail that meets current standards … then the see-through aesthetic 42-inch vehicular rail height Concrete Barrier Type 86H would be a good option.
- If the specific structure location with associated roadway alignment and profile grade does not require the bicycle railing height to be higher than the required minimum of 42-inches, then the bicycle railing shown in the Bridge Standard Detail sheets mounted on top of the Type 86H can be omitted because the vehicular bridge railing height of 42 inches already meets the minimum bicycle railing height requirement.

Typically, designer should strongly consider using a taller-than-minimum height bicycle railing when there is some combination of these below-listed factors. If the bicycle railing is modified from the standard details shown on the Type 86H Bridge Standard Detail sheets, then a special design with special modified details will be required. But if any one of them is closer to the extreme end for that particular factor, then that factor alone could determine the need for a taller-than-minimum height bicycle railing. The design considerations where a 48-inch or greater height bicycle railing would be strongly recommended are:

- Bridge located on small radius curve in roadway alignment (in relation to the posted speed limit)
- High super elevation (of 6% or more)
- A roadway shoulder that is less than the minimum required width
- If the roadway profile grade is a sustained 3% or more (where sustained is 300 feet or more along the traffic lane)
- If the roadway has frequent conditions of low or impaired visibility (fog, sandstorm, limited sight distance, etc.)
- Located at bottom of T-shaped intersection (for this situation a 54-inch bicycle railing is strongly recommended)
- If local stakeholders and the Caltrans District or local agency have agreed on a taller than minimum bicycle railing height for any reason

Aesthetics:

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Aesthetic see-through concrete barrier such as the Concrete Barrier Type 86H 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.

It's common to customize post-and-beam bridge rails with aesthetic and context sensitive details. Contact the Bridge Railing Technical Specialist in the Caltrans, Division of Engineering Services, Office of Design and Technical Services if a special design is desired.

Regarding aesthetics:

- Balusters can be in multiple shapes (two shapes with either square or chamfered cross-section are shown on the Bridge Standard Detail sheets). Baluster shapes could also be context sensitive special designed and detailed to match or complement some feature on or near the bridge. The designer must choose the baluster shape and show/ note it on the structure plans and delete the remaining baluster shape options and either Section G-G or Section H-H on xs16-127-4 must be deleted as well.
- Clear opening sizes between concrete balusters and between bicycle railing members must comply with AASHTO-CA BDS-8 Section 13.9 Bicycle Railings and Section 13.8 Pedestrian Railing. The Bridge Standard Detail sheet xs16-127-4 shows three standard shapes for the top of the clear openings (gable, squared, and arch). The designer must choose the shape to use for the top of the clear openings and show/ note it on the structure plans and delete the rest of the clear opening shape options. Delete " NOTE: Only one shape option shall be used per structure."
- 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 AASHTO-CA BDS-8.
- Concrete barrier 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 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 barriers, 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). When texture is added to

a concrete post-and-beam bridge rail, the minimum offsets from the upper beam to the posts and from the lower beam (curb) to the posts must both be preserved on the traffic side. If texture is planned for the traffic side of a concrete post-and-beam bridge rail 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.

- There are no restrictions on choice of coating color for the steel elements, except that yellow cannot be used because the Manual on Uniform Traffic Control Devices (MUTCD) reserves that color for the median striping (cannot have a yellow-colored bicycle railing 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.

- The concrete post spacing must be adjusted to have equal post spacing between bridge joints (for example, between BB and EB along the edge of deck or between bents if the bridge is a steel girder bridge or precast girder bridge that results in joints at each bent) which will results in different concrete baluster locations between concrete posts. The goal is to maximize the number of clear openings between concrete posts. The spacing of concrete balusters and clear openings between the concrete balusters must be centered between the concrete posts. The widths of the concrete balusters must be at least 6 inches and should not exceed 6 inches in width unless the desire is to match the width of an existing concrete baluster bridge rail. When the concrete post spacing is adjusted to ensure equal concrete post spacing between bridge joints, then the same adjustment will be required for the bicycle railing post spacing. Due to the length of wing walls and the minimum length of the solid concrete end blocks, the spacing of Type 86HA concrete posts will oftentimes be less than 10 feet and 0 inches.

Fixed objects, such as lighting standards or OH Signs mounted on a bridge, must be placed on a corbel or pedestal on the back side of a post location of the concrete post-and-beam style Type 86H. It's very likely that corbels supporting OH Signs mounted on a bridge will have to locate the corbel at a bent location. Corbel and pedestals 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.

If scuppers are desired/needed then contact the Bridge Railing Technical Specialist by email at DES Design and Technical Services. Also note that deck drainage can only be allowed to drop off the edge of deck by means of scuppers or down-drains if the Environmental Document allows it, and if there are no vehicular lanes/railroad tracks/bicycle path/walkway/or boating waterway directly below.

All project-specific modifications to the Concrete Barrier Type 86H 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.