

FLORIDA DEPARTMENT OF TRANSPORTATION



**CONCRETE SOUND BARRIER
QUALIFIED PRODUCTS LIST (QPL)
ACCEPTANCE CRITERIA**

**FDOT STRUCTURES MANUAL
VOLUME 6
JANUARY 2011**

Structures Design
Florida's Transportation Engineers



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CHAPTER 1 CONCRETE SOUND BARRIERS (Rev. 01/11)

1.1 GENERAL (Rev. 01/11)

The Sound Barrier Qualified Products List (QPL) is for concrete sound barriers outside the clear zone. These acceptance criteria cover three different types of QPL categories:

- A. Concrete Sound Barrier panels (see definitions) used with FDOT Standard Post and Foundations.
- B. Sound barrier posts and foundations used with FDOT Standard Precast Concrete Sound Panels or their approved alternates.
- C. Complete Concrete Sound Barrier systems (see definitions), including foundations.

Commentary: The purpose of these acceptance criteria is to allow vendors to substitute their products either in part or entirely for FDOT's Standard Precast Sound Barrier System. Alternate products must utilize the same design criteria and assumptions, which are outlined in these criteria, as FDOT's Standard Precast Sound Barrier System.

1.2 DEFINITIONS (Rev. 01/11)

The following definitions are provided for commonly used terms in these criteria (for additional definitions, see ASTM C 634 and Section 1 of the [FDOT Standard Specifications for Road and Bridge Construction](#)):

Design Life - The period of time with no discernible change in the barrier insertion loss or appearance.

Maintenance Free Life - A period during which maintenance activities will not be required.

Noise Reduction Coefficient (NRC) - The Noise Reduction Coefficient is the arithmetic average (to the nearest 0.01) of the Sound Absorption Coefficients of a material in the one-third octave bands centered at 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz.

Post - Posts are generally considered to be the vertical supports for the panels and shall be able to provide structural support of the Sound Barrier system under various loads.

Sound Absorption Coefficient (SAC) - The sound-absorbing ability of the barrier surface is given in terms of an absorption coefficient. The coefficient is defined as the ratio of the energy absorbed by the surface to the energy incident upon the surface. The Sound Absorption Coefficients shall be normalized so the highest value is no greater than 1.

Sound Barrier - A continuous structure, generally not greater than 22 feet high, with the primary function of traffic noise abatement to adjacent properties. Described as a Noise Barrier in the [Project Development and Environmental Manual](#).

Sound Barrier Panel - The component of a Sound Barrier that spans between posts. Depending on the design, several panels may be required to fill the space between posts.

Sound Barrier System - All of the components of a Sound Barrier, including the foundation.

Sound Transmission Class (STC) - Sound Transmission Class is a single number rating of the transmission loss properties of a barrier panel. Measured transmission loss data is plotted versus frequency and compared with standard contours according to rules outlined in ASTM E 90 and ASTM E 413.

1.3 REFERENCED STANDARDS

1.3.1 ASTM Standards (Rev. 01/11)

C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

C 634 - Standard Terminology Relating to Environmental Acoustics

E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

E 413 - Standard Classification for Rating Sound Insulation

1.3.2 Other Standards (Rev. 01/11)

AASHTO Guide Specifications for Structural Design of Sound Barriers 1989 with 1992 and 2002 Interims

AASHTO Standard Specifications for Highway Bridges

Federal Standard 595B Color Code

Florida Department of Transportation Standard Specifications for Road and Bridge Construction (FDOT Standard Specifications)

Industrial Acoustics Noise Control Reference Handbook

FDOT Design Standards

FDOT Soils and Foundation Handbook

FDOT Project Development and Environment Manual (PD&E Manual) Volume 2 Chapter 17

1.4 SOUND BARRIER REQUIREMENTS

1.4.1 General

1.4.1.1 Design (Rev. 01/11)

The structural components of Sound Barriers shall be designed in accordance with the ***AASHTO Guide Specifications for Structural Design of Sound Barriers 1989 with 1992 and 2002 Interims*** (load factor design) and these criteria. Sound Barrier components shall be analyzed and designed using established engineering principles.

All sound barriers in the State of Florida shall be designed for a minimum wind velocity of 110 mph. If the sound barriers are not located on other structures, the wind pressures shown in Table 1-2.1.2.C (Exposure B2) of the referenced **AASHTO Guide Specifications** shall be used. If the sound barriers are located on bridge structures, retaining walls, or traffic barriers, the wind pressures shown in Table 1-2.1.2.D (Exposure C) of the referenced **AASHTO Guide Specifications** shall be used. For sound barriers located on embankments and structures, the height zone shall be determined by using the elevation of adjoining ground as being the approximate elevation of the original ground surface prior to embankment construction.

Deflection limits for various systems and components are given below. More restrictive panel and barrier deflection limits may be required based on the specific barrier system utilized.

1.4.1.2 Concrete Sound Barrier Panels used with FDOT Standard Posts and Foundation (Rev. 01/11)

Wall panels must be compatible with FDOT's standard posts and foundations. FDOT standard posts are reinforced concrete and standard foundations are auger cast piles. Sound Barrier panels shall be concrete and demonstrate that they can be securely connected to the standard post. The Vendor shall provide details showing how movement between the panel and post will be limited.

Assumed wind load pressure for wall panel design is 47 psf. The maximum deflection of wall panels due to wind load shall not exceed the lesser of $1/180^{\text{th}}$ of the post spacing or $1\frac{1}{2}$ inches of deflection (measured relative to posts).

All concrete wall panels shall be a minimum of 6 feet high, unless emergency access is required as specified in [Section 1.10](#), then the bottom concrete panel shall be a minimum of 8 feet high.

Acoustically seal the sound panel joint between adjacent sound panels so that the acoustical efficiency of the Sound Barrier is not degraded. Details for an acoustic sound barrier seal between the panels shall be required in all cases for Sound Barrier panels.

Commentary: The minimum bottom panel height of 6'-0" was chosen to clear required fire hose access holes. The minimum bottom panel height of 8'-0" for Sound Barriers requiring emergency access was chosen to allow forming and installation of 6'-0" high doors.

1.4.1.3 Concrete Sound Barrier Posts and Foundations used with FDOT Standard Concrete Sound Panels or Their Approved Alternates (Rev. 01/11)

Submit a detailed package for the posts and foundations, including a step by step field construction manual, as appropriate (i.e., installation method is not covered by the **Specifications**). For this approval, post and foundation design calculations are required

(Section 1.13 for details). In addition to the requirements in this section, posts and foundations shall meet all requirements set forth in these criteria as applicable.

Posts shall be completely compatible with FDOT's precast concrete wall panels to allow easy substitution of alternate QPL approved Concrete Sound Barrier panels. Posts and foundations shall demonstrate how they can meet placement tolerances outlined in **Specification** Section 534.

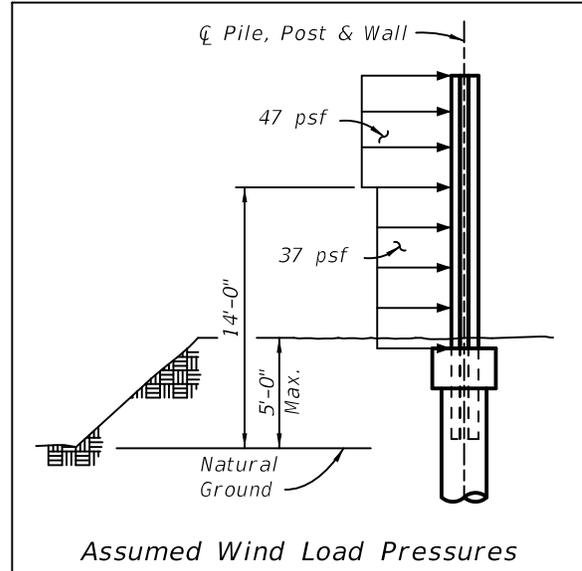
Sound Barrier posts and foundations shall be designed assuming that the wall is placed 5 feet above the surrounding ground. Assumed wind load pressures are defined below:

Wind Loads for Posts and Piles (if present):

37 psf - Height Up to 14 ft.

47 psf - Height Over 14 ft. to 29 ft.

The maximum deflection at the top of barriers or posts, due to service wind load, shall not exceed the lesser of $1/50^{\text{th}}$ of the wall height or 5 inches. Also, the lateral displacement of the pile head at ground level shall not exceed 1 inch based on either 10'-0" or 20'-0" post spacing, and with soil SPT N values of 4 to 9 and 10 to 40. The deflections shall be measured relative to the point of fixity in the soil.



Foundations shall be designed assuming the following soil conditions:

1. Standard Penetration Test (SPT) N Values ranging between 4 to 9 and 10 to 40.
2. Soil Unit Weight = 40 pcf (saturated).
3. Internal Friction Angle = 30
4. Soil Subgrade Modulus = 25 pci.

Design auger cast piles in accordance with the Soils and Foundations Handbook, Appendix B. See Design Standards Index 5200 for standard auger cast pile foundation sizes and depths. Increase auger cast pile foundation diameters to 36 or 42 inches when depths exceed 30 feet.

If project specific designs on shallow foundations are required, the maximum deflection due to service wind load shall not exceed 3 inches (deflection measured relative to the base of the barrier system).

Commentary: Design wind pressure and soil conditions assume the most likely scenario of a hurricane event (110 mph wind velocity in saturated soil).

Spread Footing Sound Barrier Foundations: In addition to meeting bearing, overturning, and sliding requirements per **AASHTO Guide Specifications for Structural Design of Sound Barriers**, all Sound Barrier spread footing designs shall meet the following:

The resultant of the ground pressure distribution shall fall within the middle-half of the footing.

Commentary: The middle-half rule addresses concerns associated with cyclic wind loads, effects of soil softening (saturated) under edges of rigid footing, potential pumping, etc.

1.4.1.4 Complete Concrete Sound Barrier Systems (Rev. 01/11)

Submit a detailed package for the entire Sound Barrier system, including the foundation, posts and panels. For this approval, Sound Barrier panel, post and foundation design calculations are required. Design criteria are the same as outlined in [Section 1.4.1.2](#) for panels and [Section 1.4.1.3](#) for posts and foundations.

1.4.2 Materials

1.4.2.1 General (Rev. 01/11)

All materials shall withstand prolonged periods of exposure to moisture. Where absorptive materials are used in a Sound Barrier panel, all edges shall be sealed to preclude moisture from entering the interior. Absorptive materials in panels shall have a 25 year minimum design life.

Support components of absorptive Sound Barriers shall not degrade potential sound attenuation.

1.4.2.2 Concrete (Rev. 01/11)

All concrete Sound Barrier components shall be Class IV as defined in **Specification** Section 346. The concrete cover on all reinforced and prestressed concrete designs shall be a minimum of 2-inches, and have a 50 year design life. All exposed concrete surfaces shall receive a Class 5 Applied Finish Coating in accordance with **Specification** Section 400 at a minimum.

1.5 LOCATION (Rev. 01/11)

On roadways with flush shoulders, Sound Barriers shall be located outside the clear zone, and as close as practical to the right of way line. Sound Barriers within the clear zone must be shielded. On roadways with curb or curb and gutter, Sound Barriers shall be a minimum of 4 feet behind the face of curb; however, additional setbacks may be required to meet minimum sidewalk requirements.

Non crash tested Sound Barriers on bridges shall be placed a minimum of 5 feet beyond the gutter line of the bridge traffic railing barrier.

1.6 ACOUSTICS

1.6.1 Sound Transmission Class (STC) (Rev. 01/11)

The random incidence sound transmission losses of the panel material when tested in accordance with ASTM E 90, shall have a STC rating of Delta "T" equal to or greater than 20.

Testing of Sound Barrier panels using concrete for structural integrity shall submit Sound Transmittal Loss (TL) verification based on Mass Law as noted in the [Noise Control Reference Handbook](#).

1.6.2 Noise Reduction Coefficient (NRC)

Sound absorptive panels shall be tested to determine the NRC in accordance with ASTM C 423. Testing shall be completed by an independent **National Voluntary Laboratory Accreditation Program (NVLAP)** certified facility. Any Sound Barrier panel or system shall achieve an NRC rating equal to or greater than 0.80 to be classified as sound absorptive. All other NRC ratings will be classified as sound reflective.

1.7 EXPANSION JOINTS

When the Sound Barrier alignment traverses structure expansion joints, the panels or system shall be capable of accommodating thermal movement of the Sound Barrier and structure within stress levels in accordance with the **AASHTO Standard Specifications for Highway Bridges** and without reducing acoustical attenuation for Sound Barriers.

1.8 HEIGHT (Rev. 01/11)

Ground mounted Sound Barrier System designs shall provide details of methods and materials to be used to accommodate heights to 22 feet above the top of the foundation.

1.9 DRAINAGE/UTILITIES

Drainage and/or utility openings shall not degrade the acoustical efficiency of a Sound Barrier by more than 0.5 dBA at 20 feet from the opening. Openings shall prevent access to pets and small children through the openings and be vandal resistant.

1.10 ACCESS

To accommodate emergency access through the Sound Barrier, it shall be demonstrated that access through the Sound Barrier panel or system can be provided when and where needed without compromising structural integrity. This entryway shall be at least 3 feet wide by 6 feet high. It shall be demonstrated that the acoustical efficiency of a Sound Barrier is not degraded by more than 0.5 dBA at 20 feet from the entryway.

The Sound Barrier panel or system design shall demonstrate how fire hose access openings and associated identification can be accommodated.

1.11 AESTHETICS (Rev. 01/11)

Since the appearance of the Concrete Sound Barrier may be a significant element in community acceptance, it shall be demonstrated that the Concrete Sound Barrier panel or system may be altered to enhance the appearance of the wall. Each supplier of Sound Barrier panels or systems shall be able to demonstrate the degree to which their products are capable of accommodating the following FDOT aesthetic criterion:

- A. Panels must accept form liners and/or graphics on one or both sides to create an appearance of a fractured fin finish, ashlar stone finish, or a similar relief appearance as shown in **FDOT Sound Barrier Design Standards**. The minimum 2 inch concrete cover shall be maintained. For Sound Barrier panels used with FDOT standard post and foundations, the maximum depth of form liners shall be 1.25 inches.
- B. Accept colors ranging from white to sandalwood brown or a mixture of other earth tones within the Federal Standard 595B Color Code.
- C. Mount front face of panels flush with the standard FDOT post system.
- D. Be capable of being angled or tied back into structure approach fills and berms or be stepped to fit existing terrain conditions.

All wall concepts shall demonstrate that they are capable of retaining their basic shape and remain in position without excessive vertical deflection or sagging. The Sound Barrier panel or system shall avoid including areas that might attract birds or permit the accumulation of dirt and debris.

1.12 REPAIRABILITY (Rev. 01/11)

The manufacturer shall submit a written procedure for removal and replacement of posts and/or panels. Include right-of-way requirements behind the barrier required for equipment access should replacement be required. The data shall also include acceptable repair methods such as patching, retexturing, repainting, saw cutting and replacing, and/or any special coatings required to have the repair match the remainder of the Sound Barrier.

1.13 APPROVAL (Rev. 01/11)

To submit a Concrete Sound Barrier panel, post and foundation, or system meeting these criteria and those shown in the Specifications for QPL approval, follow instructions shown at: <http://www.dot.state.fl.us/specificationsoffice/ProductEvaluation/QPL/SubmittalProcess.shtm>. Submittals shall include the QPL application form along with structural drawings and calculations signed, dated and sealed by a Professional Engineer licensed in the state of Florida. Include all information described in these criteria including applicable test results, repair procedures, emergency access, drainage/utility openings and aesthetic capabilities.

VOLUME 6 - REVISION HISTORY

- Chapter 1** Deleted previous Chapters 1 and 3. Renumbered chapter and changed title to "Concrete Sound Barriers". Removed references to Perimeter Walls throughout entire Chapter. Revised format of references to Design Standards and Specifications for consistency, though there is no change to technical content in these instances.
- 1.1** Added first sentence. Deleted Paragraph D. Changed "Sound Barrier" to "Concrete Sound Barrier" in Paragraphs A & C.
- 1.2** Deleted definitions for Crash Tested Perimeter Wall Systems, Crash Tested Sound Barrier Systems, NCHRP, Perimeter Wall, Perimeter Wall Panel, and Perimeter Wall System. Revised definition of Sound Barrier Panel.
- 1.3.1** Updated referenced standard list.
- 1.3.2** Updated referenced standard list.
- 1.4.1.1** Updated references in first Paragraph. Added second and third Paragraphs.
- 1.4.1.2** Deleted first three Paragraphs. Removed reference to steel H post from new first Paragraph. Added new second Paragraph. Replaced new third Paragraph. Deleted references to steel and bottom concrete panel from new fourth Paragraph and Commentary.
- 1.4.1.3** Added new second Paragraph. Clarified deflection requirements and soil NPT values in the fourth Paragraph. Added auger cast pile and shallow foundation Paragraphs. Deleted corrosion related Paragraphs and Table. Deleted post compatibility Paragraph. Deleted steel reference from Commentary.
- 1.4.1.4** Deleted wind load pressures, assumed soil conditions. Deleted subsequent sections: Deleted Section "Crash Tested Sound Barrier and Perimeter Wall Systems (Within Clear Zone Only)" (previously 2.4.1.5) and "Panel to Post Connections" (previously 2.4.1.6).
- 1.4.2.1** Deleted entire section except for references to absorptive materials and added 25 year design life.
- 1.4.2.2** Added 50 year design life. Deleted subsequent sections: "Steel" (previously 2.4.2.3), "Masonry" (previously 2.4.2.4), "Aluminum" (previously 2.4.2.5), "Plastics" (previously 2.4.2.6), "Other Materials" (previously 2.4.2.7) and "Transparent Panel Materials" (previously 2.4.2.8)
- 1.5** Deleted previous Section "Impact" (previously 2.5) and Renumbered subsequent Sections. Removed language allowing TL-4 barriers on the QPL. Deleted Paragraph three.
- 1.6.1** Deleted last three sentences.
- 1.8** Deleted height limits.
- 1.11** Deleted old Paragraph B and renumbered subsequent Paragraphs.
- 1.12** Deleted Section "Coatings and Coating Systems" (previously 2.13). Renumbered "Repairability" Section and replaced content.
- 1.13** Replaced entire Section.