NOISE BARRIERS

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I. GENERAL

A. Preliminary Considerations

The Designer shall obtain preliminary information necessary for the design of noise barriers from the Authority. This information will include the following:

- Types of noise barriers to be used
- Required height, length and offset for noise abatement
- Architectural treatments.

Refer to Subsection II for more information concerning preferred types of barriers and architectural treatments.

In general, the Authority is responsible for determining the types of noise barriers and the architectural treatments of noise barriers along with the required height, length and offset of noise barriers for noise abatement.

The Designer shall notify the State's One Call System, identify and verify all existing utility and fiber-optic conduits in the vicinity of the proposed noise barrier wall alignment. If any existing facility interferes with the noise barrier, the Authority shall be contacted for possible relocation of the existing elements or realignment of the barrier as appropriate.

B. Design Criteria

The AASHTO Guide Specifications for the Structural Design of Sound Barriers shall be used at this time. The allowable stress design method (working stress design method and a 90 mph wind design speed) shall be used for all components of noise barriers.

Design criteria, not specifically herein addressed, shall conform to applicable Sections of the AASHTO LRFD Specifications, with current interims as modified by Chapter 9 of this Manual.

The following Tables 20-1 through 20-4, obtained from the AASHTO Guide Specifications, shall be referred to for verification of the design category and shall be used for the design of Noise Barriers.

Notes:

1. Adjoining ground surface shall be defined as the ground elevation (or water elevation) immediately adjacent to the structure. In situations where noise barriers are mounted on bridges and retaining walls, the height to be utilized in determining the design wind pressure, P, shall be taken from the lowest average ground or water elevation adjacent to the noise barrier, to the centroid of the loaded area.
2. C_c refers to the combined height, exposure and location coefficient.

Table 20-1: Minimum Wind Pressure on Sound Barriers Located in Coastal Regions

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, feet, H	Cc	Minimum Pressure (P), psf for the Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	1.20	40	50	62	75
$14 < H \leq 29$	1.37	46	58	71	87
Greater Than 29	1.49	50	63	77	94

This Table is to be used for both ground mounted and structure mounted noise barriers in flat unobstructed areas exposed to wind flowing over large bodies of water and extending inland from the shoreline a distance of ½ mile.

Table 20-2: Minimum Wind Pressure on Sound Barriers Located on Bridge Structures, Retaining Walls or Traffic Barriers

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, feet, H	Cc	Minimum Pressure (P), psf for the Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	0.80	27	34	42	50
$14 < H \leq 29$	1.00	33	42	52	63
Greater Than 29	1.10	37	46	57	69

This Table is to be used in open terrain with scattered obstructions. This includes flat,

open country and grasslands. This exposure shall be used for all sound barriers located on bridge structures, retaining walls or traffic barriers not covered by Table 20-1.

Table 20-3: Minimum Wind Pressures on Sound Barriers Not Located on Structure

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, feet, H	Cc	Minimum Pressure (P), psf for the Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	0.59	20	25	31	37
$14 < H \leq 29$	0.75	25	32	39	47
Greater Than 29	0.85	28	36	44	53

This Table shall be used in urban and suburban areas with open terrain that does not meet the requirements of Table 20-4. Generally, this Table should be used for ground mounted noise barriers.

Table 20-4: Minimum Wind Pressure on Sound Barriers Not Located on Structures.

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, feet, H	Cc	Minimum Pressure (P), psf for the Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	0.37	12	16	19	23
$14 < H \leq 29$	0.59	17	21	26	31
Greater Than 29	0.59	20	25	31	37

This table is to be used in urban and suburban areas with numerous closely spaced obstructions having the size of single-family dwellings or larger that prevail in the upwind direction from the noise wall for a distance of at least 1,500 feet. Wind loads shall be applied perpendicular to the wall surface.

C. The following are load groups to which the noise barriers may be subjected. Each part of the structure shall be proportioned for the load combinations. Foundations shall be proportioned according to Subsection IV.

Wind Loads
Earth Loads
Traffic Loads
Ice and Snow Loads
Bridge Loads

The AASHTO LRFD Specifications shall be used to determine these loading conditions. The following information for Seismic Loads as well as the AASHTO Standard Specifications shall be referenced in considering the Seismic load combination.

Seismic Loads

The seismic dead load, EQD, in the following formula shall be computed as follows:

$$EQD = A \times f \times D$$

Where: EQD = Seismic dead load
D = Dead load of noise barrier, excluding foundations
A = Acceleration coefficient (as per Chapter 9, Section VI of this Manual)
f = Dead load coefficient (as shown below)

f	
0.75	Dead load, except on bridges
2.50	Dead load, on bridges
8.0	Dead load for connections of walls, not cast in place, to bridges
5.0	Dead loads for connections of walls, not cast in place, to retaining walls

The dead load shall consist of the weight of all the component materials making up the noise barrier, excluding the foundation. The point of application of the Seismic Dead Load, EQD, of the individual components shall be at their respective centers of gravity.

When a noise barrier is supported by a bridge superstructure, the wind or seismic load to be transferred to the superstructure and substructure of the bridge shall be as specified herein. Additional reinforcement may be required in concrete barrier curbs and overhangs to resist the loads transferred by the noise barrier.

D. Functional Requirements:

1). Guard rail or concrete barrier curb shall be installed when the noise barrier is located within the clear zone (see Chapter 5 for more information).

2). Stopping sight distance criteria shall apply in determining the location of a noise barrier. Horizontal clearances which reduce the stopping sight distance shall be avoided. In those extreme cases where reduced stopping sight distances may be warranted, justification shall be provided and approval shall be obtained to justify the need.

3). Minimum Height - Noise barriers should have a minimum height consistent with that of a right of way fence (measured from the top of the barrier to the ground). Height requirements will be determined by noise studies performed by the Authority. When the tops of noise walls have to be stepped, the maximum height of step should not exceed 2 feet.

When noise barriers higher than 15 feet are required by sound studies, consideration of surrounding features should be evaluated such that an exceptionally high wall does not create an unsightly impact on the environmental aesthetic features of the territory.

4). Barriers can obstruct light as well as noise. Special consideration shall be given to possible roadway icing and other induced environmental conditions caused by the placement of the wall.

5). It is important to have drainage facilities along noise barriers to assure soil stability. Soil with phi (N) angles of 25 degrees or less may develop flowing characteristics when saturated. Surface runoffs should be directed away from the noise barrier.

6). Provisions may be necessary to allow access to fire hydrants on the opposite side of the noise barrier. The designer should consult with local fire and emergency officials regarding their specific needs.

7). For noise barriers that bridge conduits, provisions should be made to accommodate differential settlement in the noise barriers substructures.

8). Noise Barriers shall be designed to retain all anticipated differential fills plus an additional 2 feet of soil as a minimum.

9). The Phase A Submission for Noise Barriers shall include a Report to address the possibility of icing, the storage of snow, utilities impact, drainage, mounting on culverts or bridges and the issues discussed in items 4, 5, 6, 7 and 8 above.

E. Maintenance Considerations:

1). Noise barriers placed within the area between the shoulder and right of way line may complicate the ongoing maintenance and landscaping operations, especially if landscaping is placed on both sides of the noise barrier. Consideration should be given to maintaining the adjoining land behind the noise barrier and adjacent to the right of way line.

2). In some urban areas, noise barriers may be subjected to graffiti being placed on their surfaces. In these locations, the surface texture selected should be such that it is difficult to place the graffiti or such that the graffiti is easily removed. Noise barriers with rough textures and dark colors tend to discourage graffiti.

3). Access to the back side of the noise barrier should be provided for inspection, litter control, soil erosion monitoring, grass mowing and maintenance. In subdivision areas, access may be via local streets, when available. If access is not available via local streets, access gates or openings are essential at intervals along the noise barrier. Offset barriers concealing the access opening must be overlapped a minimum of 2 times the offset distance in order to maintain the integrity of the noise attenuation of the main barrier. Location of the access openings should be coordinated with the appropriate agency or landowner.

F. Noise Barriers on Bridges:

1). Provisions for expansion shall be placed in the noise barrier at locations of bridge deck expansion joints and at parapet deflection joints.

2). For noise barrier retrofit onto existing bridges, the Designer must verify that the dead and live load from the wall do not overstress any component of the bridge including the existing parapets, slab overhang, girders and superstructure or substructure members.

The dead load of noise barriers can affect the overload capacity and deflection of some bridges. Check the change in load capacity of the bridge and verify whether the change is acceptable.

II. TYPES OF BARRIERS

A. Precast reinforced concrete post and panel systems are preferred; however, if unusual site conditions prohibit the use of a post and panel system, another noise barrier type may be considered (such as aluminum or lightweight proprietary systems for bridges). Determination of the type of barrier and architectural treatments to be used at a site prior to the design of the barrier will be made by the Authority. The Designer shall obtain the necessary information regarding barrier type and architectural treatments from the Authority and shall refine and incorporate this information into the design.

B. In most cases, foundations for noise barriers shall be drilled shafts; however, in cases where shallow rock formations exist, spread footings will be unavoidable. The designer shall select the most cost-effective foundation based on a thorough geotechnical investigation. Noise barriers on bridges shall be mounted on the parapets or attached directly behind the parapet.

In a retrofit or rehabilitation situation, where it is determined that the existing or rehabilitated structure cannot accommodate the noise barrier loading, a separate supporting structure for the noise barrier may be considered. Sound leakage between the parapet and noise barrier shall be prevented by the use of flashing or other mechanical means.

C. A number of proprietary sound barrier systems are available for use on bridges or where unusual site conditions prohibit the use of a post and panel system. The materials, load carrying mechanisms and capabilities vary with each system; however, these systems shall conform to the criteria outlined in Subsection I as well as the current Standard Specifications and applicable project Special Provisions. Proprietary wall systems shall be approved prior to the design of the barrier.

III. MATERIALS

A. Concrete for cast in place foundations and precast/prestressed posts and panels shall conform to the Standard Specifications. Class C concrete shall be used for foundations and Class P concrete shall be used for precast elements.

B. Reinforcing steel shall conform to ASTM A615, Grade 60, f_s =24 ksi.

Welded wire fabric fabricated from deformed wire may be substituted for reinforcing bars in noise barrier panels only. Refer to Standard Specifications for additional criteria concerning the use of welded wire fabric reinforcement.

The provision of corrosion protected reinforcement shall be as determined on a project to project basis. The location of the noise barrier panels, in relationship to the offset distance from the roadway, shall be evaluated to determine if provision of corrosion protected reinforcement is warranted.

If the location of the noise barrier panels may subject the panels to splashing from the roadway surface, provision of corrosion protected reinforcement, should be recommended. In such cases, the panels anticipated to be affected by this splashing should be scheduled for placement of corrosion protected reinforcement.

C. Allowable stresses for aluminum shall conform to the current edition of the Aluminum Association Specifications for Aluminum Structures. The allowable stresses pertaining to bridge structures shall be utilized.

IV. FOUNDATION DESIGN

A. The method of design for drilled shaft foundations shall be approved, or as directed, by the Authority. Acceptable methods shall include Broms Theory and approved computer methods of analysis such as COM624P and LPILE. The lateral load determined by the Controlling Group Load Case and from Section 20, Subsection I.C shall be applied to the noise barrier and shall be multiplied by a factor of 2 to obtain F, the applied lateral load. The intent of this procedure is to maintain a factor of safety of 2 against overturning. The allowable overstresses referenced in the Section 20, Subsection I.B publications should not be applied to the allowable soil strength.

B. Special Requirements for Sloped Soil Conditions

As stated in Appendix C, Part B of the AASHTO Guide Specifications for the Structural Design of Sound Barriers, a level ground condition is defined as one in which the ground surface is approximately level or, when sloping down and away from the drilled shaft foundation, is not steeper than 1:10 (V:H) for phi (ϕ) = 35 degrees or 1:14 (V:H) for phi (ϕ) = 25 degrees. When these conditions prevail within a distance of two times the drilled shaft foundation embedment, the ground may be considered level, regardless of steeper slopes outside these limits.

Drilled shafts located in slopes shall be protected by a berm that shall be level and provide a minimum cover of 12 inches over the drilled shaft. It shall extend a minimum of 12 inches beyond the face of the drilled shaft.

Sloped soil conditions shall be taken into account when computing the required embedment length for drilled shaft foundations.

C. A foundation report shall be submitted for noise barriers in accordance with Chapter 12 of this Manual.