Section 15 – Soundwalls

XS Sheet Numbers

Sound Wall Masonry Block on Retaining Wall, XS15-120-1 & XS15-120-2

Sound Wall Masonry Block with Barrier on Retaining Wall, XS15-130-1, XS15-130-2 & XS15-130-3

Sound Wall Masonry Block on Bridge, XS15-140-1, XS15-140-2 & XS15-140-3

Description of Component

These Sound wall masonry block details are not covered by Standard Plans. Previous Sound Wall Bridge Standard Detail Sheets (XS) were designed to meet 1997 Uniform Building Code.

Sound wall masonry block design complies with AASHTO LRFD Bridge Design Specifications, 8th Edition (AASHTO), TMS 402/602-16 Building Code Requirements and Specification for Masonry Structures (TMS), and California Building Code 2019 (CBC).

Standard Drawing Features

Sound wall masonry block on retaining wall consist of two sheets, Sound wall masonry block with barrier on retaining wall consist of three sheets, and Sound wall masonry block on bridge consist of three sheets. Details No. 1 sheet includes: General Notes, Design Notes, Elevations, Wall Section Views, and possibly a Typical Section.

Details No. 2 sheet includes: additional Typical Sections and additional details.

Details No. 3 sheet includes concrete barrier transition details and MASH-compliant details for approach end block and features the vertical slotted holes to aid with constructability of the thrie beam rail. Caltrans is adapting bridge approach end block per the crash tested and approved details developed by the Midwest Roadside Safety Facility (MwRSF) at the University of Nebraska (TRP 03-367-19-R1) for the MwRSF Pooled Fund of which Caltrans is a member State DOT.

Design/General Notes

Wind Loads

Wind loads shall be applied per AASHTO LRFD Bridge Design Specifications 8th

Edition (AASHTO) Section 15.8.2. Design wind pressures shall be determined using Section 3 of LRFD.

Section 15 – Soundwalls

The following criteria from AASHTO shall be used when designing sound walls:

V = 110 mph for strength III load case
V = 80 mph for strength V load case
V = 70 mph for service I load case
G = 0.85

$$C_D = 1.2 P_Z = 2.56 \times 10^{-6} V^2 K_Z G C_D \qquad \text{(AASHTO 3.8.1.2.1-1)}$$

Where:
P_Z = Design wind pressure
V = Design 3-second gust wind speed
G = Gust effect factor
C_D = Drag coefficient

The pressure exposure and elevation coefficient (K_Z) shall be determined based on the site ground surface roughness, wind exposure category, and structure height (Z).

For Sound Wall Bridge Standard Details sheets, the following values were used:
For all except on bridge:

Wind exposure category = D
Z = 33 feet
P_Z = 36.5 pounds per square feet for strength III load case
P_Z = 19.3 pounds per square feet for strength V load case
P_Z = 14.8 pounds per square feet for service I load case

On bridge:

Wind exposure category = D
Z = 60 feet
P_Z = 40.7 pounds per square feet for strength III load case
P_Z = 16.3 pounds per square feet for service I load case

The Sound Wall Bridge Standard Detail Sheets designs may be used in all locations where the site-determined design wind pressures (P_Z) are equal to or less than those shown above.

For special wind regions as shown in AASHTO Figure 3.8.1.1.2-1, the previously listed design wind pressure (P_Z) values shall not apply. The designer must determine the site-specific wind pressure (P_Z) and modify the design.

Seismic Loads

The following values shall be used when designing sound wall:

0.57g, except on bridges
2.0g, on bridges

Section 15 – Soundwalls

Load Combinations

A summary of the relevant load combinations and load factors is provided in the following table:

--	DC_{max}	DC_{min}	EH_{max}	EH_{min}	LS	WS	EQ	CT
Service I	1.0	1.0	1.0	1.0	1.0	1.0	--	--
Strength III	1.25	0.9	1.5	0.9	--	1.0	--	--
Strength V	1.25	0.9	1.5	0.9	1.35	1.0	--	--
Extreme Event I	1.0	1.0	1.0	1.0	--	--	1.0	--
Extreme Event II	1.0	1.0	1.0	1.0	0.50	--	--	1.0

Where:
DC = Dead load of structural components
EH = Horizontal earth pressure load
LS = Live load surcharge
WS = Wind load on structure
EQ = Earthquake load
CT = Vehicular collision force

Resistance factors are listed the tables below:

Reinforced Concrete (per AASHTO)	Strength Limit State	Extreme Limit State
For Flexure	0.9	1.0
For Shear	0.9	1.0

Concrete Masonry Units (per TMS)	Strength Limit State	Extreme Limit State
For Flexure	0.9	1.0
For Shear	0.8	1.0

General Design & Material Notes

1. Sound walls must be comprised of concrete masonry blocks. Minimum f'_m = 2000 pounds per square inches. Minimum nominal block width = 8 inches.
2. The strength-reduction factors must be used as specified in Chapter 9 of The Masonry Society (TMS). Maximum sound wall height shall be 16 feet 2 inches.
3. Reinforced concrete masonry wall design must be per TMS strength design method. Design for wall in-plane loads is not required. Design must also satisfy the requirements of the CBC.
4. Horizontal reinforcement must meet the minimum TMS requirements for intermediate reinforced masonry shear walls. Bond beams are required at all horizontal reinforcement locations. Spacing must not exceed 48 inches.
5. Vertical reinforcement must be placed in pairs. Single centered reinforcing arrangements are not permitted.
6. Maximum spacing of vertical reinforcement must be 16 inches.
7. Minimum bar size, for vertical and horizontal wall reinforcement, must be #4. Reinforcing steel for sound walls on concrete barrier must comply with ASTM A706. Minimum yield strength (F_y) for all reinforcing steel must be 60 kips per square inches.

8. Wall expansion joints are required at 96 ft max on centers for barriers and on retaining wall or wherever there is an expansion joint in the bridge or barrier. Minimum length of any wall section must be 24 feet.
9. When masonry units are laid in stacked bond, ladder type, galvanized joint reinforcement must be required. The joint reinforcement must not be less than two continuous W9 wires at 48 inches maximum. This reinforcement is to be embedded in the mortar bed joints at 24 inches maximum between bond beams. Yield line analysis may be used for the vehicular collision load ultimate resistance calculations, per AASHTO A13.3.1.

Masonry Block Sound Wall on Retaining Wall

XS15-120-1, XS15-120-2

Walls placed directly on retaining wall are permissible only when the wall is located outside the clear recovery zone (CRZ) as defined in the Highway Design Manual.

Masonry Block Sound Wall with Barrier on Retaining Wall

XS15-130-1, XS15-130-2

Whenever sound wall is placed on top of concrete barrier on retaining wall, adequacy of the sound wall must be verified by a TL-4 crash test as defined in Manual for Assessing Safety Hardware (MASH) or must be designed to resist the vehicular collision loads Criteria as shown in AASHTO sections A13.2 and 15.8.4.The yield line analysis and strength design method, as outlined in AASHTO A13.3.1, must be used for the design of fully grouted masonry block sound wall and concrete barrier. Total capacity of the sound wall, R_w, must meet or exceed the TL level selected for design. Please note that M_c is not required to independently resist the full applied loading without contribution from M_w. Shear resistance at the interface of the wall and barrier must be evaluated per the shear friction method of ACI 318. For the shear demand at this interface, it shall be assumed that the load is uniformly distributed across L_c as calculated in AASHTO A13.3.1. Refer to AASHTO A13.3.1 for explanation of F_t, R_w, M_c, M_w and L_c.

Where retaining walls (including standard retaining wall types 1, 1A, 5 or 7) are used to support sound walls on concrete barriers, the retaining wall and foundation must be investigated for the full sound wall loading. This shall include the vehicular collision loads applied directly to the concrete barrier and to the sound wall (non-concurrent).

Additional Drawings Needed to Complete PS&E

For details not shown, see RSP B11-81 & RSP B11-82. Dimensions may vary with roadway cross slope and with certain thicknesses of surfacing, See Roadway Plans. For electrolier mounting details, see RSP B11-81, RSP B11-82, ES-6A, and ES-6B. If Chain Link Railing (CLR) is required or desired, it will be permissible to be attached to Concrete Barrier Type 842 Retrofit per Standard Plan B11-7.

Section 15 – Soundwalls

If the bridge rail 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 details will be required.

Contract Specifications

Caltrans Standard Specifications: Section 51 Concrete Structures, Section 52 Reinforcement, Section 56 Overhead Sign Structures, Standards, and Poles, 58 Sound Walls, Section 75 Miscellaneous Metal, and Section 83 Railings and Barriers.

Restrictions on Use of Standard Drawings

Site-specific seismic determinations are required for walls higher than 16 feet on retaining walls or higher than 16 feet and 2 inches on barriers on retaining walls or on bridges **or** when seismic acceleration is higher than as noted above. Seismic design methodology for ground-supported walls given in ASCE 7-16 must be used.

Designers must ensure that any supporting structures such as the bridge deck overhang or retaining wall meet the requirements in the AASHTO LRFD Bridge Design Specifications Section 13, Railings, and Appendix A13 and as amended by Caltrans' California Amendments.

Sound wall cannot be mounted on Concrete Barrier Type 836/842 Retrofit.

Special Considerations

Retrofitting barriers with sound walls may require replacing the entire barrier due to either its inadequate flexural capacity to carry the wall loads, or because of inadequate anchorage of the barrier to the deck. Bridge overhangs must be checked for structural adequacy. Check as-built plans for material capacities of the existing structure. Steel girder bridges may require strengthening. Do not place masonry block walls on existing steel girder bridges when traffic is carried on the structure during masonry construction. Traffic vibration will cause settlement of blocks into the mortar bed.

The addition of sound walls to existing bridges may cause changes in the structure deflections that could result in drainage problems along the deck surface. Existing profiles, cross slopes, and deflections must be checked to ensure adequate drainage when sound walls are placed on structures with flat grades.

Sound walls on approach slabs require special consideration. Standard Plan approach slabs are not designed to accommodate the wall dead load and lateral loads transferred from it. Also, approach slab settlement and deflection may cause structural and alignment problems. Isolation of these loads are required and will require a special design. Contact the Approach Slab Specialist for recommendations.

Clearance Detail on XS 15-130-2 or XS 15-140-2 applies only if sculptural pattern is required. Designer must delete this detail if sculptural pattern is not required.

Future overlays:

The height above Finish Grade for bridge railing at completion of construction contract cannot be less than the heights shown on the Revised Standard Plan sheets for Concrete Barrier Type 842. For example: 42 inches height above concrete deck or above Finish Grade with no overlay, or 42 inches height above the Finish Grade of a polyester concrete overlay.

All project-specific modifications to the above-mentioned Bridge Standard Details Sheets, must be reviewed by the Sound Wall Technical Specialist in the Caltrans/Division of Engineering Services/Office of Design and Technical Services. Please contact the Office of Design and Technical Services.