

VIRGINIA DEPARTMENT OF TRANSPORTATION

STRUCTURE AND BRIDGE DIVISION

INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: SOUND BARRIER WALL ATTACHMENTS	NUMBER: IIM-S&B-40.2
SPECIFIC SUBJECT:	Date: DECEMBER 3, 2007
	SUPERSEDES: BR-86-40.1
DIVISION ADMINISTRATOR APPROVAL: Kendal R. Walus, P.E. / Original Signed State Structure and Bridge Engineer Approved December 3, 2007	

Changes are shaded.

CURRENT REVISION

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- Converted to electronic format. The subject matter of the IIM did not change.
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EFFECTIVE DATE

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- This memorandum is effective upon receipt.
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POLICY

Provisions for sound barrier wall attachment to bridges are to be made when requested by the Environmental Division or when shown on the road plans.

The bridge is to be designed to carry the gravity loads of the sound barrier panels, the weight of the support posts, and the weights specified in the AASHTO group loadings listed in the latest edition of the *AASHTO Guide Specifications for Structural Design of Sound Barriers*. The design of the sound wall panels, posts and anchors shall be based on the guide specifications. Typically, this will require a wind loading of twenty to forty pounds per square foot applied to the sound barrier wall and used for the design of the sound panels, posts and anchors. The wind force used for the sound barrier wall varies with the height

above geographical or manmade obstructions that can disrupt straight line wind. As a general rule, select the wind pressure using the height from the center of the exposed sound barrier wall to the ground beneath the bridge. The bridge superstructure and substructure shall be designed to carry the wind loads specified in the AASHTO *Standard Specifications for Highway Bridges*. This load is typically on the order of fifty pounds per square foot applied to the area of exposed superstructure, including the area of exposed sound barrier wall.

The contract pay item for sound barrier wall normally includes the design and detailing of structure mounted and ground mounted walls. However, the bridge plans are to detail the anchorages for the sound wall posts. A note must be placed on the plans indicating the wind pressure and the weight of the sound wall used for the design of the anchorages. The plans and calculations submitted by the contractor shall be reviewed for conformity to the plans, specifications, supplemental specifications, and special provisions included in the contract. A generic special provision for sound barrier walls is attached.

Attachment

CC: Chief Engineer
Chief of Systems Operations
Director of Virginia Transportation Research Council
Division Administrators under the Chief Engineer
District Administrators
Resident Engineers
Federal Highway Administration

ATTACHMENT

----- GENERIC SPECIAL PROVISION -----

VIRGINIA DEPARTMENT OF TRANSPORTATION SPECIAL PROVISION FOR **SOUND BARRIER WALLS**

- I. **DESCRIPTION** - Sound barrier walls shall conform to the plans, Section 519 of the Specifications and the provisions herein. Ground mounted sound barrier walls shall be precast concrete with a sound absorptive finish. All structure-mounted walls shall be metal or other approved lightweight material with sound absorptive panels. The panels on structure-mounted metal barriers shall be oriented vertically or horizontally as the case may be to match the aesthetic features of the ground-mounted walls. In either case, panel orientation shall be such that panels are free draining to prevent moisture buildup and possible corrosion. Proposed structure-mounted sound barrier walls shall aesthetically match ground-mounted barriers as to color.

- II. **DESIGN PARAMETERS** - Sound barrier walls shall be designed in accordance with the current AASHTO *Guide Specifications For Structural Design of Sound Barriers* except as otherwise noted herein. All references in the *Guide Specifications* to “an industry recognized design specification” shall not apply without the prior authorization of the Engineer.

A 70 mph up through 90 mph wind load, as deemed appropriate for a given project area, exposure category B-2 design, shall be used for designing all ground mounted sound barrier walls. All structure-mounted sound barrier walls shall also be designed to a 70 mph up thru 90 mph wind load as deemed appropriate for a given project area, exposure category C, with panels weighing roughly 7.5 pounds per square foot, and posts placed 8 feet((parapet groove spacing)) on center for bridges and 12 feet for cast-in-place concrete retaining wall..

All sound absorptive precast concrete panels and footings shall be constructed in accordance with Sections 404 and/or 405 of the Specifications, except that patching of panels will not be allowed without the approval of the Engineer. Where patching is permitted by the Engineer it shall be performed in accordance with the panel manufacturer’s recommendations. Absorptive sound barrier walls shall be designed so that the absorptive portion of the panels on the highway side shall have a minimum noise reduction coefficient of 0.70.

Sound barrier walls shall be designed to be free flowing hydraulically so as not to trap surface water. Weep holes shall be provided in panels, where necessary, to facilitate proper drainage. A graded ditch or similarly functional drainage shall be provided in front and behind of the barrier wall to control and dispose of roadway and slope drainage. The ground mounted sound barrier posts and bottom precast concrete wall panels shall be designed in consideration of the additional load created by the ditch slope where it rests against the wall. Drainage design shall not create sound leaks.

III. PANEL REQUIREMENTS - Where sound absorptive panels have a structural concrete or other approved material core, the sound absorptive finish shall be permanently bonded or attached to the core material and have the same service life as the core material. The absorptive finish of precast concrete barriers shall meet the requirements of ASTM C666, Procedure B, for 300 cycles.

Finish on the roadway side of the precast concrete absorptive barrier shall be vertically fluted. Finish on the landowner's side of precast sound barrier walls shall be fuzzy raked. No absorptive finish is required on that portion of the base panels below ground and 6 inches above the ground line. Base panels shall be a minimum height of 2 feet and shall be embedded in the ground a minimum of 6 inches to prevent sound leaks. Panels having deficiencies such as cracking, crazing, scaling, efflorescence, segregation, mottling of the color coating or stains on the finish shall be rejected.

Maximum length of ground-mounted panels shall be 24 feet. Steps created at the top of wall panels when traversing a grade shall be as uniform in height as possible. Once installed, the edges of stacked panels shall be neat, and sides that mate together shall be straight and true. Irregularities at panel edges that appear broken, ragged or chipped to the extent that a gap appears once they are stacked will be cause for rejection. When panels are stacked, horizontal joints shall typically be 4 feet c-c maximum, and aligned to create continuous horizontal lines; however, foundations and/or ground contact panels may be adjusted within the limits established herein to provide for the continuous horizontal alignment of joints. Horizontal joints formed where panels mate together and false or dummy joints (if present) must match in appearance and alignment.

Where sound barrier panels do not occupy the full width between the flanges of the sound barrier posts, panel attachment details shall be furnished with the working drawings. Such details shall also include material descriptions. Post flanges and panels shall overlap at least 1-1/2 inches after installation. Spacer blocks/wedges will not be permitted. The face of the panel on the roadway side of the barrier shall fit tightly against the post flange for the full height of the panel after installation.

Color of sound barrier walls shall be Federal Standard 595B-30313 or comparable. Proposed precast concrete ground mounted sound barrier walls shall be colored on the roadway side of the barrier only. Color of metal barrier shall match as closely as possible that of ground mounted barrier. If the structure mounted metal sound barrier walls have sound absorptive perforated metal panels, the panels shall be painted a matte powder coat finish with a colorant from the Department's approved listing. The Contractor shall contact the Project Engineer at the appropriate district office, to verify wall color prior to fabrication.

The Contractor shall erect a sample section of the ground mounted wall at the job site prior to receiving final written approval to proceed with panel fabrication from the District office. The sample section shall be three bays of panels with posts to show how panels shall be secured to posts with attachment hardware. Sample panels must show the attachment area formed in the panel. Further, sample panels shall show color and finishes of both sides of the wall.

- IV. **POST REQUIREMENTS** - If steel posts are used they shall be fabricated from steel conforming to the requirements of ASTM A36. All steel and miscellaneous hardware used above the foundation shall be galvanized after fabrication. Structure mounted walls shall have steel posts. Anchor bolts for structure-mounted walls shall be integrally cast into parapets. Adhesive or epoxy anchors will not be permitted as a method of post attachment for structure mounted walls. The details of the connection of the structure mounted wall panels to the steel posts shall be as shown in the plans for bridges and retaining walls. Connections between the panel and the posts and the sound barrier wall and the bridge shall account for the movement of the bridge as well as the expansion and contraction of the panels. Post spacing, size and attachment details shall be incorporated into the working drawings.

The Contractor is advised that slip forming of bridge parapets where structure mounted sound walls is to be attached will not be allowed by the Department due to the use of embedded anchors for post attachment. Bridges with sound barrier walls attached to the parapets have been designed assuming a mass of weight of 7.5 pounds per square foot of sound barrier wall.

The maximum deflection of supporting posts for sound barrier walls shall be limited to the pertinent span length divided by 240. The unbraced length used for bending design of steel posts shall be taken as the actual length of the cantilever unless both flanges are sufficiently braced to allow a reduction of the unbraced length of section. (This paragraph is intended as a clarification of the design specifications. It is not intended to imply additional requirements other than those already specified in the AASHTO specifications)

Anchor bolts for general use in attaching sound barrier posts shall conform to Section 226 except as provided herein. Anchor bolts shall conform to AASHTO 314, Grade 36 or 55. Where high strength anchor bolt material is used, the design shall be limited to a maximum yield strength of 55 ksi and a maximum ultimate tensile strength of 75 ksi. Hydraulic cement grout conforming to Section 218 shall be placed between the base plate and the top of the foundation to retard corrosion of the anchor bolts but shall not be considered a factor for strength purposes. Ground mounted anchor bolts shall be covered with hot asphalt after installation.

- V. **FOUNDATION REQUIREMENTS** - Existing ground line elevations shall be established and verified by the Contractor prior to submitting working drawings. The Contractor shall remove and dispose of all above ground obstruction such as trees and other clearing and grubbing items unless otherwise directed by the Engineer. Excavation of tree roots, existing limited access fence and other clearing and grubbing items such as those identified in Section 301 required for the placement of walls shall be included in the square foot price bid of the sound barrier walls.

The Contractor is advised that the Department has not performed subsurface investigation to locate existing utilities on this project. Therefore, it shall be the Contractor's responsibility to perform this work so as to avoid utility conflicts with the construction associated with the proposed sound barrier wall. The Contractor shall adjust foundations to avoid conflicts with pipes or utilities. Wall panel lengths may be shortened or lengthened so that foundation locations may be adjusted to avoid conflicts and clear existing pipes, utilities and other underground obstructions. When a conflict cannot be avoided using this method, the Contractor must submit his alternative design

for the Department's written approval. The Contractor shall modify the design of wall foundations where foundations may conflict with the limits of proposed or existing rights-of-way or where foundation designs may leave a portion of the foundation exposed above the finished ground line. Such conflicts and proposed modifications shall be reviewed with the Engineer prior to installation. Where sound barrier walls are self-supporting, they shall be designed to prevent pipe or utility damage caused by excessive bearing loads when placed over pipes, utilities or other underground obstructions.

Foundation designs may require pilings, caissons, or special design as indicated by subsurface investigations (Soil reports and boring logs) taken at appropriate intervals to establish soil capacity. Copies of the geological data are available in the office of the District Materials Engineer in which the project is located. In no case will the foundation for the wall be located on top of the duct banks for any of the TMS Center's equipment. Soil friction angle and strength of soils shall be used when designing foundations. Foundations shall be designed in accordance with *Section 4 Foundations*, of the *AASHTO Specifications for Highway Bridges*.

The Brom's method may be used for the design of laterally loaded caissons. For Group II and Group IV where wind is a contributing load, a minimum safety factor of 2.25 shall be used if soil parameters are based on the results of standard penetration tests. When parameters are based on the results of subsurface exploration and laboratory testing programs as detailed in Section 4.3 of Section 4 Foundations, or are set by the Department, a safety factor of 1.9 may be used. The soil at the surface to a depth equal to the diameter of the caisson shall not be considered effective when calculating the required embedment of the caisson. The minimum area of longitudinal reinforcement for caisson type foundations shall be greater than 1 percent of the gross area of the foundation section.

For walls on spread footings, a bearing capacity analysis shall be submitted as part of the calculations and the safety factor against bearing failure shall be taken as 2.25 for Group II and Group IV where wind is a contributing load. The ground surface slope shall be taken into account when determining bearing capacity of the soil. Embedment of footings shall be in accordance with AASHTO specifications.

For walls on piles, design shall be in accordance with Section 4, Foundations. The factor of safety shall be on the level of construction control as required in section 4.4.6.2. The required factors of safety may be modified by the allowable overstress permitted in the wind load condition.

Foundation design will be considered incidental and all costs associated with foundation design shall be included in the price bid per square foot of sound barrier wall.

VI. WORKING DRAWINGS AND REVIEW

Working drawings for sound barrier walls shall conform to the requirements of Section 105.02 except as noted herein. Working drawings shall contain all specific details and dimensions necessary for the complete review, construction and inspection of the work. The working drawings for sound barrier walls shall also reflect coordination with the working drawings for retaining walls where applicable. Working drawings shall be

certified by a Professional Engineer holding a valid license to practice engineering in the Commonwealth of Virginia.

Working drawings shall be formally submitted as described in Section 105.02 of these Provisions. In order to expedite the review of the working drawings, three advance copies shall be sent to the individual listed below. Advance copies shall contain all hand calculations verifying the adequacy of the design. Hand calculations shall also indicate the design methodology and validate the results of the worksheets. VDOT Central Office contact:

Virginia Department of Transportation
Location and Design Division
Engineering Services
1401 E. Broad Street
Richmond, Virginia 23219

Payment will be made under: Any changes to the working drawings by the Contractor after the initial submittal shall be clearly identified. Changes shall be identified on the working drawings and denoted in narrative form (i.e. cover letter) and dated after making all requested changes. This format shall be followed until all requested changes are completed to the satisfaction of the Engineer.

VII. MEASUREMENT AND PAYMENT

Precast Sound Barrier Wall will be measured and paid for in accordance with Section 519 of the Specifications except that the precast sound barrier shall be measured at the contract unit price per square foot of surface area from existing ground line or finished grade line to the sound attenuation line shown in the proposal. The 6 inch minimum embedment in the ground of all base panels of ground-mounted precast sound barrier walls will be considered incidental and will not be measured for separate payment.

Sound barrier walls will be measured at the contract unit price per square foot of surface area from the top of the bridge parapet or retaining structure to the sound attenuation line shown in the proposal.

The price bid shall also include furnishing, installation, providing modifications to avoid utility, right-of-way, foundation exposure, and other structures whose foundations or designs may conflict. The cost of foundation designs and supplemental geotechnical investigation and foundations shall be considered incidental and will not be measured for separate payment but shall be included in the price bid per square foot of sound barrier wall.

Pay Item	Pay Unit
Precast Concrete Sound Barrier Wall, Absorptive	Square Foot
Sound Barrier Wall	Square Foot

519 - SOUNDWALL COLOR COATING

- I. **DESCRIPTION** - This work shall consist of furnishing and applying a soundwall color coating in accordance with this provision. The color and location shall be as specified on the plans or as directed by the Engineer.
- II. **MATERIALS** - The soundwall color coating shall not diminish the noise absorption coefficient specified for the soundwall upon which it is applied when tested in accordance with ASTM C423. The coating shall be a semiopaque toner containing methyl methacrylate-ethyl acrylate copolymer resins with toning pigments suspended in solution at all times by a chemical suspension agent and solvent. Color toning pigments shall consist of laminar silicates, titanium dioxide and inorganic oxides. There shall be no settling or color variation. The use of vegetable or marine oils, paraffin materials, stearates or organic pigments in the coating formulation will not be permitted.

Physical properties of the coating shall be as follows:

Mass per gallon	8.3 pounds (min.)
Solids by mass	30 percent (min.)
Solids by volume	21 percent (min.)
Drying time	30 minutes (max.) at 70°F and 50 percent humidity

Coating material shall not oxidize and shall show no appreciable change in color after 1000 hours when tested in accordance with ASTM D822; shall have excellent resistance to acids, alkalis, gasoline and mineral spirits when tested in accordance with ASTM D543; shall allow moisture vapor from the concrete interior to pass through when tested in accordance with ASTM E398 or D1653; and shall reduce the absorption rate of exterior moisture into the pores of the concrete surface when tested in accordance with Federal Specification TT-C-555 B.

The soundwall color coating shall be from the approved list of absorptive concrete soundwall color coatings.

- III. **APPLICATION** - Surface preparation, application rate and application procedures shall be as specified by the coating manufacturer, using airless spray equipment, having a minimum capacity of 1,000 psi and 1/2 gallons per minute. Coating shall not be applied when the air temperature is below 50°F, to damp surfaces or when the air is misty or unsatisfactory for this work as determined by the Engineer.
- IV. **QUALITY CONTROL PANEL** - Prior to beginning coating operations the Contractor shall provide and erect on the project site a representative sample of the color coated soundwall containing at least 30 square feet, for approval of uniformity and appearance of the color coating. This approved sample shall remain on the project site and will be used by the Engineer as a basis for comparison and acceptance of the Contractor's finished coating.

V. METHOD OF MEASUREMENT - Unless otherwise specified, soundwall color coating will not be measured for separate payment but shall be included in the price bid for sound barrier wall.

When specified as a contract item, soundwall color coating will be measured in square feet of surface coated.

VI. BASIS OF PAYMENT - When specified as a contract bid item soundwall color coating will be paid for at the contract unit price per square foot, which price shall be full compensation for furnishing and applying the soundwall color coating, surface preparation and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

Pay Item	Pay Unit
Soundwall Color Coating	Square Foot