2.8 BRIDGE ARCHITECTURE AND AESTHETICS

2.8.1 GENERAL

This BDM provides guidance for bridge architecture and aesthetic design features and alternatives. Bridge architecture and aesthetics are guided by basic design principles to ensure the visual character of a bridge and/or roadway structure is pleasing in line, shape, color, and texture that awards inherent beauty to the structure's aesthetic appeal through its functional form and supporting elements.

The goal is to provide the local community and the traveling public with the best context sensitive solutions and outcomes through beautification and cohesive visual identification for each unique corridor. Route corridors within district boundaries, connecting cities and communities for the traveling population, can be uniquely individual to surrounding environments, both natural and man-made, and specific to a community's architecture and cultural history, both past and present.

All new bridge structures, widenings of existing bridges, bridge barrier replacements, seismic retrofitting, retaining walls, and tunnel portals should be reviewed by the Bridge Architecture and Aesthetics Branch. Highly visible structure components are reviewed to ensure that the structure aesthetics comply with the existing route theme. At times, opportunities arise for a new segment route theme or a special design for a non-standard or iconic structure. The Bridge Architecture and Aesthetics Branch, working with design engineers and the district, is responsible for developing new themes and designs of new structures with a goal of beautification, both in historic preservation and futuristic new ideas for aesthetic enhancement of our roadway structures.

Bridge structure components that will be addressed for aesthetics typically include:

- Deck overhangs, girders, soffits, columns, abutments, wing walls, barriers, railing, fencing, lighting, slope paving, adjoining retaining walls, seismic retrofit elements, concrete surface treatment, color, and staining applications.

Roadway structures that can be addressed for aesthetics typically include:

- Retaining walls, barriers, guardrails, lighting, fencing, soundwalls, pilasters, tunnel portals, gateway monuments, concrete surface treatment, color, and staining applications.

2.8.2 DEFINITIONS

Architectural Beauty – The harmony between form and function, the element that gives the design a connection to the human spirit. Many bridges are considered architectural marvels, showcasing innovative design and engineering. Iconic examples like the Bixby

Bridge, the Golden Gate Bridge, or the more recent Devil's Slide Bridge and tunnels, and Pitkins Curve Rock Shed attract visitors for their aesthetic appeal.

Cultural Significance – Bridges often hold historical or cultural importance, serving as symbols of connection between communities.

Inherent Beauty - Inherent beauty refers to the natural, fundamental, and essential qualities that make something beautiful, independent of external influences or opinions.

Visual Character - refers to the visual elements of a structure that are designed to appeal to the users, convey a sense of place, and maintain consistency along a particular route.

2.8.3 BRIDGES

A beautiful bridge makes a minimal impact on the environment and is harmonious with its location. It possesses sound visual character and maintains good proportions both in its integral and spatial components. It is composed of one dominant structural system using a minimum number of bents with minimal columns per bent. Architectural and aesthetic design principles such as balance, scale, movement, repetition, emphasis, and unity are utilized on both the superstructure and substructure to create a visually attractive bridge that achieves the desired appearance.

Visual character relates to the perception people obtain by viewing the structure. It is often influenced by the application of pleasing structural forms. The combination of various expertly integrated forms, whether similar or opposing, can be an effective technique that serves to relieve the monotony of a single long span or continuation of multiple span structures. In addition, through intentional refinement of the most visible lines, a feeling of gracefulness and architectural beauty can be achieved, for example, by using a gentle curve or taper, enhancing the bridge's overall attractiveness, as shown in Figure 2.8.3-1. Longitudinal frames are created through continuity of spans over several bents or piers. Clean lines and absence of clutter are primary objectives. This entails minimizing the number of individual elements in the structure and avoiding disruptive details.

Figure 2.8.3-1 Noyo Bridge Route 1

2.8.3.1 Girders

Girder type plays a major role in the architectural beauty and visual appreciation of the bridge for the community. Cast-in-place box girders or precast concrete girders provide more enhanced architectural treatment opportunities. Cast-in-place box girders are commonly preferred, but when not possible, precast bath-tub girders are preferred for the aesthetics of the structure. Ultimately, whatever type is selected, the goal is to adhere to the corridor theme or other design considerations.

Precast girder types include:

- I girder
- Bulb T
- Wide Flange
- Bath-Tub
- Voided Slab
- Precast Box, Double T (non-standard)

When an established girder type and shape exist along a route segment, it is generally encouraged to replace in kind for bridge widenings and/or bridge replacements to maintain the design integrity as well as route continuity. The exception to that rule would

be the existence of a “Corridor Aesthetic Master Plan” (CAMP), “Aesthetic Master Plan” (AMP), see Section 2.8.13.1 “Aesthetic Treatment Opportunities and Guidance”. All new structures and widenings are to follow the master plan theme.

For shorter span lengths, the girder depth is usually kept uniform throughout the entire length of the bridge. The depth of the box girder may vary gradually in longer bridges to avoid excess depth at short spans. Transitions are usually made over at least a half span length and use graceful curves or shallow tapers.

2.8.3.2 Deck Overhangs

Light and shadow play a major role in aesthetics and contribute to the overall appearance of a structure. In particular, the perceived visual depth or "thinness" of a superstructure can be manipulated by modifying the length of the bridge overhang or shape of the exterior girder to accentuate or subdue the component surfaces. As illustrated in Figure 2.8.3.2-1 and Figure 2.8.3.2-2, the desired result is achieved when the shade of the overhang merges with the shadow of the girder face and is contrasted by the brightness of the barrier face. In addition, there are alternative exterior girder designs as shown in Figure 2.8.3.2-3 and Figure 2.8.3.2-4, which effectively integrate the overhang to soften the shadow line or to keep the exterior girder completely in shadow. Figure 2.8.3.2-2 also illustrates that the visible face of the girder will be sloped with a deck overhang to provide an increased shadowed area.

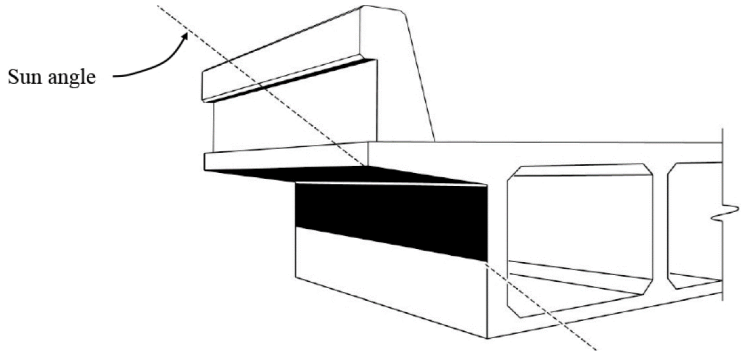


Figure 2.8.3.2-1 Typical Shadow on Box Girder

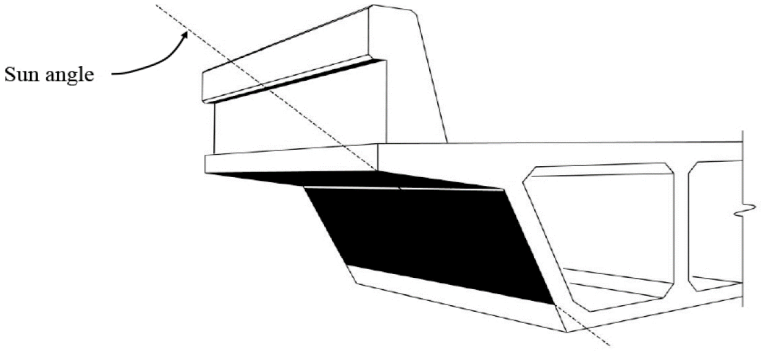


Figure 2.8.3.2-2 Typical Shadow on Sloped Box Girder

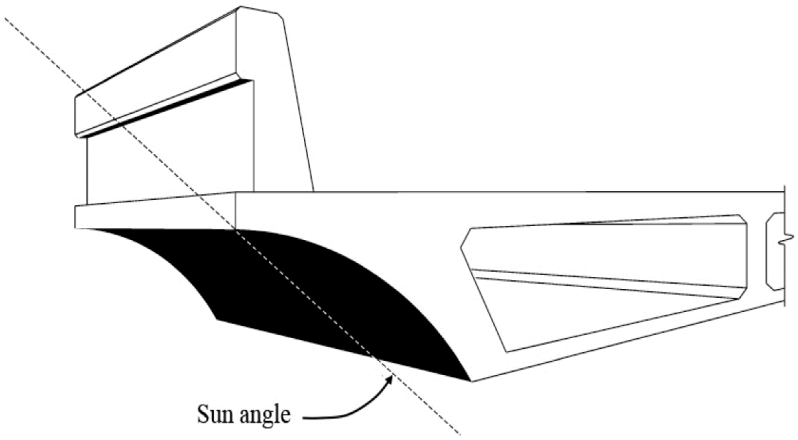


Figure 2.8.3.2-3 Shadow on Concave Hammerhead Box Girder

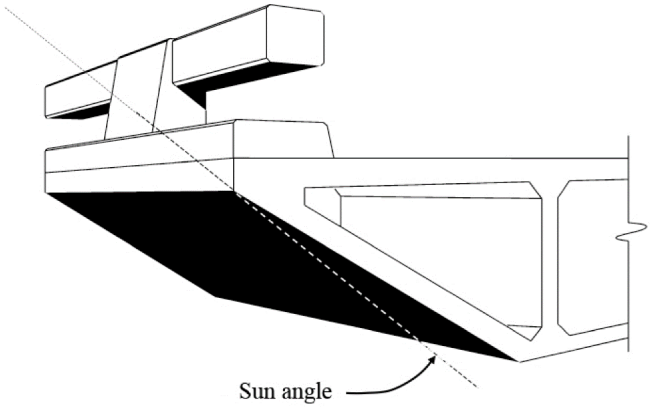
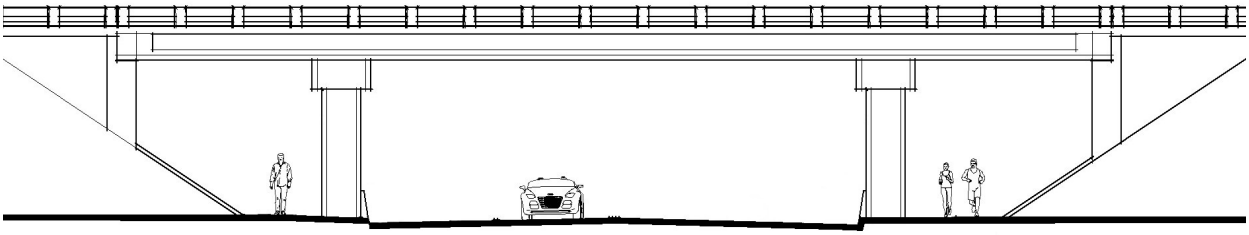


Figure 2.8.3.2-4 Shadow on Sloped Hammerhead Box Girder

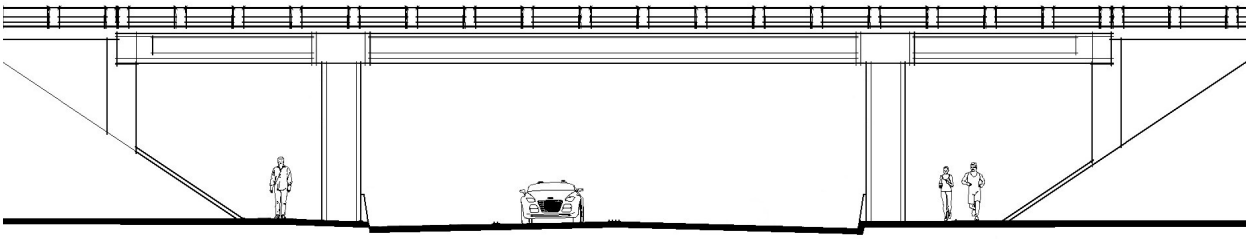
2.8.3.3 Bents, Piers, and Bent/Pier Cap Beams

The location, type, and number of piers/bents needed are determined during preliminary design. During the bridge layout, site conditions and constraints will dictate span lengths and locations of these intermediate supports.

When cap beams at intermediate piers, or bents, are made integral with girders in the same plane, the resulting effect is a continuous flow at the bridge's soffit line from one end of the bridge to the other. This technique emphasizes the horizontal dimension of the structure. The depth of the structure is seen relative to the total bridge length rather than to the individual span lengths. The objective is to make the appearance of the superstructure as slender as possible, as shown in Figure 2.8.3.3-1.



Drop Cap Beam



Integral Cap Beam

Figure 2.8.3.3-1 - Drop Cap Beam vs. Integral Cap Beam

2.8.3.4 Columns

Columns should appear to support the structure as simply as possible. Visual cohesiveness and balanced proportions of structural elements to each other are important. The goal is to balance between the apparent mass of the superstructure and the size of the column. Columns that are too thin will look spindly, and columns that are too thick will look too squat.

Columns Supporting Box Girder Structure

Columns are connected rigidly to the soffit of the superstructure, creating an integral frame. This tends to hide the column underneath the bridge and avoid interrupting the longitudinal flow. The integral connection at the top of the columns is clean without bearings or other discontinuities and adds aesthetic value to the structure.

Standard Columns

Come in a variety of shapes and sizes and are selected through both an engineering and architectural design process. Caltrans standard column types are:

- Type 1 Standard Prismatic (Figure 2.8.3.4-1)
- Type 2 Standard One-Way flare (Figure 2.8.3.4-2)
- Type 3 Standard Two-Way Flare (Figure 2.8.3.4-3)

Column shape in horizontal cross-section is either circular, square, hexagonal, or octagonal, and frequently elongated transversely. Columns can be further widened at the top using a curved flare in the transverse direction. Variations of these standards are considered modified and will be detailed as such.

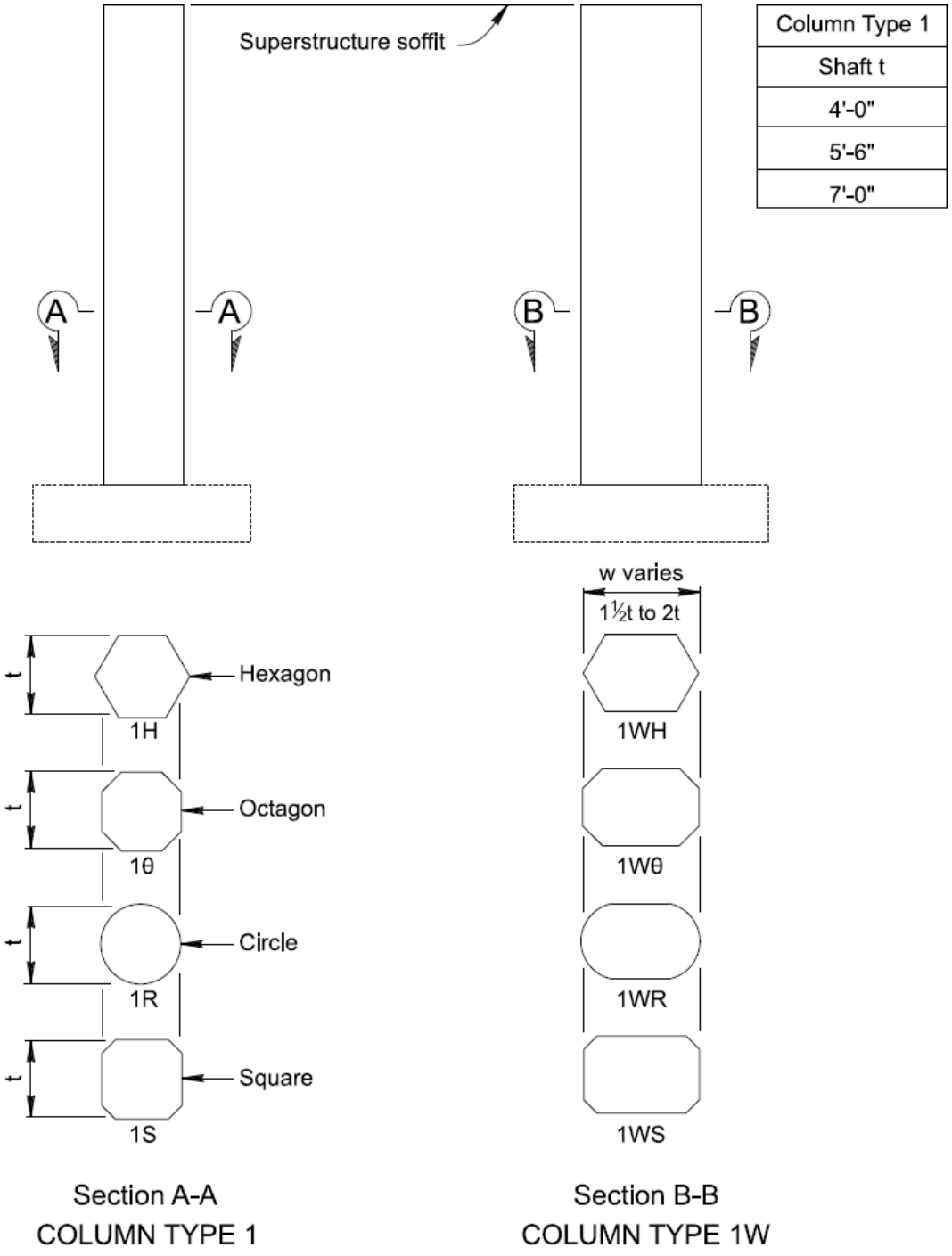


Figure 2.8.3.4-1 Type 1 Standard Prismatic Columns

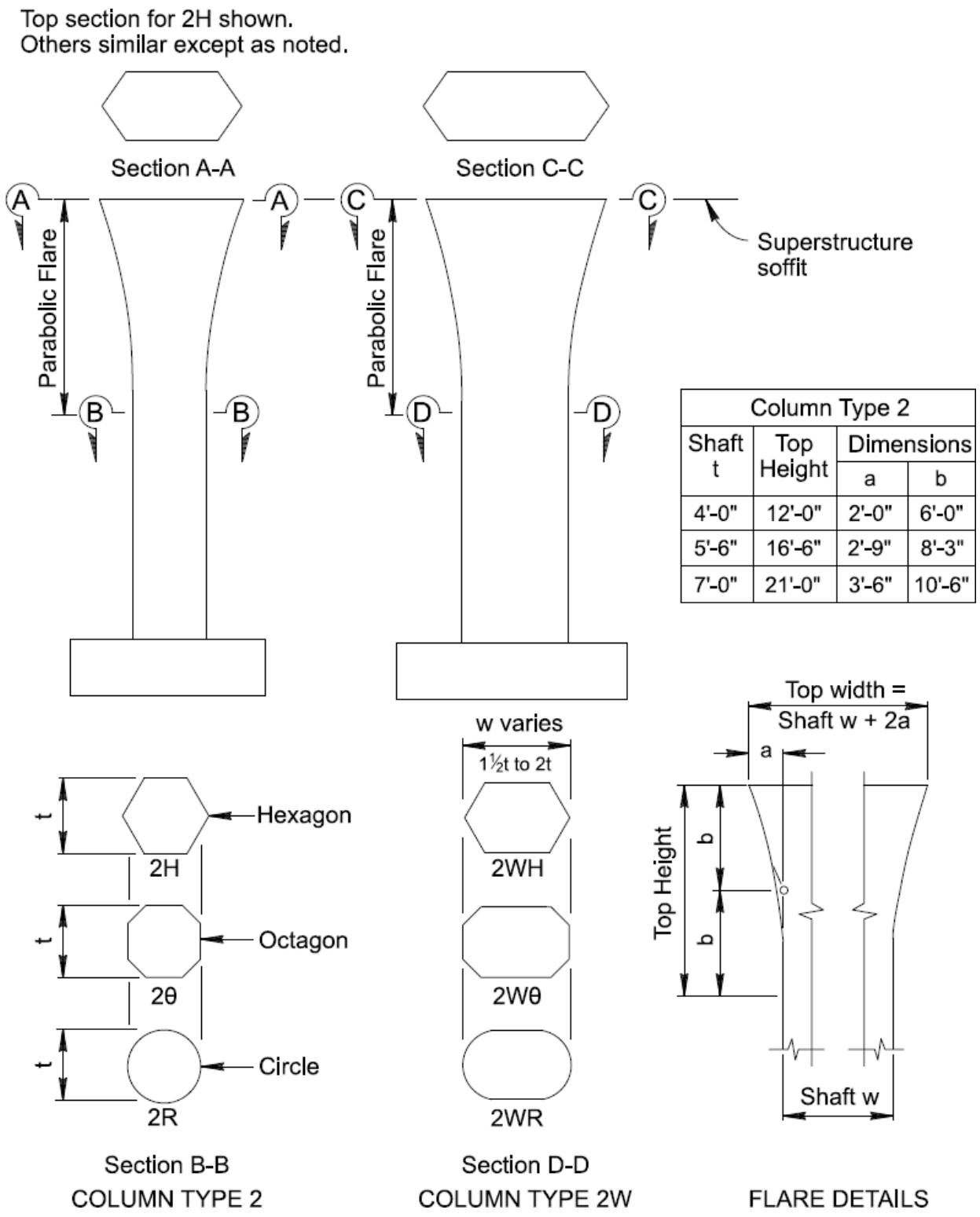
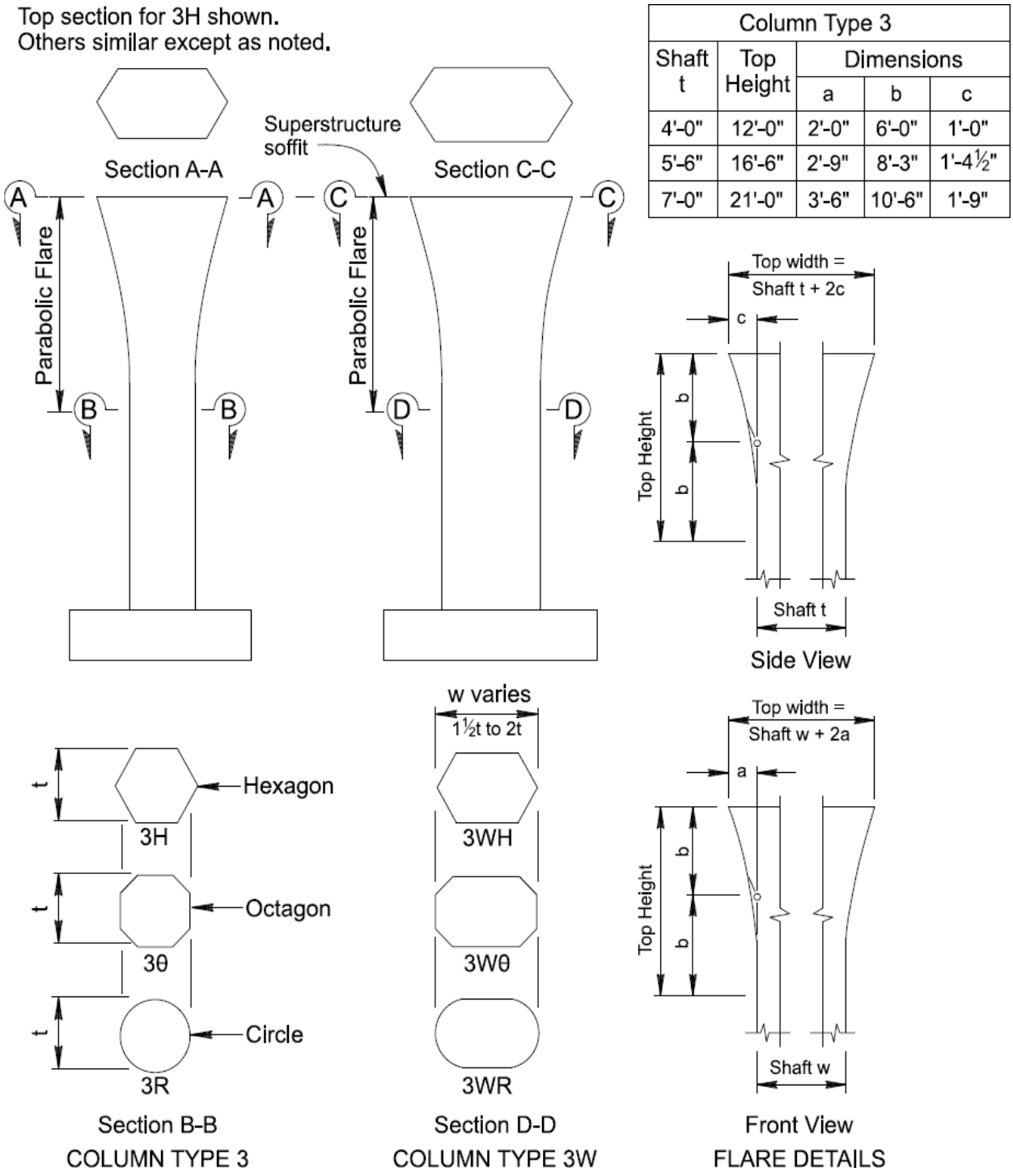


Figure 2.8.3.4-2 Type 2 Standard One-Way Flare Columns



Column Type 3				
Shaft t	Top Height	Dimensions		
		a	b	c
4'-0"	12'-0"	2'-0"	6'-0"	1'-0"
5'-6"	16'-6"	2'-9"	8'-3"	1'-4½"
7'-0"	21'-0"	3'-6"	10'-6"	1'-9"

Figure 2.8.3.4-3 Type 3 Standard Two-Way Flare Columns

Non-Standard Column Types

For projects requiring elevated bridge design and aesthetics, non-standard columns are developed as needed. Details are provided in all necessary views to convey the non-standard design to the project engineer.

Figure 2.8.3.4-4 illustrates a non-standard column type designed to complement the architecture of the bridge.

Figure 2.8.3.4.4 Non-Standard Column Type – Noyo Bridge Route 1

Column Superstructure Compatibility

As shown in Figure 2.8.3.4-5, when the superstructure has a sloped exterior girder, a flared column, such as a Type 2 or Type 3, is recommended to visually integrate the column with the superstructure, and when the superstructure has a vertical exterior girder, a prismatic or Type 1 column is recommended. Similarly, flared architectural columns are not compatible with vertical exterior girders, as shown in Figure 2.8.3.4-6.

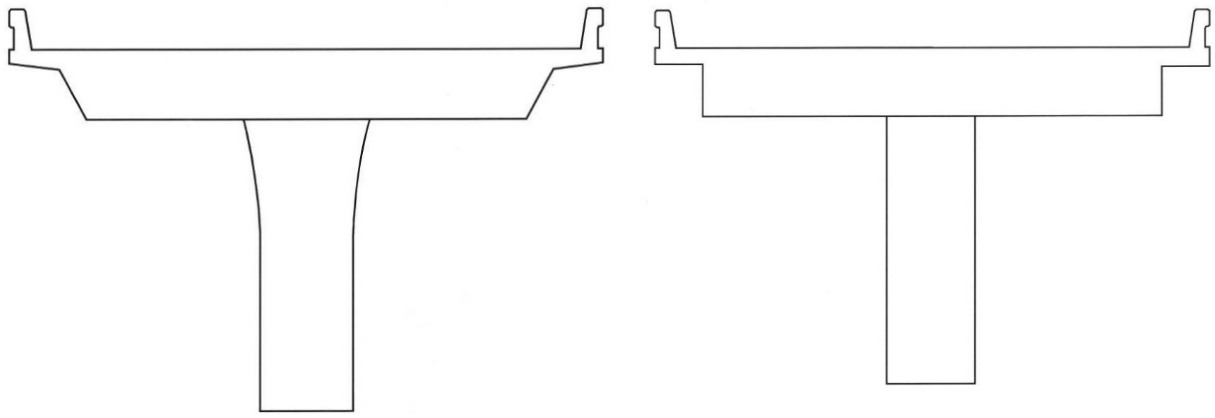


Figure 2.8.3.4-5 Recommended Column and Superstructure Compatibility

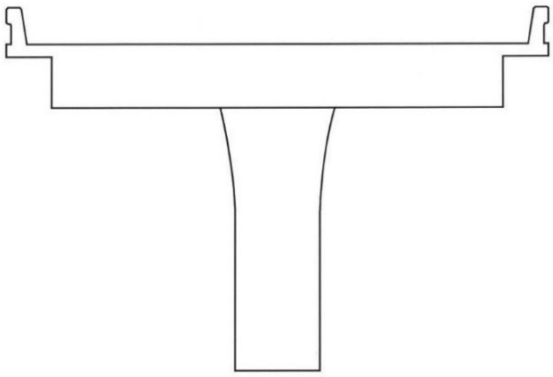


Figure 2.8.3.4-6 Incompatible - Not Recommended Compatibility

2.8.3.5 Abutments

Each project poses different design considerations regarding the type, size, and proportion of the abutment and wing wall. The selected abutment type will make a difference in the challenges involved for the desired aesthetic final outcomes. Based on the proximity of the abutment stem to the traffic passing under the bridge, abutments can be open-end or closed-end abutments.

- An open-end abutment is shallow in height and is placed high on the top of the approach embankment to provide an open appearance to the adjacent traffic, thus keeping the mass of the abutment small, avoiding large surfaces of concrete that are difficult to make aesthetically acceptable. See Figure 2.8.3.5-1a and b.
- A closed-end abutment is placed closer to the traveled way with a taller backfilled abutment face than an open-ended one. A wide bridge with a closed-end non-textured abutment surface is unattractive and more likely to get graffiti. See Figure 2.8.3.5-2a and b.

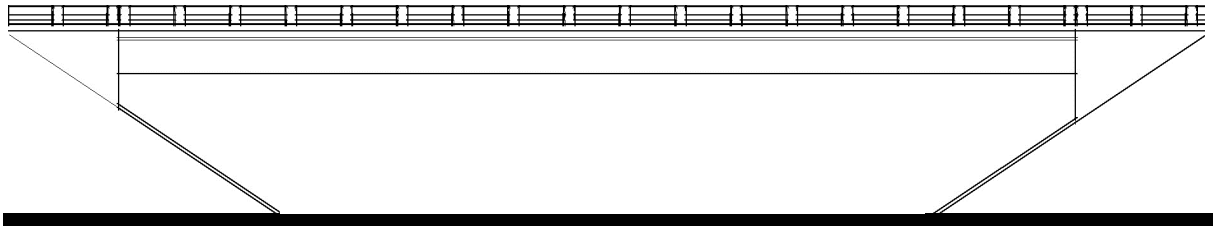


Figure 2.8.3.5-1a Open-End Abutment

Figure 2.8.3.5-1b Open-End Abutment Treated

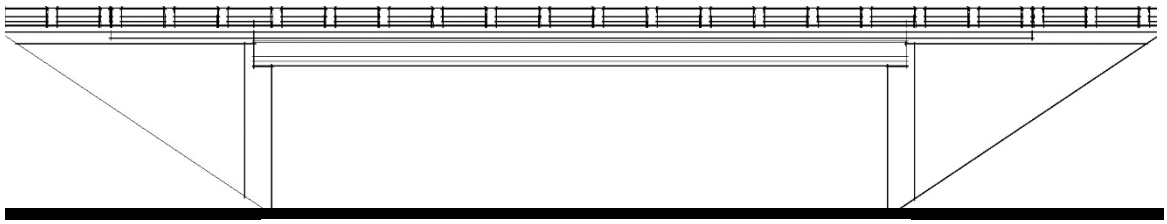


Figure 2.8.3.5-2a Closed-End Abutment

Figure 2.8.3.5-2b Closed-End Abutment Treated

Abutment end surfaces and wingwalls are usually in line with the deck overhang. However, the bridge architect may sometimes request that the wingwall be recessed slightly in from the edge of the roadway deck, for example, see Figure 2.8.3.5-3.

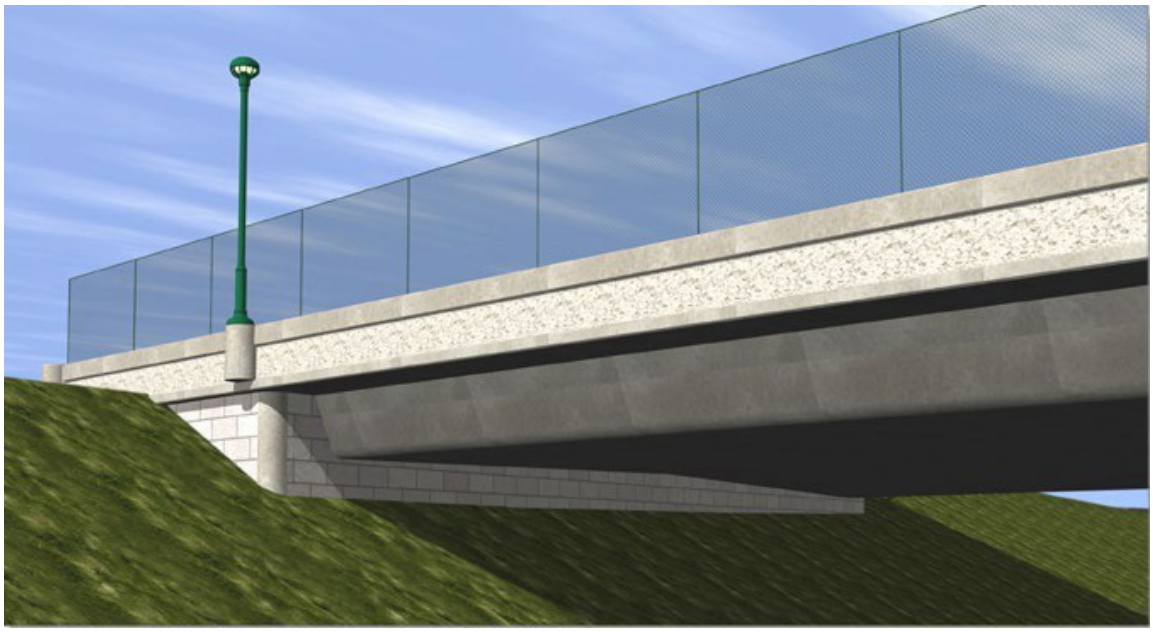


Figure 2.8.3.5-3 (Visualization) Route 29 Trancas Street OC

Superelevation, skewed alignment, and finish grades can result in very different finished construction heights of two opposing abutment faces. It is the responsibility of the architect to verify and coordinate with the engineer when such a condition exists, especially when a complex graphic motif is being considered. See Figure 2.8.3.5-4.

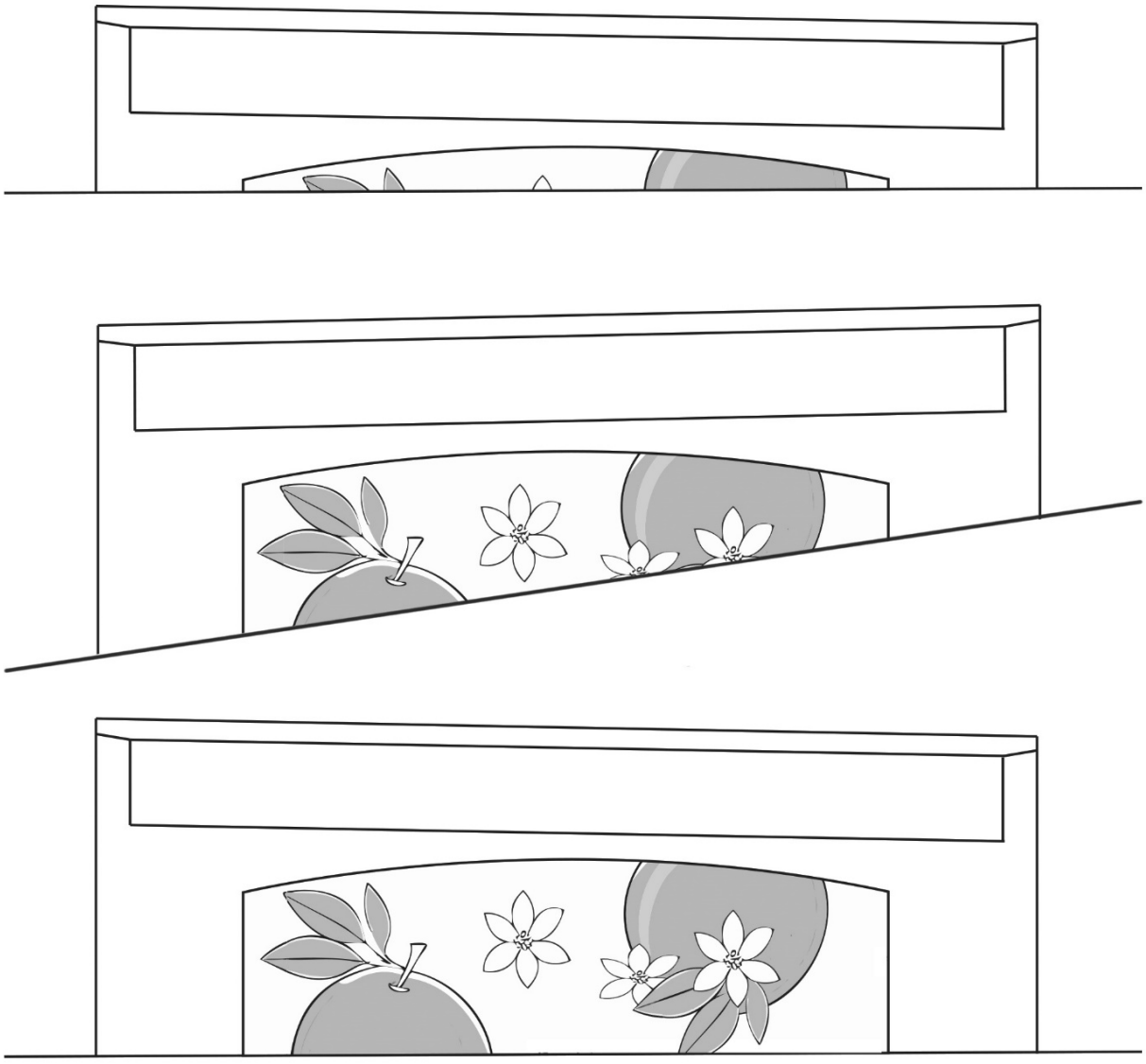


Figure 2.8.3.5-4 Finish Grades

2.8.3.6 Wing Walls

Wing Walls are considered an important structural component for adding architectural treatment. Treatment can include partial or full height added concrete to the wall surface to allow for relief (in) of texture and/or specific areas for thicker concrete, allowing the addition of coping or banding. Depending on the planned aesthetics for the structure, this surface treatment may be requested by the architect to continue across the abutment face. This should be established early in the project to ensure that there are no right of way or clearance issues for the additional inches of surface treatment. Having a texture form-lined surface for bridge wing walls provides visual beautification as well as discouraging graffiti.

2.8.3.7 Slope Paving

Slope paving is a reinforced concrete slab used to provide protection and erosion control, stabilizing soil around the abutments and under the bridge. Slope paving also improves the overall appearance of the bridge. When properly used, slope paving is an integral element of bridge design that ties together the bridge structure and the surrounding roadway and visually anchors the structure to the environment. See example Figure 2.8.3.7-1

The selection of materials under bridges can be varied. Naturally colored river rock embedded in mortar can be designed to be compatible with the established corridor color palettes, textures, and themes. Alternative slope paving treatments for surfaces facing the community could include colored pavers, artistic relief sculptures, patterns, murals, etc. Slope paving improves the overall appearance of the bridge.

The district usually determines the need for and type of slope paving. The district representative should consult with the architect on any questions regarding aesthetic coordination with the bridge structure's aesthetics.

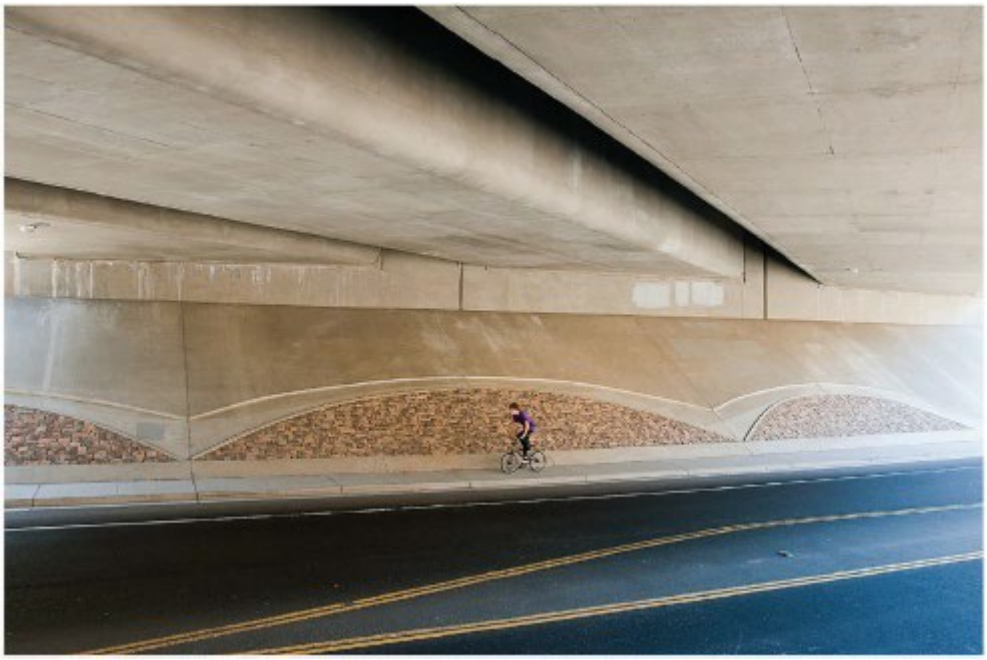


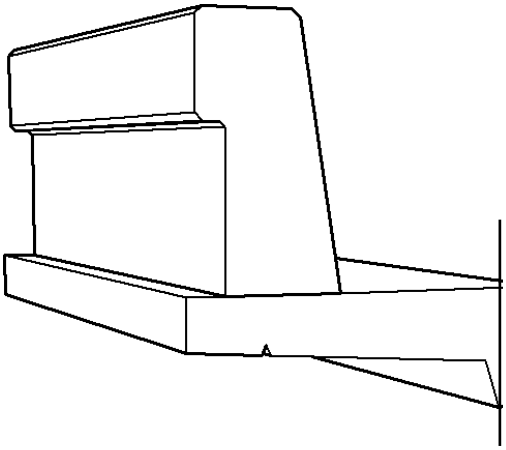
Figure 2.8.3.7-1 Slope Paving Architectural Treatment

2.8.3.8 Bridge Railings

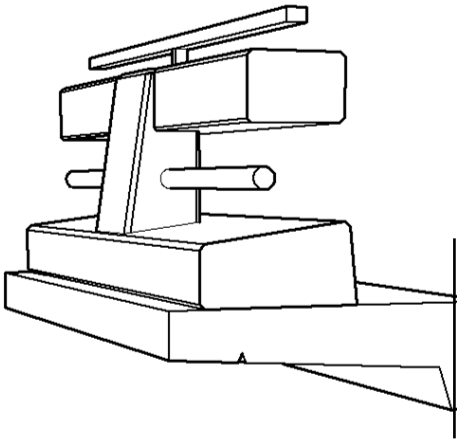
To meet the requirements for traveler safety, only MASH compliant concrete or steel barrier railings are to be constructed on the bridge structure.

Concrete MASH Compliant Barrier Rails

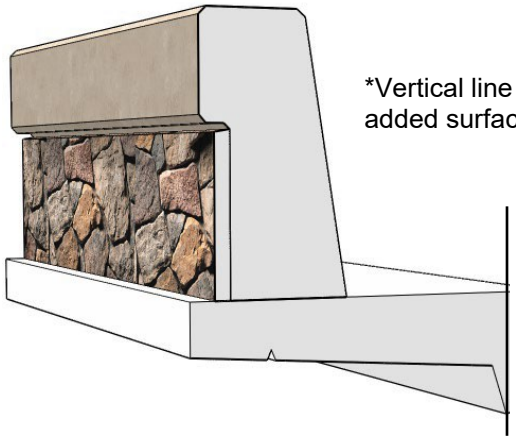
Textures can be applied without affecting the safety or function of the barrier, but must not exceed the parameters for MASH guidance for the added width of the concrete surface. When modifications are made, the barrier is designated with M after the barrier type, e.g., Type 836M or Type 85M, as shown in Figure 2.8.3.8-1. The texture coverage detail must be added to the standard structural detail section, and may need added reinforcement when necessary.



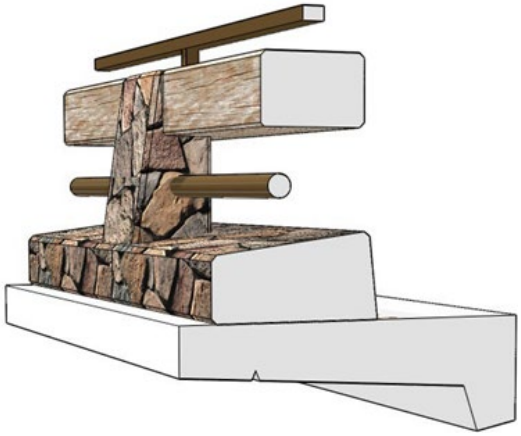
MASH Concrete Barrier Type 836



MASH Concrete Barrier Type 85



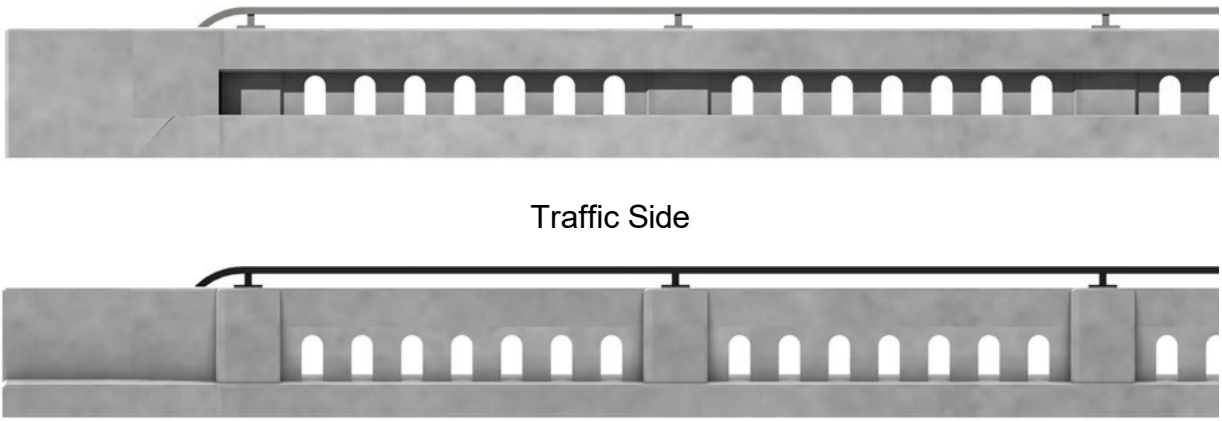
MASH Concrete Barrier Type 836M



MASH Concrete Barrier Type 85M

Figure 2.8.3.8-1 Treated Modified Barriers

The MASH Type 85, 86H, and 511H concrete barrier works well for a bridge that is valued for its cultural significance, having a desire to maintain its iconic or scenic beauty, and or for historic preservation of an existing barrier that is structurally failing, or outdated and is being replaced for safety reasons. The addition of arches between the posts mimics a historic bridge railing while still meeting current safety standards. See Figure 2.8.3.8-2.



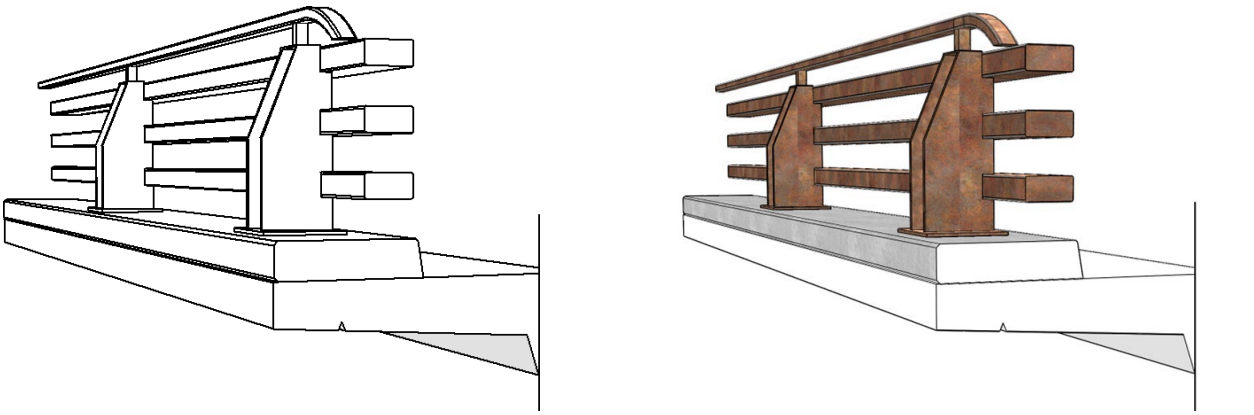
Traffic Side

Non-Traffic Side

Figure 2.8.3.8-2 Type 85M

Steel MASH Compliant Barrier Rails

Steel barriers are an alternative to concrete barriers and are designated as see-through barriers. Color can be added to a steel barrier for aesthetic beautification without compromising safety, see example Figure 2.8.3.8-3.



Standard ST-75 Bridge Railing

Standard ST-75M Bridge Railing (Natina Finish)

Figure 2.8.3.8-3 Treated Modified Steel Barrier Railing

Steel Bike Rails

Bike rails, when required, can be added to concrete barrier rails. The steel bike railing is secured to the back of each concrete barrier post for Type 85 (Type 80 obsolete). The addition of a bike rail often allows for creative context sensitive designs. These creative designs are well thought out and designated non-standard, yet must strictly adhere to Caltrans bike rail safety standards. See example Figure 2.8.3.8-4.

Figure 2.8.3.8-4 RTE 1 - Devil's Slide bridge Type 80 barrier with bike railing

Barrier Rail Transition End Block

Barrier railing transition end blocks will be constructed at the beginning and end of steel barrier rails for the termination of the rail and for traveler safety. See Figure 2.8.3.8-5. When design modifications are made with added texture, shape, or color (which do not affect the safety or function of the barrier), the end block is to be designated as modified. See examples in Figure 2.8.3.8-6.

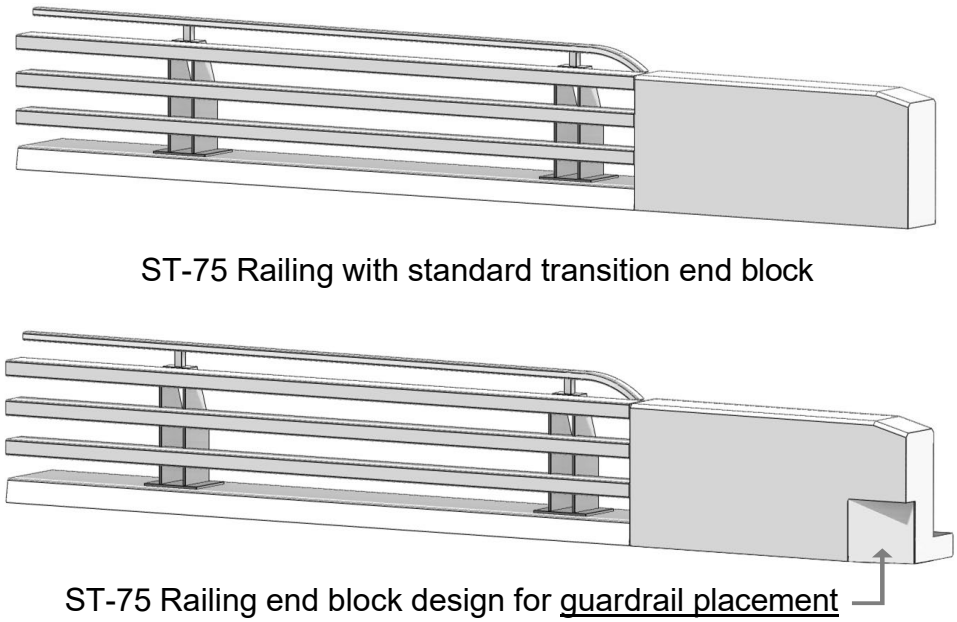
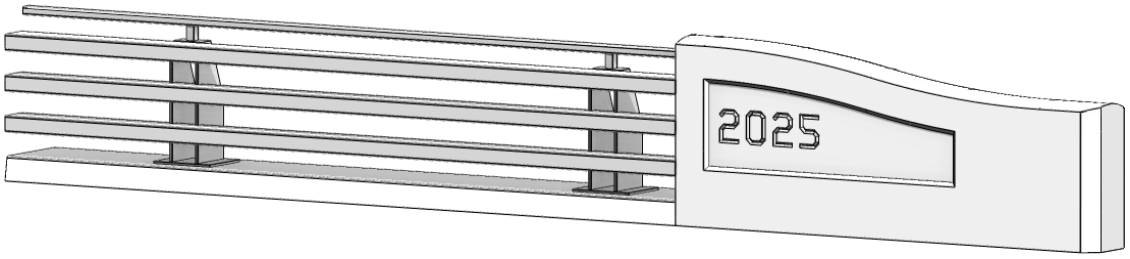
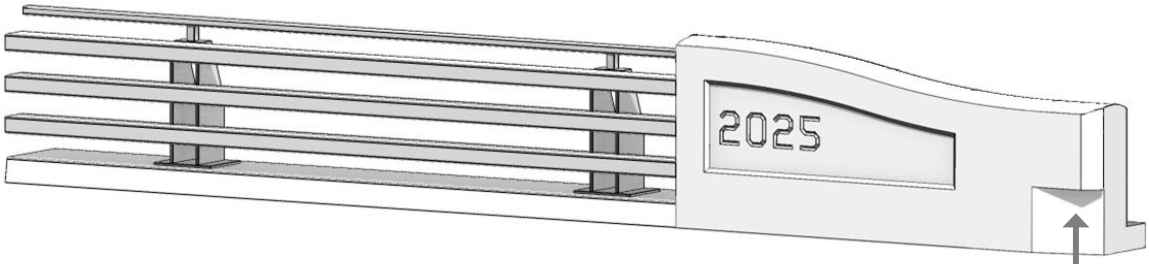


Figure 2.8.3.8-5 Steel Barrier Railing Standard End Block



ST-75 Railing with modified standard transition end block



ST-75 Railing end block design for guardrail placement

Figure 2.8.3.8-6 Steel Barrier Railing Modified Transition End Block

Chain Link Railing

Generally, three Caltrans standard types of chain link railing are proposed:

- Type 3 - Bridge Standard Details sheet xs16-160,
- Type 6 - Bridge Standard Details sheet xs16-2000,
- Type 7 - Standard Plan B11-52.

Decorative Non-Standard Railing

A maintenance agreement is needed with the jurisdiction city if a decorative chain link railing or picket railing is desired. For example, theme fencing consists of a decorative metal picket design, a 1-inch grid of vinyl coated mesh, and a black painted finish. The theme fence will be located on top of the concrete barrier and the curb (as with pedestrian overcrossings). A galvanized chain link fence per Caltrans standard specifications will be used to divide the corridor right-of-way from the local areas to prevent pedestrians from entering the freeway right-of-way.

Figure 2.8.3.8-7 Treated Modified Type 6 Steel Chain Link Railing

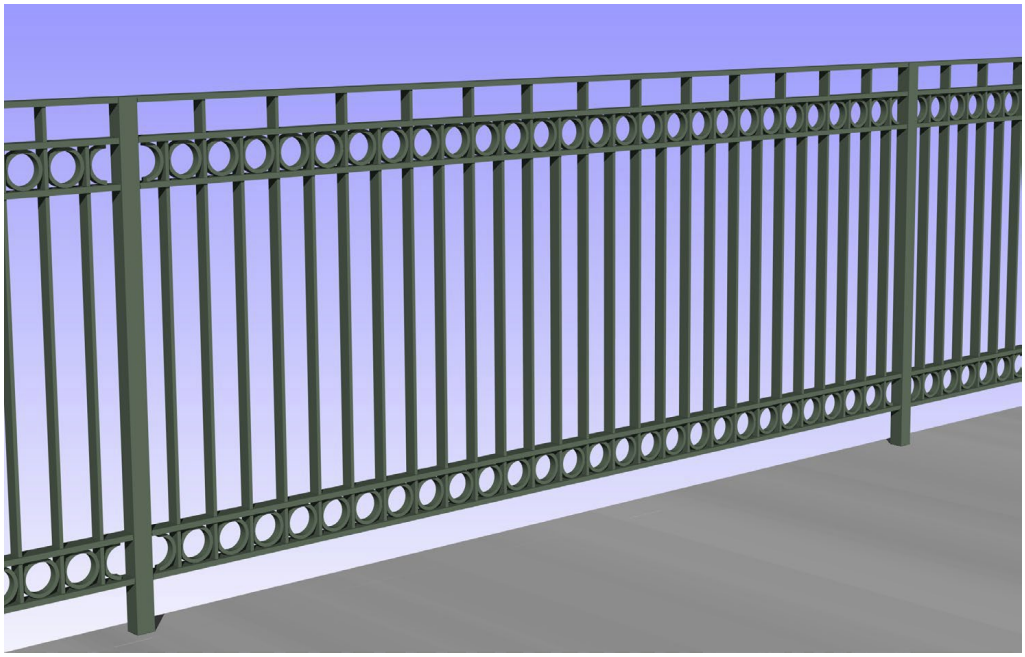


Figure 2.8.3.8-8 Modified decorative Picket Steel railing

2.8.4 RETAINING WALLS

There are several types of retaining walls, see Figure 2.8.4-1:

1. Timber Lagging
2. Sculpted Shotcrete
3. Tie back/Soil Nail
4. Soldier Pile
5. Type 1 RW
6. MSE
7. Gabion Basket

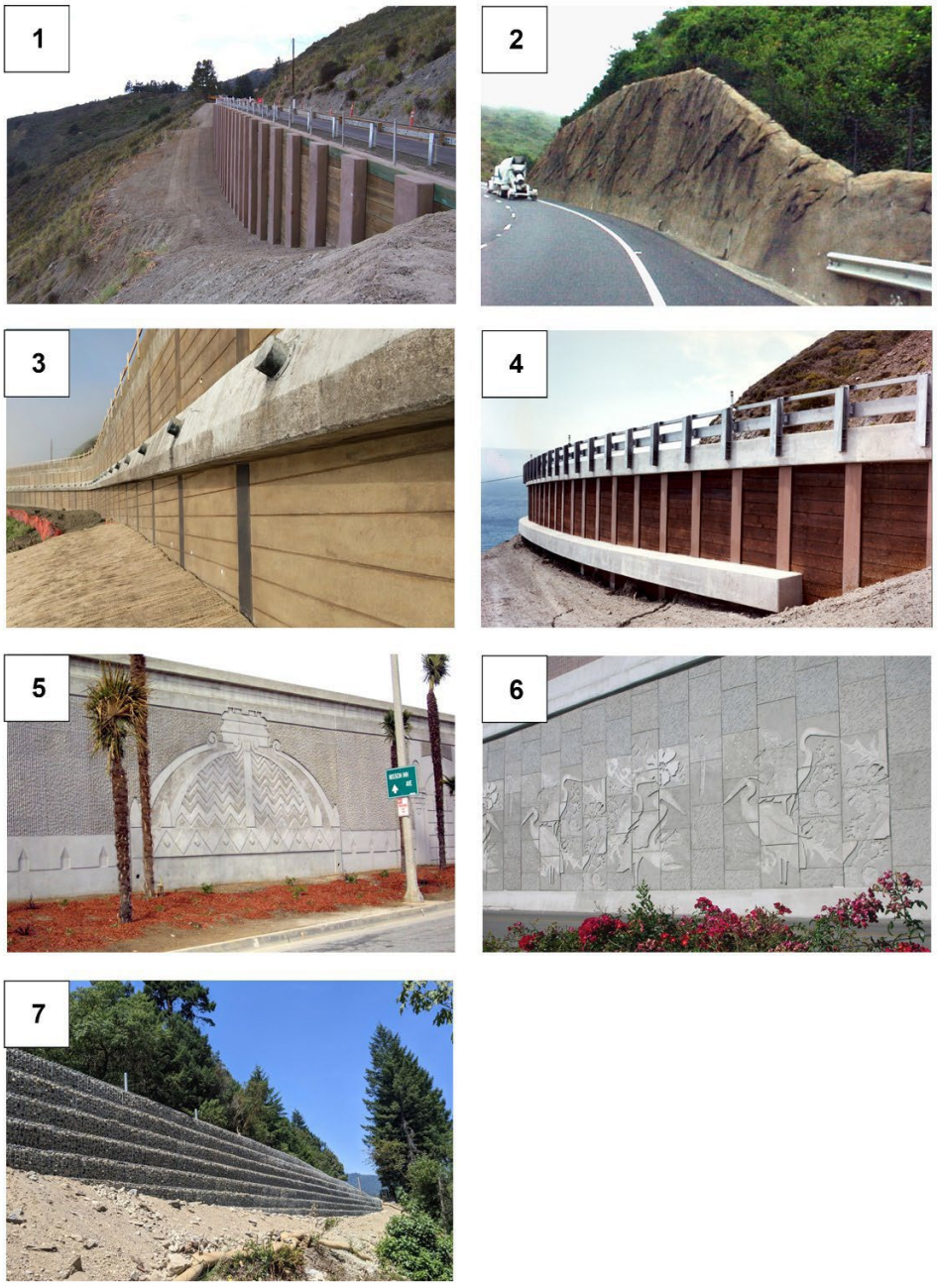


Figure 2.8.4-1 Retaining Wall Types

Retaining walls within the corridor are recommended to have textured form-lined surfaces. The architectural designer chooses from an array of readily available patterns on the market, used primarily as background fill. For more special, highly visible walls, and at the request of the district, a combination that includes custom designed patterns or graphic motifs. The form liner method affords flexibility for innovative design, as well as adding interest to retaining wall surfaces. Prior to approval for the final installation of a customized form liner, measurements should be taken to verify that the scale and correct depths are present, as per the plan details. It is customary practice to submit a concrete test panel representative of a predetermined portion of the architectural treatment for approval. The approved test panel often does not include the entirety of the motif. On rare occasions, textures, defining grooves, and other features have been misplaced or missing on the formliners. These mistakes can occur even though a test panel has been approved.

Complexly designed motifs often involve multiple custom form liners, and especially for that reason, each liner needs to be carefully inspected to avoid missing details or errors. It is good practice for the motif's designer/architect to be notified when liners are available for review and to be allowed to participate in the inspection process to identify discrepancies between the liners and the plan details. Elastomeric form liners allow minor corrections to be made at the job site before installation, without needing a remake, thereby delaying the scheduled concrete pour. Examples are shown in Figure 2.8.4-2 (A - Typical custom liner, B - Taking measurements & C - Example of on-site corrections).

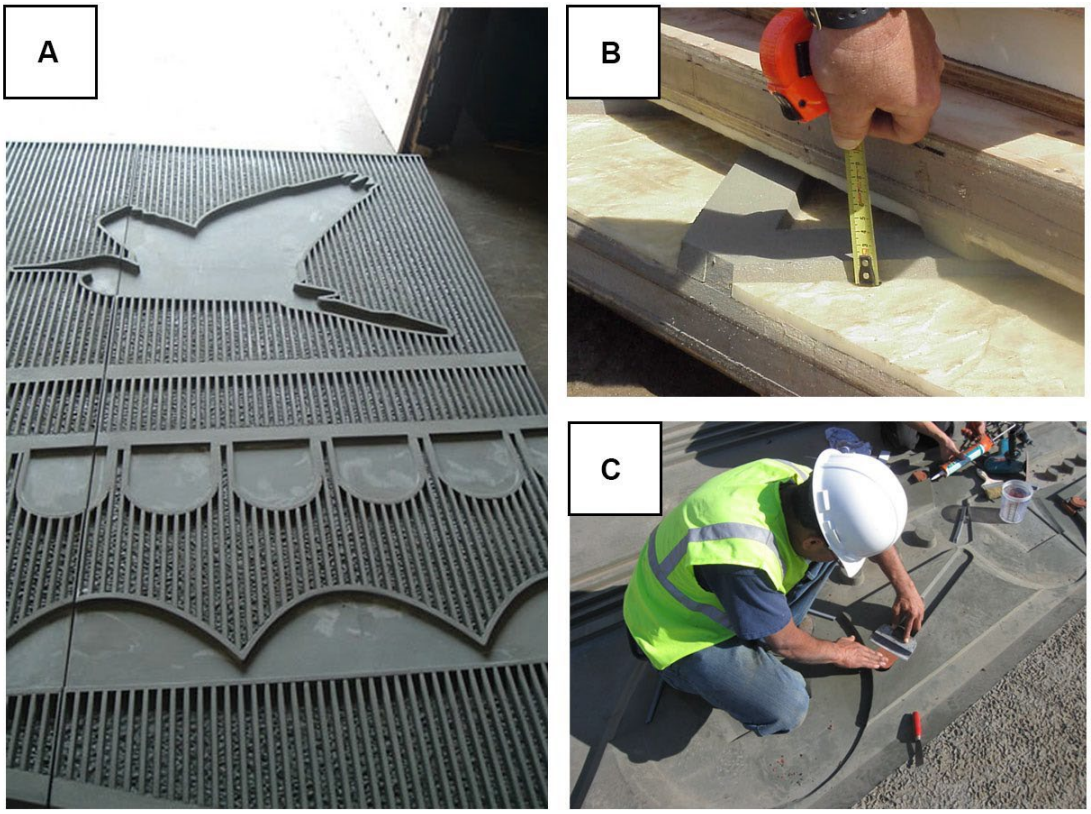


Figure 2.8.4-2 Inspection of Custom Liner before Installation

A visually pleasing yet functional profile elevation of a retaining wall should be smooth and continuous, complementing the earth it is retaining. Walls with extreme height variations can be modified to achieve smoother vertical profile transitions. Walls with sharp angles or sudden changes in elevation (“kinks”) are better rounded to create a smoother transition and a more fluid appearance. This also becomes less visually disruptive for the traveler, creating a sense of safety and a smoother ride. See Figure 2.8.4-3 and Figure 2.8.4-4 for examples of design considerations for retaining walls.

Note: Sudden dip in the wall height showing a discontinuity of visual flow

Figure 2.8.4-3 Undesirable Wall Profile

Note: Continuously smooth profile and gradually descending wall height

Figure 2.8.4-4 Desirable Wall Profile

Typically, the retaining wall layout line (LOL) for architectural treatment is at the exterior face of the wall and is aligned with the superstructure's edge of deck (EOD). Standard layout practice indicates that a wall LOL is not adjusted to the outer limits of the surface treatment but remains where it would be if this additional material were not applied to the surface at all. In some cases, however, wall design modifications are made that allow for the surface treatment to recess into the face of the retaining wall, thus eliminating an offset distance between the EOD/LOL and the wall's finished surface.

2.8.5 SOUND WALLS

Viewed from both the mainline and the community side, sound walls are highly visible and imposing because of their length, height, and alignment with arterial streets, which are also visible to the traveling public at much slower speeds from the community side. The incorporation of strategically placed pilasters at consistent intervals along the soundwall is a design choice that can serve to add community identity and beauty while also breaking up the monotony of long-distance masonry block soundwalls. There are two types of pilasters shown as examples: cast-in-place (see Figure 2.8.5-1) and precast (see Figure 2.8.5-2).

Soundwalls constructed atop retaining walls, depending on the vertical profile of the retaining wall, can become even more visually imposing from the community side and subject to graffiti if left untreated. When soundwalls are atop retaining walls running parallel to a sidewalk, frontage roadway, business district, or any other condition highly visible to the public, the architect often will add treatment to the barrier and retaining wall. When a soundwall is interrupted with a pilaster, the backside of the pilaster may also then receive the same architectural treatment as the mainline side, as shown in Figure 2.8.5-3.

Figure 2.8.5-1 Cast-In-Place

Figure 2.8.5-2 Precast

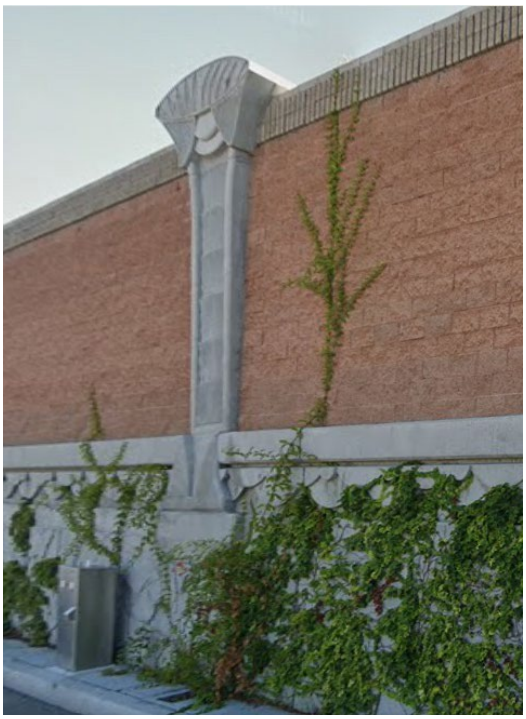


Figure 2.8.5-3 Community facing Soundwall/Retaining Wall

Note: Notice Figure 2.8.5-3 has added allowable thickness to the pilaster on the community facing side when the traffic barrier was not a factor at this location.

Considerations for selecting soundwall profile design:

1. Choosing to follow the grade or to step the soundwall.
2. Interrupting soundwall lengths with pilasters.
3. Transitioning soundwall elevation step with a pilaster.

Soundwall on a bridge generally occurs at an undercrossing

2.8.6 PEDESTRIAN OVERCROSSINGS (POC)

Overcrossings are generally preferred over undercrossings for pedestrians to cross highways safely. The superstructure should be Deck Type rather than Through Type to minimize graffiti defacement and provide an open view for personal safety. The profile of the structure should have a rising symmetrical vertical curve over the traffic lanes to enhance the appearance of the structure. Curved changes in horizontal alignment are preferable rather than angular changes. Pedestrian structures should be compliant with the Americans with Disabilities Act. Pedestrian overcrossings offer the architect opportunities to beautify structural forms and components, as shown in Figures 2.8.6-1 and 2.8.6-2.

Figure 2.8.6-1 Pedestrian Overcrossing over I-5-Casilada Way

Hwy 50 Rancho Cordova

Hwy 50 Bedford Ave Placerville

Figure 2.8.6-2 POC Examples

2.8.7 TUNNEL PORTALS

An architectural design and treatment of the tunnel portal facade can be simple, straightforward, or extremely complex in its design, textures, and color, depending on the importance of the location and the surroundings. For example, Figure 2.8.7-1, the Devil's Slide North and South tunnel portals. Surrounded by California's highly scenic Pacific Coastlands environment, the final design chosen to be built was comprised of 3 custom form-lined textures that are specific to textures found at or near the site location's rock formations. One of the textures lined the complex scallop-formed interior walls of the portals, another for the exterior, and the third for the pedestals. The portals at the south tunnels were then artfully crowned with faux sculpted rock forms that mimicked the natural embedded rocks on the hill above the portals, tying the portals to the dramatic nature of the existing landscape. Another example, Figure 2.8.7-2, is the Iconic Caldecott tunnel portal facade, which mimics architectural features upon entering the San Francisco Bay Area.

Figure 2.8.7-1 PCH RTE 1 Devil's Slide South Portals

Photo credit: Screenshot from Google Maps

Figure 2.8.7-2 RTE 24 Caldecott East Portal

2.8.8 MODIFYING EXISTING STRUCTURES

2.8.8.1 Bridge Widenings

When existing bridge structures are widened on only one side, bridge columns, girders, and barriers should match the existing structure for visual consistency. When both sides are widened, bridge column shapes should be consistent with existing columns; however, they may receive enhanced aesthetic treatment, i.e., surface texture, addition of a column capital, and, depending on the treatment of the girder and barrier, the addition of color, whether integral color or staining, for example. If a Corridor Aesthetic Master Plan (CAMP or AMP) exists for the route, it should be followed.

2.8.8.2 Seismic Retrofit Effect on Aesthetics

All retrofit work affects the appearance of existing structures. The ideal seismic retrofit would result in the retrofitted structure showing no change in appearance. However, conditions will dictate the use of various seismic retrofit solutions, which will alter the appearance of the retrofitted structure. This change in appearance should be minimized. Some retrofits will require additional structural parts. These functional parts should be integrated into the design of the original structure. Shape, texture, and color should be utilized to accomplish the integration.

1. **Cable:**

    a) If the cables are between girders, above the girder bottom flange, or are attached by means of small fittings, they are least objectionable.

b) If the cables are wound around columns or other structural members visible from a position outside the structure, they are more objectionable.

c) If the cables are visible in silhouette and are obviously not a part of the major structural scheme, they are most objectionable (See Figure 2.8.8.2-1).

All the above is further influenced by the environment: sky, background, color, character, etc.

Figure 2.8.8.2-1 Pitt School Road OC - Solano County- Route 80

2. Steel Column Casings:

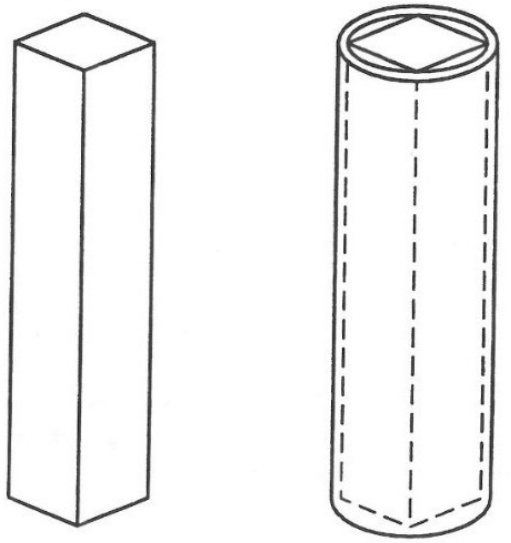
Three types of steel column casings are currently in use:

a) Type 1 - Prismatic Circular should be installed continuously from the soffit to the ground, minus a structural gap at the ends. The ideal use is on existing circular prismatic columns. Existing column cross-sections other than circular will undergo an appearance change when a circular section retrofit is installed. The extent of this appearance change will be greater if all the existing columns are not retrofitted. See Figure 2.8.8.2-3.

b) Type 2 - Prismatic Elliptical should be installed continuously from the soffit to ground, minus a structural gap at the ends. The resulting shape is an elliptical column that provides restraint without using tie rods on rectangular or oblong column cross-sections. It is difficult to determine the difference in appearance when this shape is compared to round or oblong columns in actual use. See Figure 2.8.8.2-4.

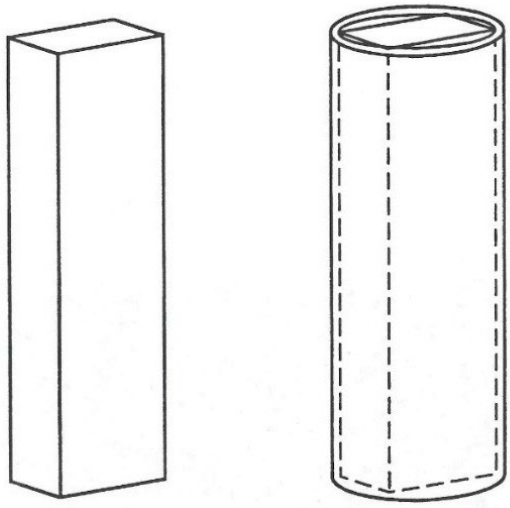
c) Type 3 - Formfitting is ideal for flared columns and columns with multiple cross-sections. The ideal application would show no change in the appearance of the

column after the steel casing is painted. See Figure 2.8.8.2-5.



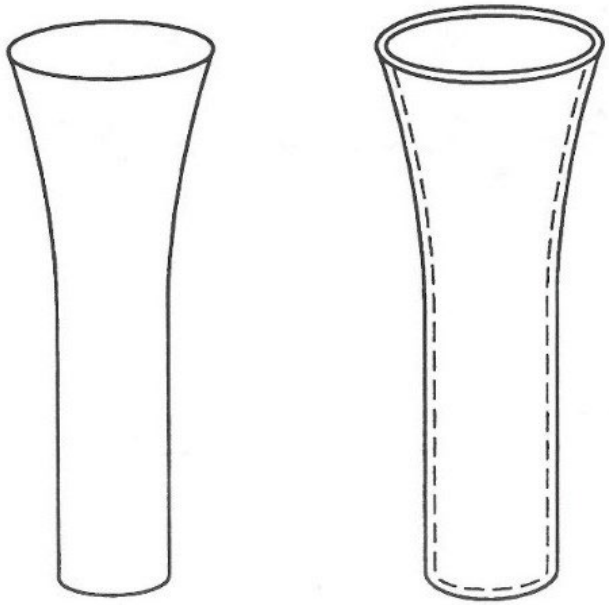
Existing Squared Concrete Column Circular Steel Casing

Figure 2.8.8.2-3 Type 1 Prismatic Circular



Existing Rectangular Concrete Column Elliptical Steel Casing

Figure 2.8.8.2-4 Type 2 Prismatic Elliptical



Existing Concrete Column with Flare Form Fitting Steel Casing

Figure 2.8.8.2-5 Type 3 Formfitting

2.8.9 CONCRETE SURFACE TREATMENT

Important consideration should be given to the detailing of concrete surface treatment to prevent any conflicts with the component's structural section. This includes barriers, wing walls, abutments, slope paving, exterior girders, retaining walls, and columns. The structural component's design should maintain specific clearances between the concrete surface and the reinforcement. *See "California Amendments to AASHTO LRFD Bridge Design Specifications"* section 5: Concrete Structures 5-175B, Table 5.12.8-1 and "Bridge Design Details" Section 1-4.1.

2.8.9.1 Specified Concrete Finishes

All visible smooth concrete surfaces are to receive a high-quality Class 1 finish without any coating.

Requirements for the final finishing of concrete surfaces are found in Sections 51-1.03C(2) and 51-1.03F of the Standard Specifications and should be reviewed for any possible conflicts between concrete forms and architectural treatment forms. These sections describe the materials and expected results required for the three classes of surface finish:

1. Ordinary Surface Finish
2. Class 1 Surface Finish
3. Class 2 Surface Finish

Concrete architectural surface treatment should not intrude into the minimum required clearance to reinforcement, see Figure 2.8.9.1-1. Proper communication between the bridge designer and the bridge architect or aesthetics designer is paramount for the detail engineer's understanding of the depth of added concrete required for the architectural concrete surface treatment. There may be instances when the additional concrete surface required would affect the structural design due to added weight or the structure's face layout line, and/or the architect's ability to design to the desired relief ins and outs of surface treatment due to right-of-way and/or cost issues.

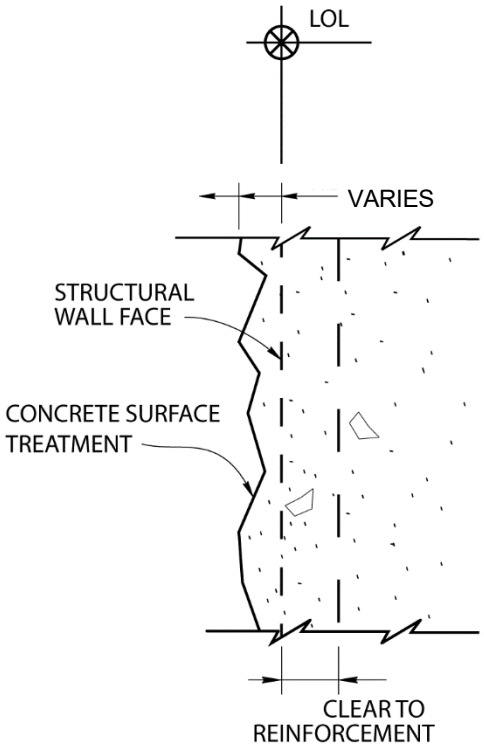


Figure 2.8.9.1-1 Maintain Minimum Minimum Clearance to Reinforcement

2.8.9.2 Samples and Mock-Ups

Referee Samples – A referee sample is generally a small full scale lightweight fabricated sample depicting the desired final texture and may, if the final is to have color, the referee will show the precise staining and modeling of colors required to be mimicked by the contractor on the approved test panel to obtain approval to proceed, see Figure 2.8.9.2-1. Usually, the Project's Standard Special Provisions (SSP) contain the location and contact information for viewing the referee sample by the contractor.

Concrete Test Panel – A full scale portion of the architectural treatment that is required for approval prior to construction to ensure that the final construction has the best desired outcome. The project architectural detail sheets will usually show the size and specific area from which the test panel is taken. The project's SSP may also confirm the dimensions of the required test panel area. Typical test panel example shown in Figure

2.8.9.2-2. Sometimes, due to the complexity of a corridor motif, a much larger area and even a full height test concrete pour will be required. See Figure 2.8.9.2-3.

Figure 2.8.9.2-1 Referee Sample Example

Figure 2.8.9.2-2 Test Panel Example

Figure 2.8.9.2-3 Full Height Test Panel Example

Concrete Mock-up - A full scale mock-up may be required for a modified or a non-standard concrete barrier to be approved for a project's special aesthetics design or even for safety

crash testing. An example of a mock-up of a full-scale portion of a Type 85M concrete barrier is shown in Figure 2.8.9.2-4. The photo examples shown in Figure 2.8.9.2-4 are before any color staining.

Back

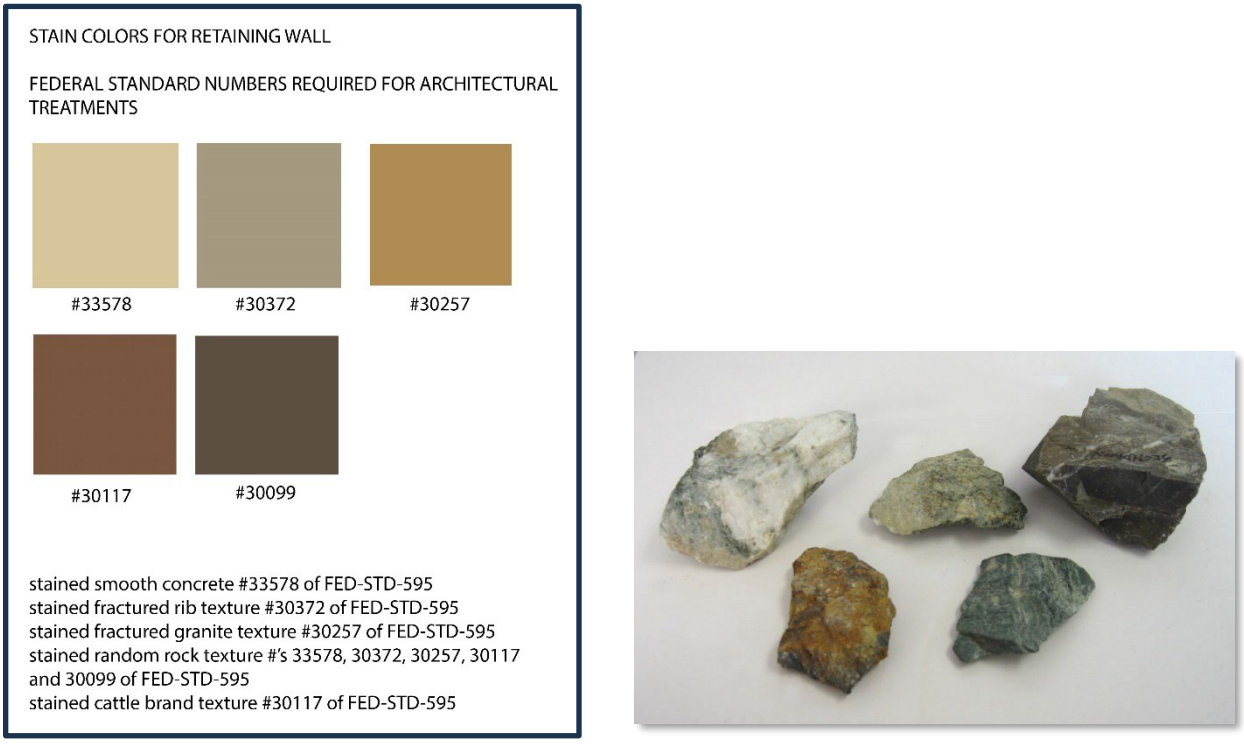
Traffic Side

Figure 2.8.9.2-4 Concrete Mock-up Example

Steel Mock-up – A mock-up may be required when non-standard or modified custom fabrication of steel components has been approved for a project's aesthetics. A typical steel mock-up for a customized picket fence railing design is shown in Figure 2.8.9.2-5. The photo shows the custom fabrication as well as the color and application of the required powder coating to obtain approval to proceed. A host of things can be obtained by a full-scale mock-up, i.e., by taking measurements to determine that the heights and openings between steel members meet Caltrans safety standards, quality of welds, finishes, etc.

Figure 2.8.9.2-5 Steel Mock-up Example

Color Study Selection Process – Colors should be chosen with great care by the architect and very thoughtfully so that the best outcome for the success of the project is achieved. Site visits can be a helpful method to come up with the best color palette for the structural components. Color choices may be selected to complement the local environment, i.e., city, industrial, rural farmland, foothills, coastal, or forested mountains, etc., see Figure 2.8.9.2-6 (A). When a stone pattern is selected, rock samples can be gathered from the site or in near proximity so that colors can be matched to the samples collected, see Figure 2.8.9.2-6 (B). Note: AMS-STD-595 is the new standard for “Colors Used in Government Procurement”. The AMS-STD-595 standard is essentially the same as the previous FED-STD-595C, but now with SAE International responsible for the colors maintenance and updates.



(A) (B)

Figure 2.8.9.2-6 Color Study Examples

RE Pending File – RE (Resident Engineer) Pending File, for Bridge Architecture and Aesthetics Branch, is an important communication file for the inclusion of additional supplemental information, such as graphic aids, to pass on to the contractor that otherwise is not provided in the plan set. Formliner manufacturers employ skilled craftsmen and sculptors to produce the positive molds from which to cast the negative formliner. It is imperative that the architect has a pathway to communicate important information to the artists. For example, what was submitted by Bridge Architecture and Aesthetics Branch for inclusion in the RE Pending File, see Figure 2.8.9.2-7, which shows the cover page for a Graphics Package. A sample of what was provided in the Graphics Package is a precise computer 3D modeled depiction of the stylized fish scales and how

they were to gradually lessen in depth as they head towards the belly of the fish, as shown in Figure 2.8.9.2-8.

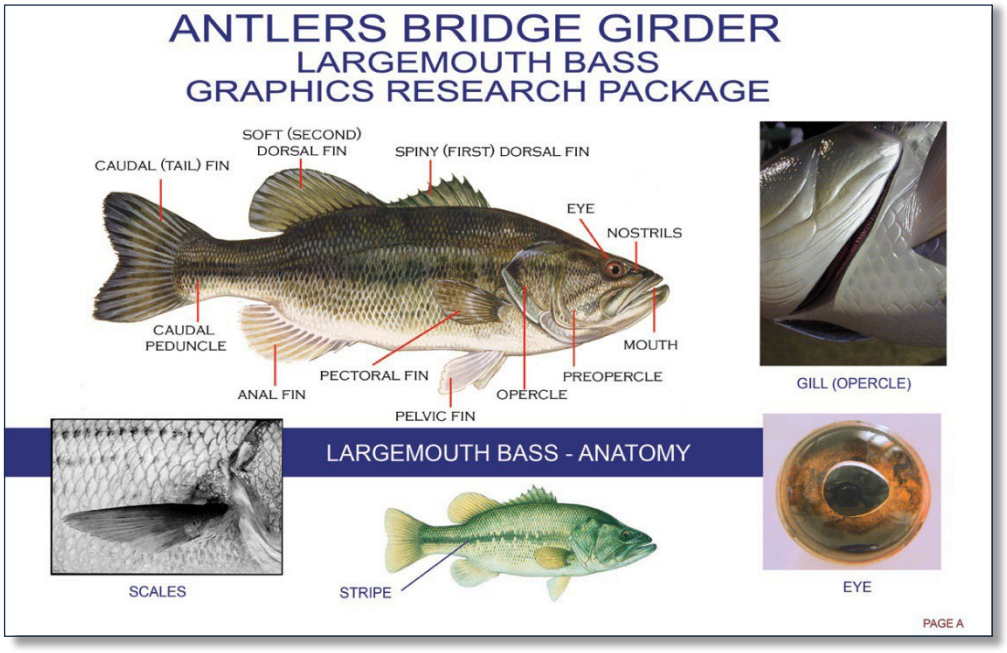


Figure 2.8.9.2-7 Typical Graphics Package Cover Sheet

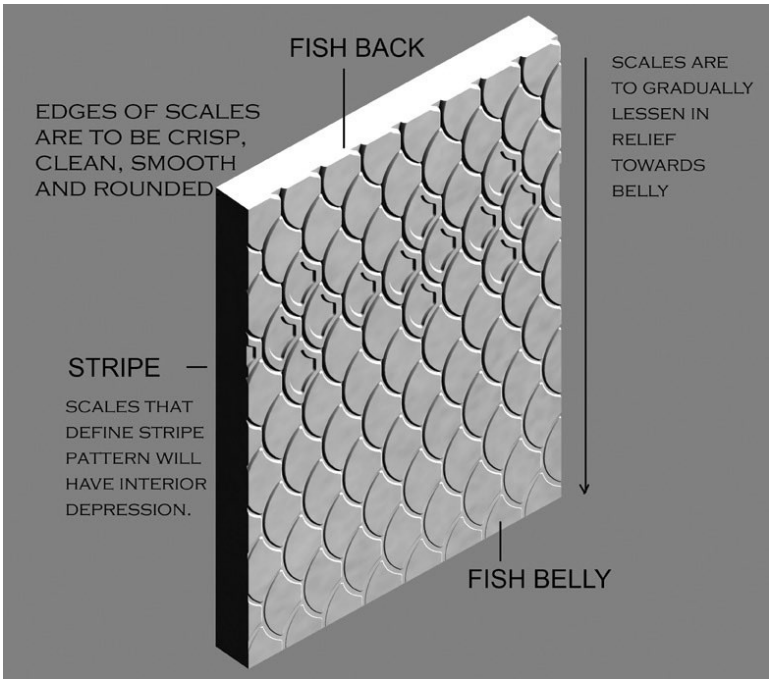
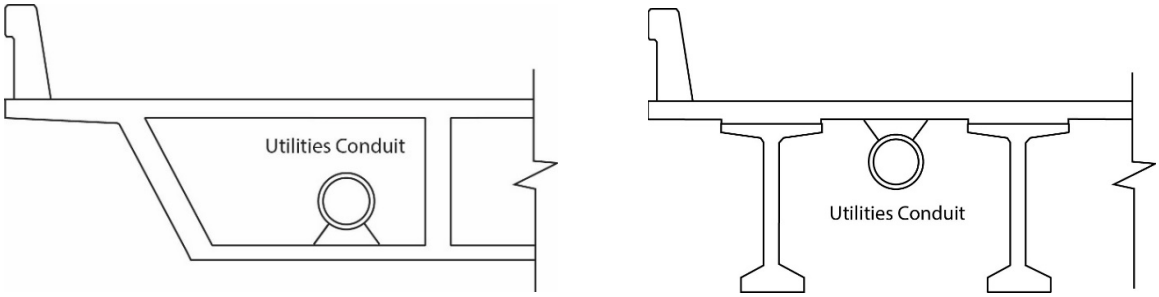


Figure 2.8.9.2-8 Example of Content "3D CADD Information"

2.8.10 UTILITIES

It is recommended that, whenever possible, downspouts, electrical conduits, or other utilities be located within the box girder cell (A) or placed between precast girders (B) to avoid being visually exposed, as shown in Figure 2.8.10-1. (example shown not for use as standard detail)



(A) (B)

Figure 2.8.10-1 Utilities Conduit Location for Better Aesthetics

2.8.10.1 Lighting

Lighting is an important design feature for a bridge structure, both in its functionality and appearance. Certain considerations are necessary when selecting lighting, such as safety, security, and maintenance, which should primarily meet the needs of both motorists and pedestrians. Typically, two types of lighting are used: Caltrans standard lighting or decorative lighting. Usually, a maintenance agreement with the city is required

if decorative lighting is desired. Therefore, the choice of lighting on bridges will be dependent on the city with jurisdiction over that area. See Figure 2.8.10.1-1.

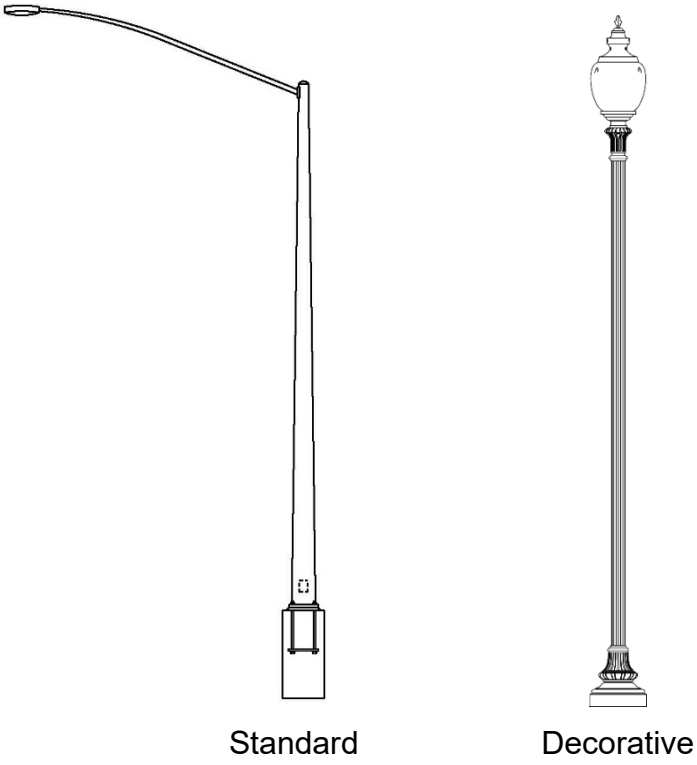


Figure 2.4.10.1-1 Lighting Considerations

2.8.11 GRAFFITI ABATEMENT AND REMOVAL

Concrete surface texture is often incorporated into the structure designs to discourage graffiti. The following final coating methods can also be used to address graffiti problems:

1. Sacrificial - Sacrificial anti-graffiti coatings are applied and removed after each instance of vandalism, meaning they must be reapplied after each graffiti removal. This type of coating is usually less expensive, but there is a risk of erosion or damage to the underlying surface that can occur with multiple washings. The sacrificial coating must be reapplied after cleaning.
2. Non-sacrificial or permanent.

Advantages Of Sacrificial Coatings:

- Less expensive
- Easier to apply
- Nobody will notice the coating
- Water based
- Low sheen appearance

Apply non-sacrificial/permanent anti-graffiti coating to facilitate easier removal. Removal methods include:

1. Preferred method - a professional graffiti removal system that utilizes an initial environmentally friendly spray paint breakdown application and then a high-powered washing off with water.
2. Recommended process: maintenance personnel should always obtain and use matching color paint/stain to cover graffiti. Each district Landscape Architect Office should have information for the exact Federal Standard Color numbers used on the route segment between postmiles.
3. Not Preferred - painting over graffiti with a non-matching color. Although it covers the graffiti, it also spoils the intended beauty of the surface for the public to see. See Figure 2.8.11-1.

Graffiti Removal and Preventative Materials can be found on Caltrans Authorized Materials Lists (AML).

Figure 2.8.11-1 Undesired Result from Painting Over Graffiti

2.8.12 TRANSPORTATION ART

Transportation Art is a Caltrans permit program for pre-existing structures and can be free-standing or placed upon required engineered transportation features such as a noise barrier, retaining wall, bridge, bridge abutment, bridge rail, or slope paving. It is subject to the Transportation Art Guidelines and is reviewed through the permit process. Art applied to replacement or new walls as part of the widening project is considered an integral part of the freeway design package. Mammoth elephant silhouettes were added to a bridge chain-link fence as Transportation Art, see Figure 2.8.12-1.

Figure 2.8.12-1 Mammoth elephants SR 99 Le Grand Rd. OC near Plainsburg

2.8.13 COMMUNITY IDENTIFICATION AND GATEWAY MONUMENTS

Community Identification is a concept developed by Caltrans to allow surrounding cities to display and express their unique attributes within the right-of-way. This can include visual images, graphics, text, or sculptural artwork. Community Identifiers are often incorporated into and/ or safely and securely placed on structures such as bridges, bridge abutments, bridge rails, slope paving, or retaining walls, see Figure 2.8.13-1.

A Gateway Monument is a free-standing, non-integral, or non-required highway structure or sign that communicates the name of a local city, county, or incorporated town and can also occur at a state line, see Figure 2.8.13-2. Gateway monuments are planned, designed, funded, constructed, and maintained by the public agency sponsoring the project, although built within the State right-of-way. Any such additions should adhere to Caltrans safety standards.

Figure 2.8.13-1 Route 22 Garden Grove

Figure 2.8.13-2 Gateway Monument on Highway 40 near State Line

2.8.14 AESTHETIC TREATMENT OPPORTUNITIES AND GUIDANCE

To ensure that roadway structures in each district corridor or corridor segment maintain their own unique aesthetic identity, a CAMP or AMP is often created to provide guidance in that effort. The Bridge Architecture and Aesthetics Branch, in collaboration with District Landscape Architecture and input from Community Stakeholders, undergoes an extensive effort to develop a themed master plan as a guideline for the architecture and aesthetic treatment of structures, hardscape, and landscaping. Knowledge of the existence of, and adherence to, the CAMP or AMP for the project is vital to its success. Usually, in an 11 x 17 format, a typical cover page example is shown in Figure 2.8.14-1.

State Route 91 example: The State Route 91 CAMP outlines architectural aesthetic guidelines for new bridges and the widening of structures along the corridor. In addition, there are many new and replacement retaining walls and sound walls. The “Artesian Theme” will be applied to all structures, including bridges, overcrossings, undercrossings, pedestrian overcrossings, viaducts, interchanges, connectors, retaining walls, sound walls, etc. Aesthetic treatments of these structures will provide significant opportunities to beautify and enhance visual continuity in the corridor.

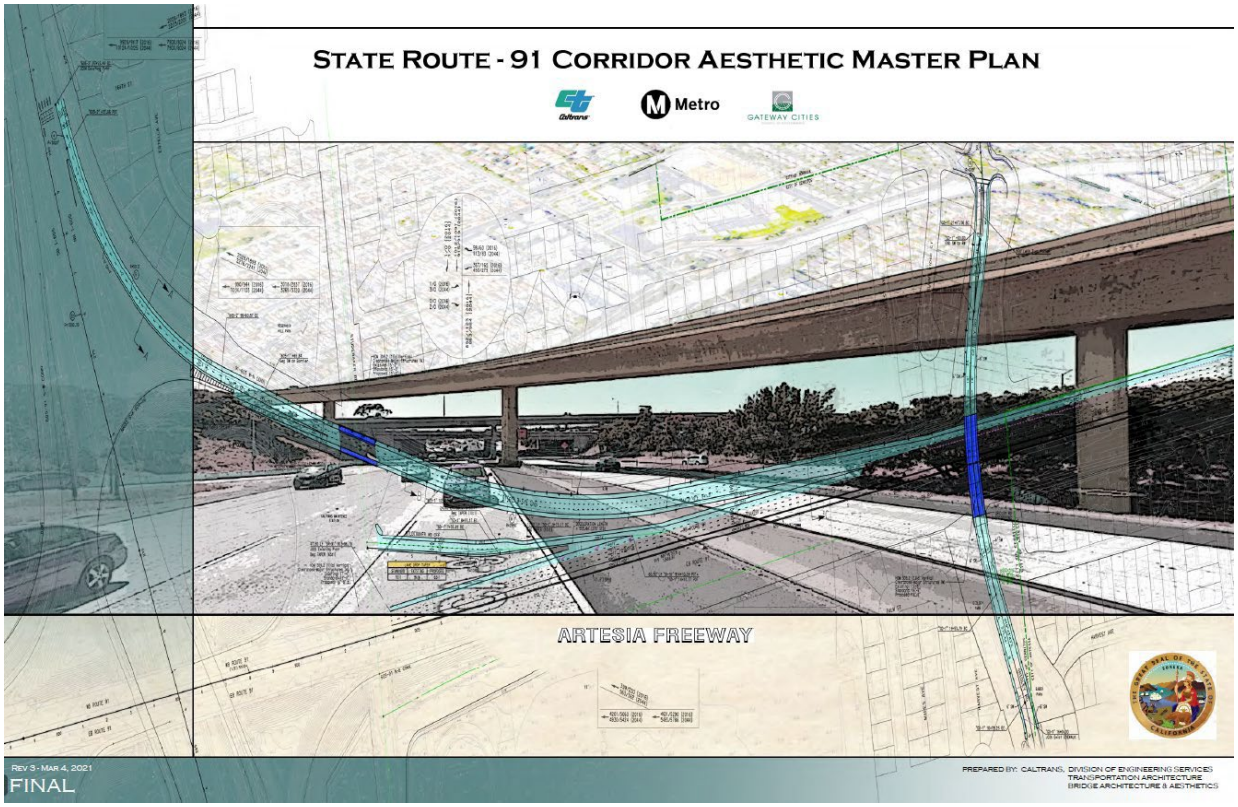


Figure 2.8.14-1. Typical Corridor Aesthetic Master Plan (cover page example)

2.8.15 REFERENCES

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