

Session 23

Tom Andres

FDOT Central Office Structures

Noisewalls – Struct. / QPL (Complement Rds.)

Topic Description

Noise barrier wall design related discussions.

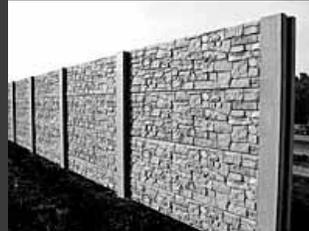
Speaker Biography

BSCE University of Florida

20 years experience with the Florida Department of Transportation. Currently Area Engineer for Districts 4, 7 and Turnpike.



Designing Noise Barriers



2006
DESIGN CONFERENCE

Designing For More Than Bridges and Roads

Noise Wall FDOT References

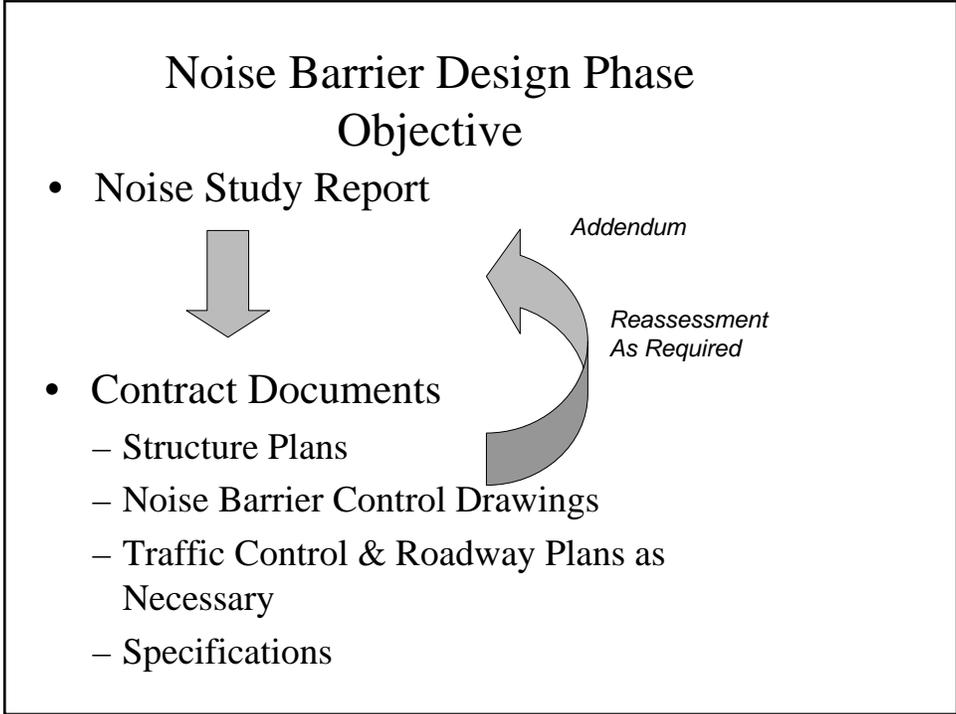
- PD&E Manual Chapter 17
http://www.dot.state.fl.us/emo/pubs/pdeman/updated/PT2CH17_10-6-03.pdf
- PPM Chapter 32
<http://www.dot.state.fl.us/rddesign/PPM%20Manual/2006/Volume%201/ZChap%2032.pdf>
- Appendix B, Soils and Foundations Handbook
<http://www.dot.state.fl.us/structures/Manuals/SFH.pdf>

Noise Wall FDOT References (cont.)

- **Precast & Traffic Railing Design Standards**
http://www.dot.state.fl.us/rddesign/rd/RTDS/06/2006_Standards_5k.htm
- **Instructions for Design Standards – Structures Manual Volume 3**
<http://www.dot.state.fl.us/structures/StructuresManual/CurrentRelease/instructionalStandards.pdf>
- **Proprietary Noise Wall Acceptance Criteria – Structures Manual Volume 6, Chapter 2**
<http://www.dot.state.fl.us/structures/StructuresManual/CurrentRelease/FDOTBridgeManual.htm>

Noise Wall FDOT References (cont.)

- **QPL Approved Proprietary Noise Walls**
<http://www.dot.state.fl.us/specificationsoffice/QPLindex.htm>
- **MicroStation cell, 05200 Sound Barrier Data Table**
- **Sound Barrier Specification Section 534**
<http://www.dot.state.fl.us/specificationsoffice/July06WB/5340000SS.pdf>



- Noise Barrier Design Phase**
- General Design Process
 - Utilizing the FDOT Design Standards
 - Special Designs
 - Other Design Related Issues

General Design Process

1. Review the noise study report
 2. Create preliminary noise barrier control drawings
 3. Stake out the noise barrier in the field and determine conflicts with overhead/ underground utilities, drainage structures
 4. Select noise barrier types
 5. Finalize noise barrier control drawings
 6. Begin the geotechnical investigation
 7. Design noise barrier
- Preliminary Location
- Determine Constraints
- Based on Constraints
Finalize Location
and Type
- Provide Structural Design

Stake Out the Noise Barrier in the Field and Determine Conflicts with Overhead / Underground Utilities, Drainage Structures



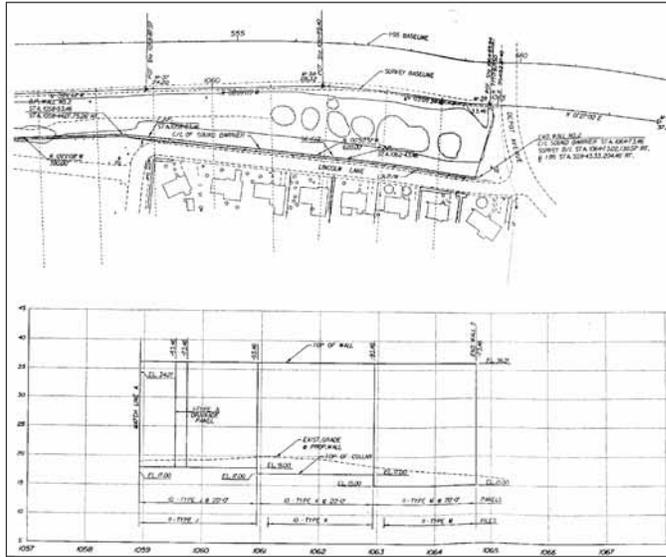
Noise Barrier Control Drawings

- Plan & elevation depicting noise barrier alignments (horizontal and vertical)
- Noise barrier limits
- Location of existing utilities
- Location of graphics

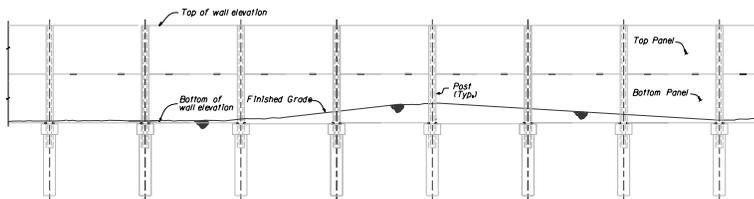
Noise Barrier Control Drawings (cont.)

- Location of fire-access openings
- Location and size of drainage openings
- Location of soil borings
- Lengthen noise barrier to eliminate special panel sizes on either end

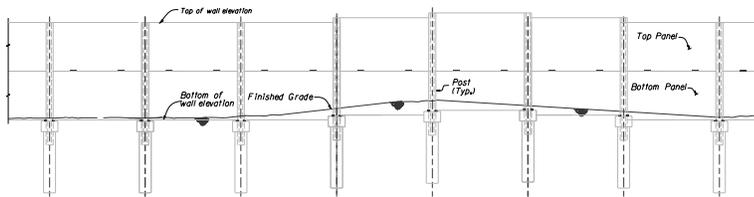
Noise Barrier Control Drawing Example



Precast Noise Barrier Standards – Steps in Wall



TYPICAL ELEVATION
(Pile/Post Connection Option A Shown)



TYPICAL ELEVATION
(Pile/Post Connection Option A Shown)

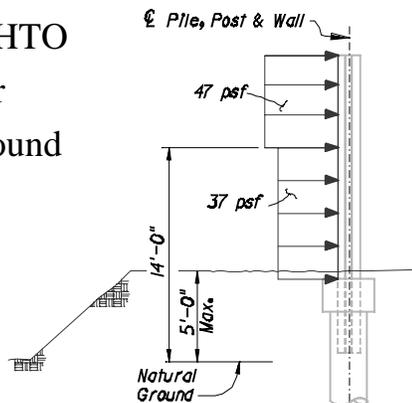
Step Seven in Design Phase: Design Noise Barrier



Design Noise Barrier: Ground Mounted

- Design Based on AASHTO
Guide Specification for
Structural Design of Sound
Barriers

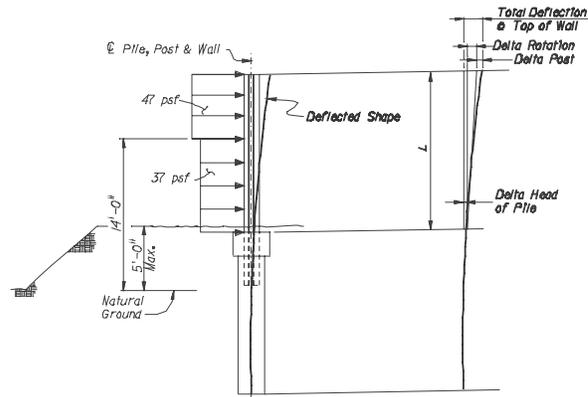
- Exposure B2
- 110 MPH Winds



- Deflection Criteria
per PPM, 32.6

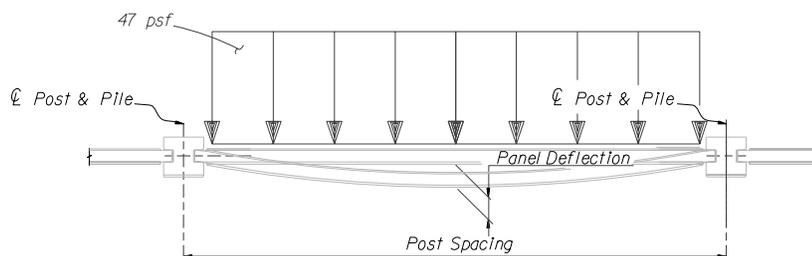
Ground Mounted Pressure Distribution

Deflection Criteria per PPM, 32.6: Ground Mounted



- The Total Deflection @ Top of Wall $< 1/50$ th of the wall height or 5 inches.
- Delta Head of Pile < 1 inch.

Deflection Criteria per PPM, 32.6: Ground Mounted Panels



- For panels, the maximum deflection due to service wind load shall not exceed the lesser of $1/180$ th of the post spacing or $1\frac{1}{2}$ inch (deflection measured relative to posts).

Soils and Foundations Handbook, Appendix B, Design Guidelines for Auger Cast Piles for Sound Walls.

- The minimum length of the auger cast pile for deflection per PPM 32.6
- The soil modulus is correlated with the SPT N values for sands
- Rock with SPT N-values of less than 30 blows should be modeled as sand, not rock.
- Water table at ground surface.

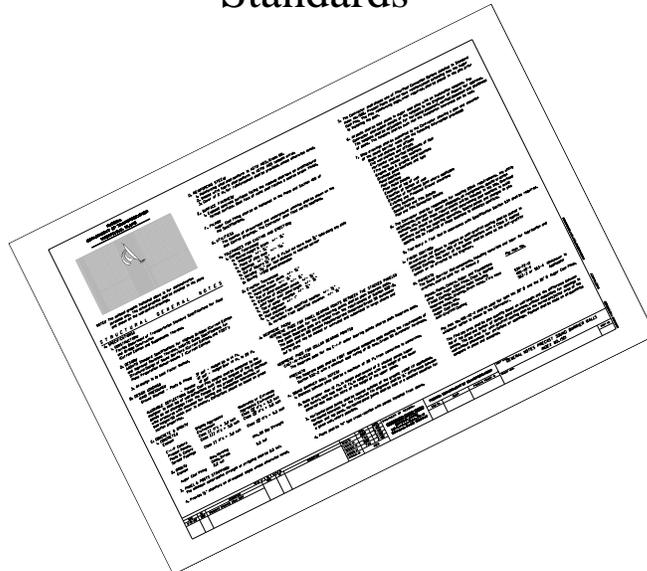
k values in Sands.

k values input into LPILE, or COM624 shall not exceed the following values, without lateral load tests:

N (blows/ft)	k (pci)
0-4	0-10
5-10	10-20
11-20	20-30
21-30	30-60
30-40	60-90
40-50	90-125
>50	125

Note: No distinction will be made between dry and submerged conditions.

Utilizing the FDOT Design Standards



Precast Noise Barrier Standards – Ground Mounted

Instructional Sheet – Volume 3 Structures Manual

<http://www.dot.state.fl.us/structures/StructuresManual/CurrentRelease/instructionalStandards.pdf>

Design Standards

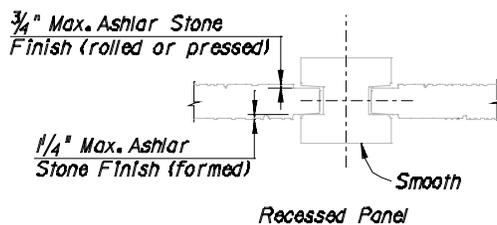
General Notes	5200
Texture Options (8 Options for Both Posts and Panel)	5201
Flush Panel and Posts	5202
Recessed Mounted Panel and Posts	5203
Access and Drainage Details	5204
Pile and Post Details (5 Contractor Options)	5205
Pile and Post Reinforcement Table	5206

Structure Cells

Project Aesthetic Requirements Barrier	MicroStation cell, 05200 Sound Data Table
Graphics (Pelican, Gull, Ibis etc.) (Examples)	MicroStation cell table, Sound Barrier Graphics

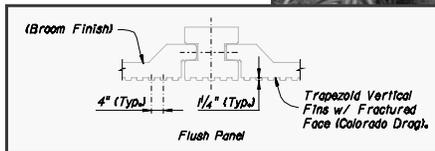
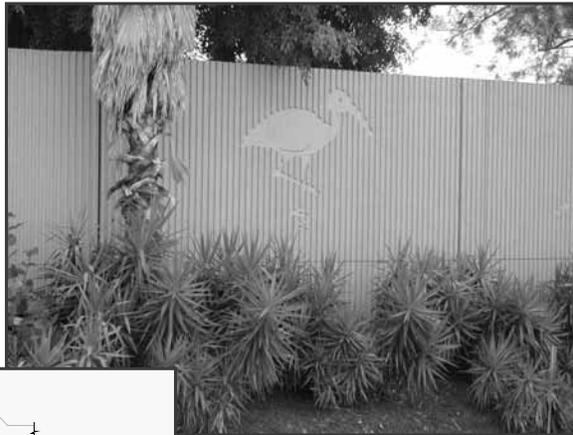
Precast Noise Barrier Standards – Ground Mounted – Recessed Panel

Recessed Panel
Allows Textures on Both
Sides of Noise Barrier



Precast Noise Barrier Standards – Ground Mounted – Flush Face Panel

Flush Panel
Allows
Textures on
One Side of
Noise Barrier

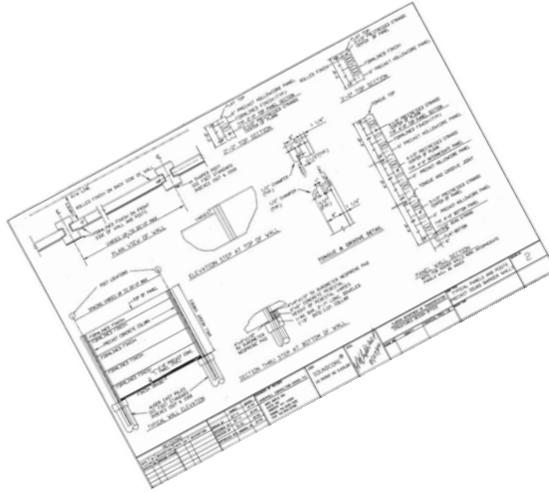


Precast Noise Barrier Standards – Texture Options Index 5201

	<p>Type 10¹ SMOOTH</p>		<p>Type 10² RUND-OUT BRICK</p> <p>1/4" Depth</p> <p>1/2" Min. ROUNDED CORNER</p> <p>2 1/2" x 7 1/2" RUNDING BRICK BRICK</p>
	<p>Type 10³ ROUGH STONE</p> <p>3/8" MAX. FIN</p> <p>1 1/2" FREE FIN</p> <p>1/2" MIN. FIN</p> <p>3/8" to 1 1/2"</p>		<p>Type 10⁴ PEX GRAVEL</p> <p>3/8"</p> <p>Random 1/4" - 1/2" GRAVEL TEXTURE</p>
	<p>Type 10⁵ SPLIT FACE RANDOM BRICK BRICK</p> <p>1/2" MIN. FIN</p> <p>1/2" MIN. FIN</p> <p>3/8" MIN. FIN</p> <p>8" x 16" RUNDING BRICK BRICK</p>		<p>Type 10⁶ VERTICAL FRACTURED FIN</p> <p>1" MIN.</p> <p>1/2"</p>
	<p>Type 10⁷ FRACTURED CONCRETE</p> <p>3/8" Depth</p>		<p>Type 10⁸ TRAPEZOID VERTICAL FIN W/ FRACTURED FACE (COLORADO DRAG AND AGGREGATE)</p> <p>4" MIN.</p> <p>1/4" MIN.</p> <p>1/2" MIN.</p>

Precast Noise Barrier Standards – QPL Vendor Drawings

<http://www.dot.state.fl.us/specificationsoffice/QPLindex.htm>



Precast Noise Barrier Standards QPL Vendor Submission (Part 1)

SOUND BARRIER QPL SUBMITTAL INFORMATION FORM	
Submission Type (Check Box Below)	
<input checked="" type="checkbox"/> Sound Barrier Panel	<input type="checkbox"/> Sound Barrier System
<input type="checkbox"/> Sound Barrier Post and Foundation	<input type="checkbox"/> Crash Tested System
Trade Name of Product: Soundcore Sound Barrier Panels	
Manufacturer's Name, Address, Telephone Number and Plant Locations: Note: Some plants (precast and prestressed concrete, steel and miscellaneous metals, etc.) must institute and maintain a Quality Control Program in accordance with DOT Specifications Section 6, "Control of Materials". Click on the following link for more information: http://www.dot.state.fl.us/specificationsoffice/QPLindex.htm The State Materials Office is responsible for approving Quality Control Plans. Click on the following link for more information: http://www.dot.state.fl.us/materialsoffice/programs/qualitycontrolprogram.htm	
Manufacturer Information: Soundcore, Inc. 4553 Maple Woods, Suite 156 Amherst, New York 14226 Phone: (716) 833-7651 Fax: (716) 833-2782	Plant Information: Cement Industries, Inc. 2708 Jeffcott Road Fort Meyers, Florida 33901 Phone: (239) 332-1440 FDOT Assigned Plant No.: 12-481
Product Characteristics and Aesthetics	
Sound Barrier Posts and Foundations (Check All Applicable Boxes Below) <input checked="" type="checkbox"/> N/A	
Post Material:	Aluminum (if other, list material(s) at right)
Foundation Material:	Aluminum (if other, list material(s) at right)
General statement as to the composition of all materials (i.e., grade, alloy, polymer type, etc.) and method of production:	
Post spacing (including systems): <input type="checkbox"/> 10 ft. <input type="checkbox"/> 20 ft. Other:	
Sound Barrier Panels (Check All Applicable Boxes Below) <input type="checkbox"/> N/A	
Panel Material Type:	Concrete - Hollow (if other, list material at right)
General statement as to the composition of all materials (i.e., grade, alloy, polymer type, etc.) and method of production: Concrete is produced using FDOT specified and certified concrete mix design for Class IV concrete as specified in the FDOT Standard Specifications. Reinforcing steel for solid wet cast panels (used when graphics are required only) is Grade 60 deformed bars meeting the requirements ASTM A 615. Prestressing strands are 1/2" diameter, 7 wire, Grade 250 strands meeting the requirements of ASTM A 416.	

Precast Noise Barrier Standards QPL Vendor Submission (Part 2)

Panel Type:	<input checked="" type="checkbox"/> Reflective	<input type="checkbox"/> Absorptive
Panel Mounted in relation to front face of post:	<input type="checkbox"/> Flush	<input checked="" type="checkbox"/> Recessed
Post spacing (for products consisting of panels only):	<input checked="" type="checkbox"/> 10 ft.	<input type="checkbox"/> 20 ft. <input type="checkbox"/> N/A
Aesthetics (Check All Applicable Boxes Below)		
The product is able to accept graphics or colored coatings:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
<i>If you explain in detail, The sound barrier panels ability to accept colored coatings, such as FDOT's Class 5 finish as outlined in FDOT's Specifications Section 400, is identical to FDOT's Standard Precast Sound Barrier Recessed Panels.</i>		
The product is able to accept colors ranging from white to a sandalwood brown or a mixture of other earth tones within the Federal Standard 595B Color Code:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
<i>If you explain in detail, The sound barrier panels ability to accept colors is identical to FDOT's Standard Precast Sound Barrier Recessed Panels.</i>		
The product (other than concrete) is able to accommodate textured surface(s) on:	<input checked="" type="checkbox"/> N/A	
the front face (roadway side):	<input type="checkbox"/> Yes	<input type="checkbox"/> No
the back face (non-roadway side):	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Maximum depth of textures:	Front Face =	Back Face =
The product (concrete only) is able to accept form liners for relief appearances or graphics, as shown in FDOT Standards, on:		
the front face (roadway side):	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
the back face (non-roadway side):	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Maximum depth of textures:	Front Face = 1.25"	Back Face = 0.5"
The product is capable of being angled or tied back into structure approach fills and berms or be slugged to fit existing terrain conditions:		
<i>If you explain in detail, The sound barrier panels capabilities to be angled or tied back are identical to FDOT's Standard Precast Sound Barrier Recessed Panels.</i>	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Product Testing		
Acoustics: (Check All Applicable Boxes Below)		
<input checked="" type="checkbox"/> ASTM E 90	STC Rating = 51	
<input type="checkbox"/> Mass Law STC Verification:	STC Rating =	
<input type="checkbox"/> Exempt	STC Rating of Panel Material =	Mass of non-convoluted, flattened out panel =

QPL Acceptance Criteria Structures Manual, Volume 6

QPL Acceptance Criteria
Sound Barriers
January 2004

Chapter 2 Sound Barriers

2.1 General (01/05)

These acceptance criteria cover four different types of QPL approvals:

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

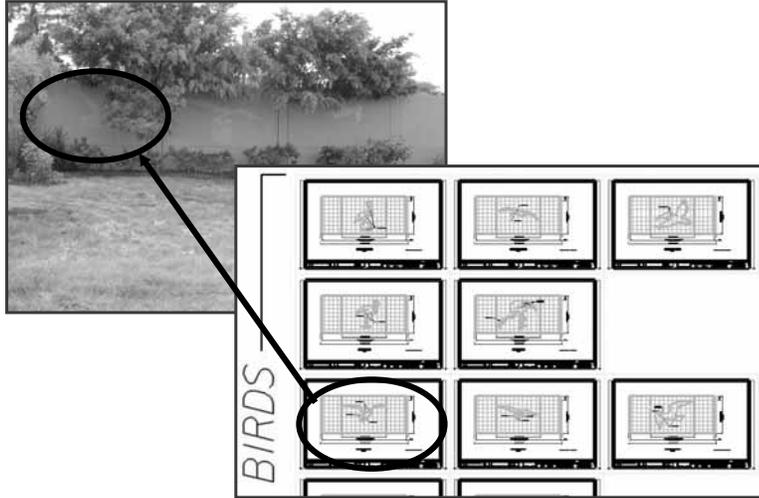
Crash Tested Sound Barrier Systems - Barriers within the clear zone that meet NCHRP 350 Test Level 4 (TL-4) crash level criteria.

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

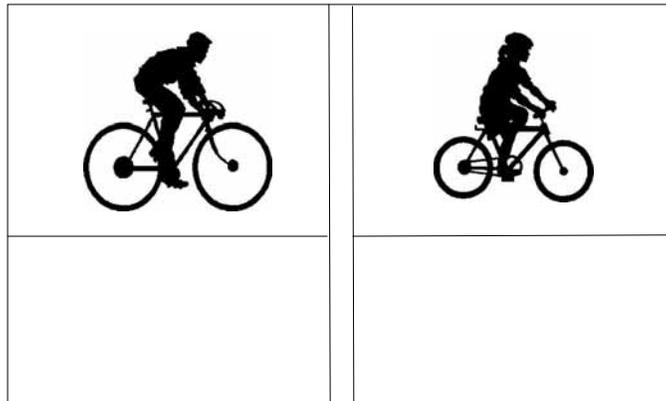
Maintenance Free Life - A period during which maintenance activities will not be required.

NCHRP - National Cooperative Highway Research Program

Precast Noise Barrier Standards –
MicroStation cell table, Sound Barrier Graphics



Precast Noise Barrier Standards –
Graphic Possibilities



Special Designs

Sometimes The Precast Standard Noise Barriers Or Crash Tested Standard Noise Barriers Do Not Apply



Like trying to hammer a square peg into a round hole!

Ground Mounted – Masonry/CIP Noise Barriers

- Masonry Noise Barriers Or CIP Noise Barriers May Be Justified On Projects:
 - with short noise barriers (12 to 14 feet high maximum)
 - where construction access is difficult
 - where quantities are not large enough to justify precast noise barriers
 - where underground or overhead utility restrict precast noise barriers

Special Designs – Overhead Utility Conflict

- Side Loaded Panel Application
- Problem: Setting precast panel with a crane typically requires large overhead envelope.



Parallel overhead utility line

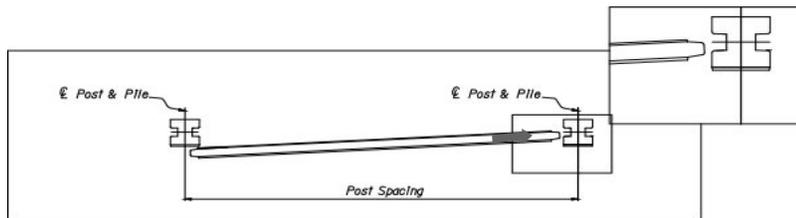
Short term construction equipment clearances

Long term wall clearances

Can electric line be relocated or shut down?

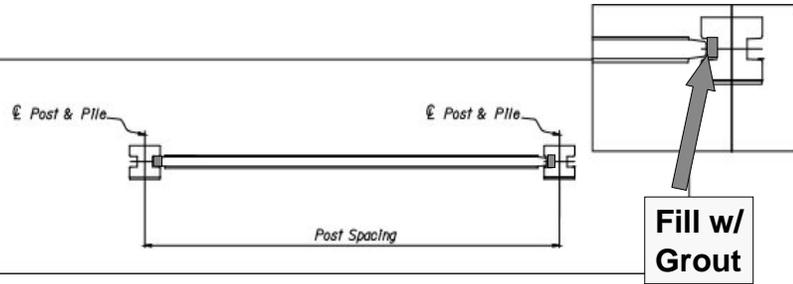
Special Designs – Overhead Utility Conflict

- Side Loaded Panel Application



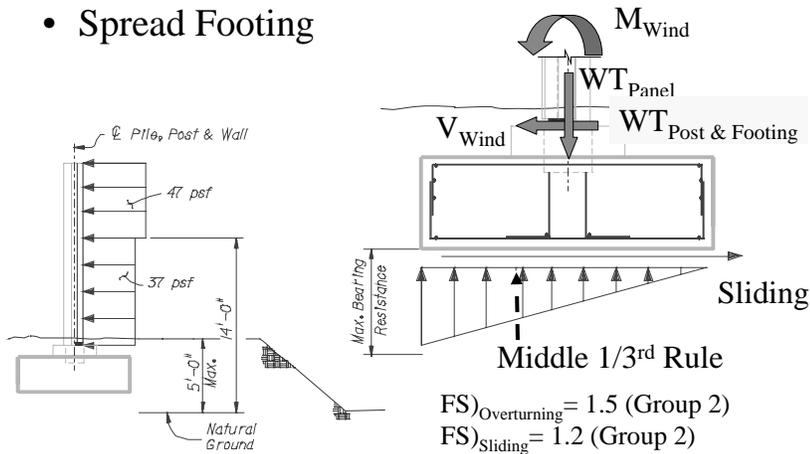
Special Designs – Overhead Utility Conflict

- Side Loaded Panel Application



Special Designs – Overhead Utility Conflict

- Spread Footing



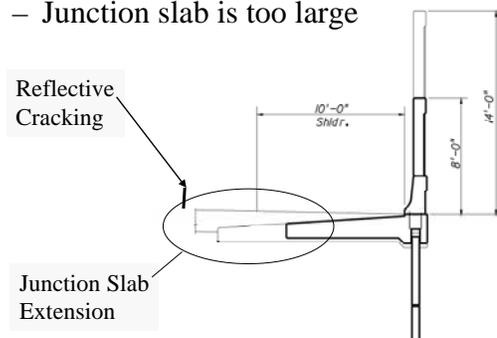
Maximum Noise Barrier Heights*

- Ground mounted outside the clear zone or 5' behind crash tested barrier.....22'
- Bridge or wall mounted.....8'
- Shoulder mounted noise barriers on embankments.....14'

* *Variance required when noise barriers exceed these heights.*

Special Designs – Noise Barriers Greater Than 8' on MSE Retaining Walls

- C.I.P. Retaining Wall/ Crash Tested Noise Barrier Combination
- Problems:
 - Variance is required
 - Junction slab is too large



Special Designs – Noise Barriers Greater Than 8’ on Retaining Walls

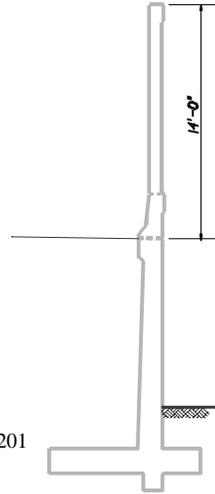
- C.I.P. Retaining Wall/ Crash Tested Noise Barrier Combination

- Cost Example:

- Delta)_{MSE/CIP} = \$40/SF
- Cost)_{14’ Sound Barrier} = \$39/SF

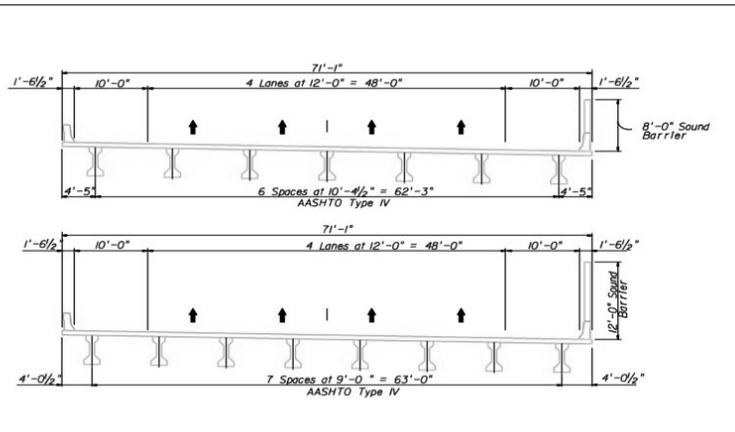
Pay Item 521-7-1		
Wall Height	Cost per Linear Foot	Cost per Square Foot
8’	*\$260	\$32
12’	**\$450	\$38
14’	***\$545	\$39

- * Projects 23193715201, 23191825201, and 23191815201
- ** Project 24964815201
- *** Linear Extrapolation



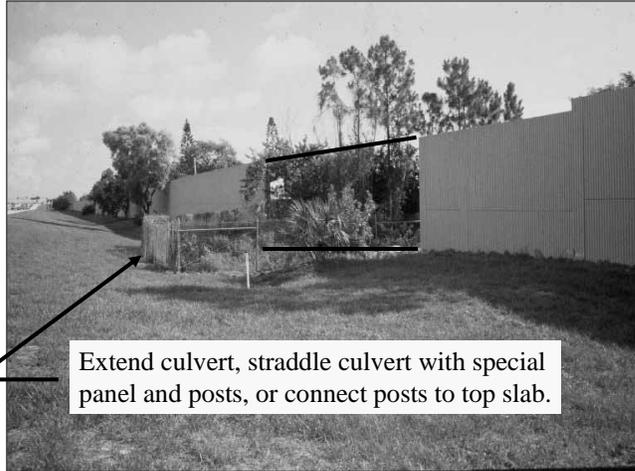
Special Designs – Noise Barriers Greater Than 8’ Walls on Bridges:

- Example showing affects of 12’ on Bridge – More Beam Lines Required



Special Designs – Special Panels

- Culvert Extensions And Special Panels / Posts



Utility Conflicts

- Conflicts with overhead and underground utilities
- Overhead electric permanent or temporary envelope requirements:
 - temporary shutdowns, spread footings, non-precast noise barrier options, side loaded panels.
- Extend culverts and make noise barrier continuous where possible.



Other Design Related Issues:

- Back-Of-Noise Barrier Issues
- Anti-Graffiti Coating
- Drainage Openings
- Fire Access Openings
- Roadway Items

Back-of-Noise Barrier Issues



- Design/ Construction
PIO Coordination With
Homeowners
- Consider Eliminating
Alleyway By Removing
L/A Fence And
Extending Property
Fence
- Temporary Fencing

Back-of-Noise Barrier Issues

- Provide Delineators and Guardrail at Dead Ends Behind Noise Barriers

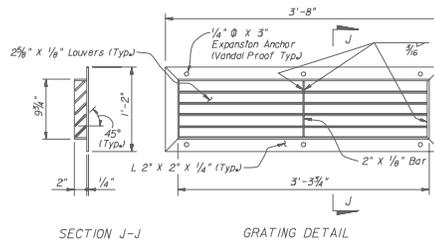


Anti-Graffiti Coating



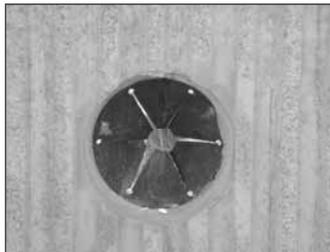
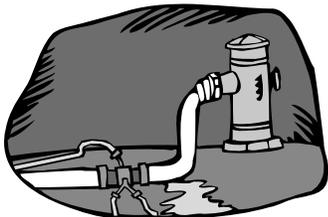
Drainage Openings

- Show On Control Drawings
- Field Verify Heights



Fire Access Openings

- Show on Control Drawings
- Locate at Existing Hydrant Locations



Roadway Items

- Precast Noise Barriers Require:
 - additional space for cranes
 - consideration of overhead utilities conflicts
 - traffic control to off-load materials
 - leveling of swale areas require restoration items



Questions???

