



Florida Department of Transportation

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MEMORANDUM

TO: District Directors of Operations, District Directors of Production, District Design Engineers, District Structures and Facilities Engineers, District Maintenance Engineers, District Construction Engineers, District Structures Design Engineers, District Materials Engineers

FROM: William N. Nickas, State Structures Design Engineer

COPIES: Bob Greer, Freddie Simmons, Bill Albaugh, , Jack Evans, Larry Sessions, Marcus Ansley, Jeffrey Ger (FHWA), Ananth Prasad, Sharon Holmes, Henry Bollmann, Steve Plotkin, Tom Andres, Robert Robertson, Tony Mireles, Rafiq Darji, David O'Hagan, Charles Boyd, Andre Pavlov, Duane Brautigam

SUBJECT: Temporary Design Bulletin C04-07
Sound Barrier Acceptance Criteria
Effective Immediately

Requirements: Replace the current Sound Barrier QPL Acceptance Criteria found in the Structures Manual Volume 6 Chapter 2, with the new QPL Acceptance Criteria attached to this Bulletin.

Commentary: During the review of some Sound Barrier QPL submittals, it was determined several areas of the Acceptance Criteria needed to be clarified or expanded. Due to concerns about flame spread, damage, and maintenance, the bottom 6 feet of all Sound Barrier Systems is now required to be made of concrete or steel. Also, the new QPL Acceptance Criteria clarifies the following areas:

Loading and assumed soil properties
Exact criteria are now contained in Section 2.4.1.

Flame Spread
Exact criteria for Flame Spread measurement is now contained in Section 2.4.2.1. and 2.4.2.6.2.

Impact Resistance (Hurricane and Road Debris)
Exact criteria for Impact resistance testing is now contained in Section 2.5.

Background: These revisions are necessary to ensure good performance of Sound Barriers during hurricanes and fires.

WNN/AP/h

Chapter 2 Sound Barriers

2.1 General

These acceptance criteria cover four different types of QPL approvals:

- A. 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 sound barrier systems (see definitions), including foundations.
- D. Crash Tested Sound Barrier Systems (see definitions).

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.

2.2 Definitions

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):

Crash Tested Sound Barrier Systems - Barriers within the clear zone that meet NCHRP 350 Test Level 4 (TL-4) crash level criteria.

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

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

NCHRP - National Cooperative Highway Research Program

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 Panel – The component of a sound barrier that spans between posts. Depending on the material and the design, numerous 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.

2.3 Referenced Standards

2.3.1 ASTM Standards

- A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
- C 90 - Standard Specification for Load-Bearing Concrete Masonry Units
- 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
- C 652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
- C 1329 - Standard Specification for Mortar Cement
- D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- D 660 - Standard Test Method for Evaluating Degree of Checking of Exterior Paints
- D 661 - Standard Test Method for Evaluating Degree of Cracking of Exterior Paints
- D 714 - Standard Test Method for Evaluating Degree of Blistering of Paints
- D 968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
- D 1141 - Standard Test Method for the Preparation of Substitute Ocean Water
- D 1242 - Standard Test Method for Resistance of Plastic Materials to Abrasion
- D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics
- D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- D 2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
- D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- D 3359 - Standard Test Methods for Measuring Adhesion by Tape Test
- D 3719 - Standard Test Method for Quantifying Dirt Collection on Coated Exterior Panels
- D 3801 - Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position
- D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
- D 4812 - Standard Test Method for Unnotched Cantilever Beam Impact Resistance of Plastics
- E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

- E 313 - Standard Test Method for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates
- E 413 - Standard Classification for Rating Sound Insulation
- E 695 - Standard Method of Measuring Relative Resistance of Wall, Floor and Roof Construction to Impact Loading
- G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- G 155 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

2.3.2 Other Standards

- AASHTO Guide Specifications for Structural Design of Sound Barriers
- AASHTO Standard Specifications for Highway Bridges
- American National Standards Institute (ANSI) Standard Z97.1 – Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test
- American Welding Society Code D 1.1
- Federal Standard 595B Color Code
- Florida Building Code
- Florida Department of Transportation (FDOT) Plans Preparation Manual
- Florida Department of Transportation Standard Specifications for Road and Bridge Construction (FDOT Standard Specifications)
- Highway Innovative Technology Evaluation Center (HITEC) Guidelines for Evaluating the Performance of Highway Sound Barriers, October 1996
- National Cooperative Highway Research Program (NCHRP) Report 350 - Recommended Procedures for the Safety Performance Evaluation of Highway Features
- Specifications for Aluminum Structures

2.4 Sound Barrier Requirements

2.4.1 General

2.4.1.1 Design

The structural components of the sound barrier shall be designed in accordance with the latest edition of the AASHTO Guide Specifications for Structural Design of Sound Barriers (load factor design), FDOT Plans Preparation Manual, FDOT Structures Design Guidelines and these criteria. Sound barrier components shall be analyzed and designed using established engineering principles.

2.4.1.2 Sound Barrier Panels used with FDOT Standard Posts and Foundation

Submit a detailed package for the sound barrier panel. For this approval, sound barrier panel design calculations are required (see Section 2.15D for details). In addition to the requirements in this section, sound barrier panels shall meet all requirements set forth in these criteria as applicable.

Assumed wind load pressure for sound barrier panel design is 47 psf. The maximum deflection of sound barrier panels due to wind load shall not exceed the lesser of 1/180 of the post spacing or 1½ inch (deflection measured relative to posts).

Sound barrier panels constructed of materials other than concrete or steel shall be tested to their design strength in accordance with ASTM E 72.

Submissions for sound barrier panels must be compatible with FDOT's standard posts and foundation. FDOT standard posts are either reinforced concrete or steel H post and standard foundations are auger cast piles. Sound barrier panels shall 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.

All sound barrier panels, except those made entirely of concrete or steel materials, shall be integrated into a sound barrier system where the bottom panel is a concrete panel. The bottom concrete panel shall be a minimum of 6 feet high for non-crash tested sound barrier systems, unless emergency access is required as specified in Section 2.11. For sound barrier systems requiring emergency access, the height of the bottom concrete panel is required to be a minimum of 8 feet high. These bottom panel height requirements do not apply to crash tested sound barrier systems. Acoustically seal sound panel joint between the bottom concrete panel and adjacent sound panel so that the acoustical efficiency of the sound barrier is not degraded. It is not necessary to submit details for the bottom concrete sound barrier panel if FDOT's standard precast concrete sound barrier panel will be used. Submit details of the bottom concrete sound barrier panel if an alternate to FDOT's standard precast concrete sound barrier panel will be used. Details for an acoustic sound barrier seal between panels shall be required in all cases.

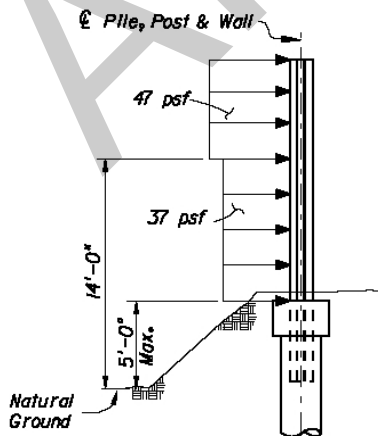
Commentary:

Due to safety concerns about horizontal flame spread along highway sound barriers and maintenance issues (i.e., roadside debris, mowers scraping panels), the decision was made to limit the bottom panel in all sound barrier systems to concrete or steel. Both materials resist flame spread in all directions and have a proven history of providing the required 50 year design life for sound barriers. 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. Flame spread and design life requirements are discussed in further detail later in these criteria.

2.4.1.3 Sound Barrier Posts and Foundations used with FDOT Standard Concrete Sound Panels or Their Approved Alternates

Submit a detailed package for the posts and foundations, including a step by step field construction manual, as appropriate (i.e., installation method(s) is not covered by FDOT Standard Specifications). For this approval, sound barrier post and foundation design calculations are required (see Section 2.15D for details). In addition to the requirements in this section, sound barrier posts and foundations shall meet all requirements set forth in these criteria as applicable.

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.

Assumed Wind Load Pressures

For posts or top of barrier, the maximum deflection due to service wind load shall not exceed the lesser of 1/50 of the wall height or 5 inches (deflection measured relative to the point of fixity in the soil). Also, the lateral displacement of the pile at the base of the wall shall not exceed 1 inch.

Sound barrier foundations shall be designed assuming the following soil conditions:

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

Foundation materials subject to corrosion shall utilize a corrosion protection system. Proposed corrosion protection systems shall be included in the submittal and approved by FDOT's State Materials Office for use.

Steel foundations may utilize a sacrificial thickness as the corrosion protection system. Use the following corrosion rates to determine required sacrificial thickness vs. environmental classification:

<u>Environmental Classification</u>	<u>Corrosion Rate</u>
Slightly Aggressive	0.001 inches per year
Moderately Aggressive	0.002 inches per year
Extremely Aggressive	0.003 inches per year

Commentary:

Design wind pressure and soil conditions assume a worst case scenario of a hurricane event (110 mph wind velocity in poor saturated soil). Steel corrosion rates were provided by FDOT's State Materials Office. For environmental classification definitions, see SDG Section 1.3.

Additionally, posts shall be completely compatible with FDOT's precast concrete sound panels to allow easy substitution of alternate QPL approved sound barrier panels. Posts and foundations shall demonstrate how they can meet placement tolerances outlined in FDOT Specifications Section 534.

2.4.1.4 Complete Sound Barrier Systems

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 (see Section 2.15D for details). Design wind load pressures, assumed soil conditions and deflection criteria for the system are the same as outlined in Section 2.4.1.2 for panels and 2.4.1.3 for posts and foundations. In addition to the requirements in this section, sound barrier systems shall meet all requirements set forth in these criteria as applicable.

2.4.1.5 Crash Tested Sound Barrier Systems (Within Clear Zone Only)

Submit a detailed package for the entire sound barrier system, including the foundation, posts, panels and crash test information. For this approval, sound barrier panel, post and foundation design calculations are required (see Section 2.15D for details). Design wind load pressures, assumed soil conditions and deflection criteria for the system are the same as outlined in Section 2.4.1.2 for panels and 2.4.1.3 for posts and foundations. In addition to the requirements in this section, crash tested sound barrier systems shall meet all requirements set forth in these criteria as applicable.

Crash tested sound barrier systems shall be tested in accordance with (NCHRP) Report 350 to TL-4 crash criteria at a minimum. Sound barrier panels shall not dislodge from posts during crash testing or employ a mechanism to prevent panels from falling in the event that they do dislodge. Present testing and/or other supporting documentation for any such mechanism utilized in a crash tested system. Additionally, sound barrier systems shall not compromise the protection of persons and properties on roadways and other areas underneath a structure.

2.4.1.6 Panel to Post Connections

All connectors shall be fabricated of nonferrous materials, stainless steel, or be hot dip galvanized after fabrication according to the requirement of ASTM A 123 or A 153. All exposed steel shall be primed and painted with an approved 3 coat inorganic zinc painting system in accordance with FDOT Specification Section 560.

Field welds (where allowed) shall conform to the American Welding Society Code D 1.1.

2.4.2 Materials

2.4.2.1 General

The use of wood for the construction of sound barrier panels and/or systems is not permitted.

All materials used in the sound barrier system shall have a minimum design life of 50 years for the site environmental conditions, except sound absorptive panels shall have a minimum design life of 25 years for the site environmental conditions. All sound barriers components shall have a maintenance free life of 25 years. All sound barrier materials shall be tested by an independent laboratory qualified to perform the relevant standardized tests (as listed in Section 2.3). If performed in-house, testing shall be witnessed and certified by a qualified, independent observer trained to perform the relevant standardized tests.

All components shall be consistent in appearance, dimensions, and quality.

All components shall be resistant to corrosion. All materials subject to corrosion shall receive a protective coating or coating system meeting the requirements of Section 2.13 of these criteria or approved by the FDOT State Materials Office.

Commentary:

Due to the wide variety of coatings and coating systems commercially available, additional information for some coatings and coating systems not specifically outlined in these criteria will likely be required. Section 2.13 of these criteria primarily covers requirements for a paint coating. The majority of coating systems will require the approval of the FDOT State Materials Office.

All materials shall have low flame spread and smoke development classifications in accordance with ASTM E 84. The maximum acceptable flame spread index and smoke developed index are 50 and 180, respectively for sound barrier panels. The maximum acceptable flame spread index and smoke developed index are 25 and 180, respectively for sound barrier posts. Concrete components are exempt from this test. For composite sound barrier panels, the flame spread index shall be for the panel as a whole, rather than the individual materials that make up the sound panel. Materials with standard weathering coatings other than paint shall be tested with coated specimens. Sound barrier components composed of materials with a flame spread index greater than 25 and/or that burn to consumption shall not be used within 100 feet of buildings (i.e., residential dwellings, schools, hospitals, motels, etc.) with an occupancy or use classification other than low hazard storage, except animal shelters which are also classified as low hazard storage.

Commentary:

Smoke development index of 180 is based on HITEC's recommendation. Flame spread index (FSI) of 50 is based on flame spread classifications from the Florida Building Code. In the Florida Building Code, materials are classified for flame spread as either Class A (FSI = 0-25), Class B (FSI = 26-75) or Class C (FSI = 76-200). Class C materials are considered highly volatile and Class B materials will catch fire easily and help to spread a fire. Panel materials classified as Class C or in the upper half of Class B are not allowed due to the close proximity of sound barriers to occupied buildings. Post materials must be Class A so as not to propagate flame spread horizontally. The requirement to be at least 100 ft. from occupied buildings was made to keep heat generated from burning panels from damaging surrounding buildings. Definitions of occupancy classifications can be found in the Florida Building Code.

All materials shall be non-toxic to the environment and pose no known health hazards. Submit a Material Safety Data Sheet as required under the Occupational Safety and Health Act Enforcement (OSHA) Communication Standard to identify hazardous chemicals, health and physical hazards, exposure limits and precautions as appropriate. National Fire Protection Association (NFPA) Hazard Rating for Health category shall be 0 (zero).

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 require submission of water absorption testing. Water absorption percentage shall not exceed 2% by volume when tested in accordance with the appropriate ASTM Standard or an alternate standardized testing procedure.

Support components of absorptive sound barriers shall not degrade potential sound attenuation.

Sound barrier systems or panels using polymeric materials shall be resistant to fungus in accordance with ASTM G 21.

2.4.2.2 Concrete

All concrete sound barrier components shall be Class IV as defined in FDOT Standard Specifications Section 346. The concrete cover on all reinforced and prestressed concrete designs shall be a minimum of 2 inches. All exposed concrete surfaces shall receive a Class 5 Applied Finish Coating in accordance with FDOT Specifications Section 400 at a minimum.

2.4.2.3 Steel

All steel sound barrier components, except bolts, shall be fabricated from stainless steel or be hot-dip galvanized after fabrication in accordance with ASTM A 123. Bolts shall be galvanized in accordance with ASTM A 153.

Steel panels shall be a minimum of 20 gauge (0.0359 inch) thickness. All steel sheeting, except stainless steel shall receive a protective coating meeting the requirements of Section 2.13 of these criteria or as approved by the FDOT State Materials Office. All pop rivets shall be either aluminum with an aluminum mandrel or stainless steel with a stainless steel mandrel.

Bolts shall meet the requirements of ASTM A 325 or A 307.

2.4.2.4 Masonry

Masonry sound barrier panels shall be made of concrete or clay.

Concrete masonry panel units shall be hollow and load bearing, and conform to ASTM C 90. Burned clay panel units shall be hollow and load bearing, and conform to ASTM C 652. The mortar used shall conform to ASTM C 1329. A panel cap or flashing shall be used to protect the

top row and posts of masonry barriers. Masonry panel units shall be placed on a concrete spread footing or leveling pad.

2.4.2.5 Aluminum

Aluminum sound barrier components shall conform to the thickness tolerances of the Aluminum Association, Inc., as found in the latest edition of Aluminum Standards and Data.

All aluminum panels shall have a minimum nominal thickness of 0.063 inch. Any shearing, cutting, or punching of the panels shall be done prior to the application of any coatings.

2.4.2.6 Plastics

2.4.2.6.1 General

Sound barrier components made of plastic or fiberglass are to be tested for resistance to ultraviolet-light exposure in accordance with ASTM G 155. Subject the specimen(s) to 8000 hours minimum of exposure at a temperature of 145° F (63° C). Perform the test at 20 minute cycles, consisting of 17 minutes of light and three minutes of water spray plus light. The lamp filter shall be Daylight. The lamp's irradiance level shall be 0.35 W/m²/nm and the wavelength shall be 340 nm. Plastic or fiberglass component shall also be tested for resistance to salt spray (fog) exposure in accordance with ASTM B 117. Use salt spray in accordance with ASTM D 1141. Adjust the pH of solution to 4.7 with dilute H₂SO₄. There shall be no delamination, fading, discoloration, or embrittlement after exposure. All glazing material shall comply with the requirements of ANSI standard Z97.1.

2.4.2.6.2 Material Testing

Plastic and fiberglass components shall meet material requirements outlined in the following table:

Property	ASTM	Weathering/ Exposure	Requirement
Salt Spray (Fog) Resistance	B 117	* Before and After 8000 hours	No signs of deterioration
Burn Rate and Extent of Burning	D 635	None Required	Burn Rate < 2.5 inches/min.
Resistance to Abrasion	D 1242 Method A	None Required	No signs of deterioration
Ignition Temperature	D 1929	None Required	≥ 650° F (343° C)
Color Change***	D 2244	** Before and After 8000 hours	Color change shall not exceed 3 National Bureau of Standards Units
Smoke Density	D 2843	None Required	Smoke Density Rating < 50%
Burn Characteristics in a Vertical Position	D 3801	None Required	Afterflame plus Afterglow time of ≤ 3 sec. and dripped material does not ignite cotton
Brittleness	D 4812	** Before and After 8000 hours	Panel retains 75% of its' impact resistance after accelerated weathering when tested at 74° F (23° C) and 0° F (-18° C)

* Weathering shall be in accordance with ASTM B 117 as outlined in Section 2.4.2.6.1.

** Weathering shall be in accordance with ASTM G 155 as outlined in Section 2.4.2.6.1.

*** This test is not required for transparent plastic panels.

2.4.2.7 Other Materials

All other materials shall be resistant to ultraviolet rays for the expected service life of the components without loss of structural capability delamination, fading, or embrittlement. Perform testing for resistance to weathering and sunlight in accordance with ASTM G 155 as outlined in Section 2.4.2.6.1, as applicable. Perform testing for resistance to salt spray (fog) in accordance with ASTM B 117 as outlined in Section 2.4.2.6.1, as applicable. Material samples may be required for evaluation and approval by FDOT's State Materials Office.

2.4.2.8 Transparent Panel Materials

Transparent panel materials must meet the following additional requirements for optical properties:

Property	ASTM	Weathering *	Requirement
Luminous Transmittance	D 1003	After 8000 hours	≥ 90%
Percent Haze	D 1003	After 8000 hours	≤ 10%
Yellowness Index	E 313	After 8000 hours	≥ 5

* Weathering shall be in accordance with ASTM G 155 as outlined in Section 2.4.2.6.1.

2.5. Impact

It shall be demonstrated that the sound barrier can withstand the impact of windborne debris during hurricane events. All sound barrier panels shall be shatterproof. Impact testing shall be performed in accordance with Florida Building Code Testing Application Standard (TAS) 201-94. Sound Barrier elements shall be subjected to both the large and small missile impact test outlined in (TAS) 201-94, but not cyclic wind pressure loading. When more than one material comprises the shell of a composite panel, both sides shall be tested for impact resistance. Solid concrete panels at least 2 inches thick and concrete masonry panels at least 8" thick are exempt from this requirement. Passing requirements for impact tests are outlined in the table below:

Impact Test	Requirement
Large Missile	Breakage or damage is allowed, but with no penetration of the panel or excessive deflection which would allow the panel to dislodge from posts
Small Missile	No breakage or damage allowed to the panel

It shall also be demonstrated that the sound barrier can withstand the impact of projectiles that are thrown by or from passing vehicles and impacts from maintenance equipment such as mowers and weed trimmers. Impact load testing shall be performed in accordance with ASTM E 695. Sound Barrier elements shall be subjected to the impact test outlined in the following table:

Impact Test	Height	Weight	Requirement
Roadside Debris	3'-0"	10 lbs (4.5 kg)	No breakage or damage allowed to the panel

Sound barrier panels that are not damaged during the (TAS) 201-94 large missile test are exempt from this requirement.

Commentary:

The Florida Building Code Testing Application Standard (TAS) 201-94 Large Missile test simulates an object being struck by a 2 x 4 at approximately 35 mph. The concrete and masonry panel exclusions are based on recommendations from the Florida Building Code.

2.6 Location

On roadways with flush shoulders, sound barriers shall be located outside the clear zone unless shielded, and as close as practical to the right of way line. On roadways with curb or curb and gutter, sound barriers shall be a minimum of 4 feet back of the face of curb. However, additional setbacks may be required to meet minimum sidewalk requirements.

Unless it meets the NCHRP 350 TL-4 criteria for crash testing, sound barriers on bridges shall be placed a minimum of 5 feet beyond the gutter line of the bridge traffic railing barrier.

Sound barriers may be combined with safety barriers on a common foundation if the combination meets the crash test requirements of NCHRP 350 TL-4 criteria.

2.7 Acoustics

2.7.1 Sound Transmission Class (STC)

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 STC verification based on Mass Law as noted in the Noise Control Reference Handbook.

For all other materials, test verification under ASTM E 90 is required unless the following conditions are met:

- A. The mass of the non-corrugated, flattened-out panel material is not less than 4 pounds per square foot.
- B. The STC of the panel material is demonstrated to be 32 or greater.

2.7.2 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.

2.8 Expansion Joints

When the sound barrier alignment traverses structure expansion joints, the sound barrier 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.

2.9 Height

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. The height of a sound barrier located on a bridge structure or retaining wall system normally will be limited to 8 feet unless offset or crash tested in accordance NCHRP 350 TL-4 criteria.

2.10 Drainage/Utilities

Drainage and/or utility openings shall not degrade the acoustical efficiency of the 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.

2.11 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 the 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.

2.12 Aesthetics

Since the appearance of the sound barrier may be a significant element in community acceptance, it shall be demonstrated that the standard 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. For concrete sound panels, accept form liners and/or graphics on one or both sides to create an appearance of a fractured fin finish, an ashlar stone finish, or a similar relief appearance as shown in FDOT Sound Barrier 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. For all panels composed of materials other than concrete, accept a textured surface other than those specified in FDOT Sound Barrier Standards.
- C. Accept color ranging from white to sandalwood brown or a mixture of other earth tones within the Federal Standard 595B Color Code.
- D. Mount front face of panels flush with the standard FDOT post system.
- E. 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.

2.13 Coatings and Coating Systems

Coating materials shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subarticle C rules, Table 1 of 40 of the Code of Federal Regulations (CFR) 261.24, "Toxicity Characteristic".

Upon curing, all coatings and coating systems shall produce an adherent coating that is visually uniform and capable of performing according to its designated purpose for the design life of the sound barrier component.

The coating and or coating system shall be tested in a weatherometer in accordance with the standard practices outlined in ASTM G 155. Weathering shall be in accordance with ASTM G 155 as outlined in Section 2.4.2.6.1. The coating system shall be evaluated for the following weathering effects when rated in accordance with the appropriate ASTM standard:

Weathering Effect	ASTM Standard
Checking	D 660
Cracking	D 661
Blistering	D 714
Color Change	D 2244
Adhesion	D 3359
Chalking	D 4214

There shall be no checking, cracking, blistering, or loss of adhesion. The chalking rating shall be no less than #7. The color change shall not exceed 3 National Bureau of Standards units.

The coating or coating system shall be evaluated for the following salt fog exposure effects (ASTM B 117) when rated in accordance with the appropriate ASTM standard:

Salt Spray (Fog) Exposure Effect	ASTM Standard
Checking	D 660
Blistering	D 714
Adhesion	D 3359

Salt spray (fog) exposure shall be in accordance with ASTM B 117 as outlined in Section 2.4.2.6.1. There shall be no checking, blistering, loss of adhesion, or corrosion along the sample edges.

The coating or coating system shall be tested for impact resistance in accordance with ASTM D 2794. Perform test with a 30 in/lb impact.

The coating or coating system shall be tested for its resistance to abrasion in accordance with ASTM D 968. Perform the test using 3000 liters of sand. There shall be no loss of the coating thickness.

Additionally, finish coatings shall be tested for fungal resistance in accordance with ASTM D 3273 and dirt pick-up in accordance with ASTM D 3719. The fungal and dirt pick-up rating shall not exceed 10.

All exposed sound barrier surfaces or weather coatings shall be able to accept an FDOT approved water based anti-graffiti coating. Anti-graffiti coating for concrete components shall meet the requirements of FDOT Specification Section 563.

2.14 Repairability

The manufacturer shall demonstrate the repairability of the sound barrier panel or system submitted for approval. The manufacturer shall include a written procedure for the removal and replacement of posts, panels, or other parts. The manufacturer's data shall specify repair methods acceptable for their product, such as: patching, retexturing, repainting, replacing, saw cutting and replacing, or by using special coatings. For plastic, fiberglass and transparent panels, include repair methods for scratches caused by knives or similar cutting items. It shall also specify conditions under which the manufacturer recommends repair or replacement. The texture and color of the repair shall match the remainder of the sound barrier. The data shall also include specific retexturing methods recommended for their product.

The sound barrier system shall resist graffiti and facilitate its removal. Removal may include non-caustic chemical agents, sandblasting, pressure washing, or other methods. Include graffiti removal method(s) in the QPL submittal. The manufacturer's data shall specify if the product requires reapplication of an anti-graffiti coating after removal of graffiti. The texture and color of the sound barrier after graffiti removal shall match the remainder of the sound barrier.

Replacement parts shall be readily available. A list of distributors for replacement parts shall be provided. The submission shall include the latest information available on the cost of replacement parts.

The procedure shall discuss right-of-way needs behind the barrier to allow equipment access and facilitate replacement.

2.15 Approval

Sound barrier panels, posts and foundations or systems will be approved only if the design and materials are determined to conform to these criteria. The Department reserves the right to request additional information and/or testing not specifically outlined in these criteria to assist in the evaluation of any sound barrier component.

Commentary:

Due to the unknown nature of QPL submittals and the variety of sound panel products available, additional information for some materials not specifically outlined in these criteria will likely be required. The testing of these materials shall be in accordance with the latest industry standards. Include all standard test methods other than ASTM Standard Test Methods in the QPL submittal with the accompanying test results.

In order for a sound barrier panel, post and foundation or complete sound barrier system (including crash tested) to be considered for approval, the manufacturer shall complete the "Sound Barrier QPL Submittal Information Form", available at the following internet address:

www.dot.state.fl.us/structures/StructuresManual/CurrentRelease/Structures_Manual.htm

Submit the completed form to the FDOT Product Evaluation Administrator along with additional information as applicable. Additional information must be submitted to the FDOT Product Evaluation Administrator in the order outlined in the Submittal Form. Additional information includes the following:

- A. Results of tests, as outlined in this criteria, performed by an independent test laboratory.
- B. Detailed material specifications.
- C. Material Safety Data Sheet(s) in either OSHA or ANSI format.
- D. Structural design calculations for sound barrier panels, posts and foundations or systems for heights up to 22 feet. Calculations shall include, but not be limited to, the following:
 1. Sound barrier panels- Calculations shall include panel/post connection for 10 foot and/or 20 foot post spacing consistent with FDOT's Standard Posts and Foundation.
 2. Sound barrier posts and foundations - Calculations shall include panel/post connection for 10 foot and/or 20 foot post spacing consistent with FDOT's Standard Precast Panels and post/foundation connection. Foundation calculations shall also be included.
 3. Sound barrier systems – Calculations shall include panel/post and post/foundation connections. Foundation calculations shall also be included.Calculations shall be signed, dated and sealed by a Professional Engineer licensed in the State of Florida.
- E. Foundation design calculations shall allow for barrier heights up to a minimum of 22 feet assuming the poor soil conditions outlined in Section 2.4.3.1. Calculations shall be signed, dated and sealed by a Professional Engineer licensed in the State of Florida.
- F. Crash Test Information.
- G. Detailed structural drawings showing the sound barrier panel or system. All Structural Drawings shall be in either MicroStation (preferred), Autocad or PDF format and signed, dated

and sealed by a Professional Engineer licensed in the State of Florida. Details shall include, but not be limited to the following:

1. Sound Barrier Systems
 - a. General Notes. General Notes shall outline design criteria, material requirements, fabrication and erection tolerances consistent with the requirements outlined herein and FDOT Standard Specifications Section 534. The list of distributors where replacement parts may be obtained shall also be included in the General Notes, as required.
 - b. Wall Dimensions and Details. Details shall include panel bearing details, connections to post and foundation system, accommodation of steps in wall and variations in wall height and alignment, method of acoustically sealing panel joints, fire access and drainage holes.
 - c. Foundation Dimension and Details. Details shall include complete foundation details.
2. Sound Barrier Panel
 - a. General Notes. General Notes shall outline design criteria, material requirements, fabrication and erection tolerances consistent with the requirements outlined herein, FDOT's Standard Post and Foundation and FDOT Standard Specifications Section 534. The list of distributors where replacement parts may be obtained shall also be included in the General Notes, as required.
 - b. Panel Dimensions and Details. Details shall include panel bearing details, connectivity to FDOT's Standard Post, accommodation of steps in the wall, variations in wall heights and alignment, and method of acoustically sealing panel joints. Provide details for fire hose access and drainage holes for bottom concrete panels that are not FDOT's standard concrete panel.
3. Sound Barrier Post and Foundation
 - a. General Notes. General Notes shall outline design criteria, material requirements, fabrication and erection tolerances consistent with the requirements outlined herein and FDOT Standard Specifications Section 534. The list of distributors where replacement parts may be obtained shall also be included in the General Notes, as required.
 - b. Post Dimensions and Details. Details shall include panel/post and post/foundation connection and accommodation of steps in wall and variations in wall height and alignment.
 - c. Foundation Dimension and Details. Details shall include complete foundation details.
- H. Other information and/or testing pertinent to the design and performance of the sound barrier panel, post and foundation or system as applicable, including coatings and coating systems.
- I. A statement relative to construction requirements to install the sound barrier panel, post and foundation or system. Information may include contractor means and methods, tolerances, minimum distance required from adjacent property to build the wall system and the adaptability of system to avoid underground and overhead utility conflicts.
- J. General maintenance requirements for sound barrier panel or system, applicability to coating systems, and reparability methods.