

## **Session 62**

**Andre Pavlov**

FL. Dept. of Transportation

### ***MSE Wall Standards***

#### **Topic Description**

Overview of FDOT MSE Wall Design Policies, Design Standards, and Qualified Products List.

#### **Speaker Biography**

12 years of experience with the Florida DOT

11 years of experience with the New York State DOT

Currently an Assistant State Structures Design Engineer

# FDOT Retaining Wall Policies and Design Standards



Andre Pavlov - Structures Design Office - Tallahassee

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## New FDOT Retaining Wall Policies

### Structures Design Bulletin C05-16

- Effective for Lettings beginning July 2006
- Used with
  - 2006 Design Standards
  - Standard Specification 548
- Includes:
  - Revised Structures Design Guidelines
  - Revised Plans Preparation Manual Chapter 30
  - New Qualified Products List Acceptance Criteria
  - New table for Design Standard Index 5300
- Explains how all the documents work together

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# Design Standards



- 2004 Design Standards and Process
  - 8 approved permanent (125 sheets)
  - 5 approved temporary (20 sheets)
  - Designer specifies system(s) by name in plans
- 2006 Design Standards and Process
  - Common Details (Design Standards, 15 sheets)
  - Approved Systems & related details on QPL
  - Designer specifies *FDOT Wall Type* in plans (PPM)
  - Contractor selects wall system from approved *FDOT Wall Types* on QPL

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# Design Standards - 05300

NOTES		GENERAL NOTES	
<p><b>1. GENERAL</b></p> <p>The Contractor shall be responsible for providing all materials and labor necessary to construct the retaining wall system shown on the drawings. The Contractor shall be responsible for obtaining all necessary permits and approvals from the appropriate authorities.</p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p>		<p><b>2. MATERIALS</b></p> <p>All materials shall be of the highest quality and shall conform to the specifications of the Florida Department of Transportation. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p>	
<p><b>3. CONSTRUCTION</b></p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p>		<p><b>4. FINISHES</b></p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p> <p>The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings. The Contractor shall be responsible for providing all necessary details and specifications for the retaining wall system shown on the drawings.</p>	

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# Design Standards - 05300

Wall Type <sup>1</sup>	QPL ITEM	Settlement Category	Design Settlement Limitations			Typical Wall Construction
			Total Settlement <sup>2</sup>		Differential Settlement <sup>3</sup>	
Type 1	No	1	≤ 2"	and	≤ 0.2%	Cantilever, Gravity, and Counterfort Walls
Type 1A	Yes					
Type 1B						
Type 1C						
Type 1D <sup>4</sup>						
Type 2	No	2	≤ 6"	and	≤ 0.5%	MSE Walls
Type 2A	Yes					
Type 2B						
Type 2C						
Type 2D						
Type 2E						
Type 2F <sup>4</sup>						
Type 3	Yes	3	n/a		≤ 2.0%	Temporary Walls

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# Design Standards - 05300

**Table of FSD**

Wall Type	QPL ITEM	Design Settlement <sup>1</sup>	Settlement Category	Typical Construction	Settlement Category	Other Alternative Wall Type <sup>2</sup>
Type 1	No		1	Cantilever, Gravity, and Counterfort Walls	1	n/a
Type 1A	Yes	4.0"				
Type 1B						
Type 1C						
Type 1D <sup>4</sup>						
Type 2	No		2	MSE Walls	2	
Type 2A	Yes	4.0"				
Type 2B						
Type 2C						
Type 2D						
Type 2E						
Type 2F <sup>4</sup>						
Type 3	Yes	n/a	3	Temporary Walls	3	n/a

**FOOT WALL TYPE TABLE NOTES**

- Listed in the Foot Wall Type Table are both Settlement Limitations and Durability Factors.
- Amount of wall settlements that will occur in its design life and include both short and long term settlements. Short term settlements occur during wall construction and the eventual degree of settlement and distribution settlement. See the Settlements section after the completion of the wall and may include construction site secondary construction/traffic settlements.
- Settlements along the alignment of and perpendicular to the wall horizontally are not uniform. Expansion joints for the wall-to-pavement and also joints for wall-to-wall are provided to control wall and joint cracks, respectively.
- Include all underground walls and walls subjected to water.
- For concrete requirements, see Specification Section 046 using slightly aggressive environment.
- Other Alternative Wall Type<sup>2</sup> refers to an "N" base Settlement Limitations and Durability Factors greater than those required for the "Wall Type" column is.

**TYPICAL RETAINING WALL SECTION WITH A TRAFFIC RAILING**  
(MSE Wall Type Shows, Others Similar)  
(Showing Limits of the Reinforced Soil Volume)

**TYPICAL RETAINING WALL SECTION WITHOUT A TRAFFIC RAILING**  
(Counterfort Wall Type Shows, Others Similar)  
(Showing Limits of the Soil Volume)

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PERMANENT RETAINING WALL SYSTEMS

5300

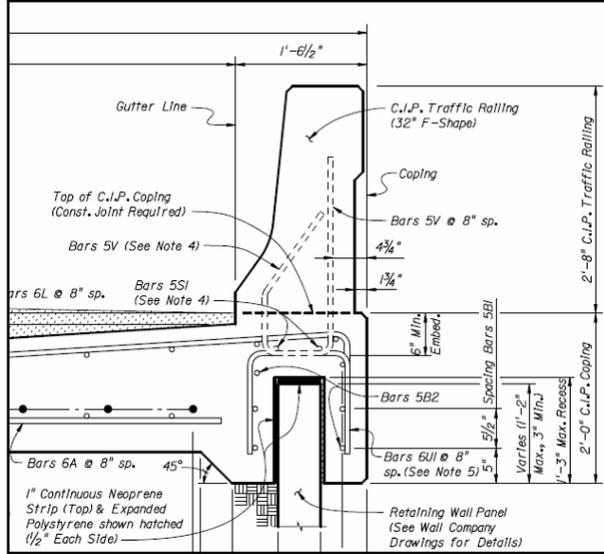
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# Design Standards - 05300



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# Design Standards - 05300

1.	All bar dimensions in the bending diagrams are set in inches.
2.	All reinforcing steel or expansion joints will have a 2" minimum cover.
3.	Use splices for Bars 5B2 with a minimum of 2'-0".
4.	For Precast Coping only, use splice Bars 5L with Bars 5A. Splice offset will be a minimum of 2'-0".
5.	For C.I.P. only, see Note 5000 for Bars 4C and 4E.
6.	The Contractor may use Welded Wire Fabric when approved by the Engineer. Welded Wire Fabric will conform to ASTM A 185.

MARK	SIZE	PRECAST C.I.P. COPING	C.I.P. COPING	5A
A	5	VARIES	N/A	Precast Coping - Vertical
B	5	9'-0"	N/A	Precast Coping - 8'-0"
C	5	AS REQ'D	AS REQ'D	Length as Req'd
D	4	2'-0"	N/A	Precast Coping - 9'-0"
E	5	VARIES	VARIES	
F	4	8'-0"	N/A	
G	5	VARIES	N/A	

REINFORCING STEEL NOTES

- All bar dimensions in the bending diagrams are set in inches.
- All reinforcing steel or expansion joints will have a 2" minimum cover.
- Use splices for Bars 5B2 with a minimum of 2'-0".
- For Precast Coping only, use splice Bars 5L with Bars 5A. Splice offset will be a minimum of 2'-0".
- For C.I.P. only, see Note 5000 for Bars 4C and 4E.
- The Contractor may use Welded Wire Fabric when approved by the Engineer. Welded Wire Fabric will conform to ASTM A 185.

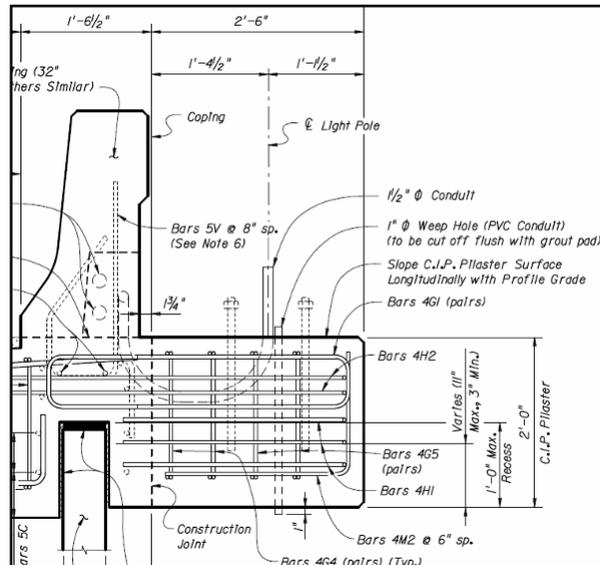
PRECAST COPING/PARAPET AND SIDEWALK NOTES

- When used in concrete, use only the size of rebar as shown.
- When Cross Size of Transverse or Diagonal.
- Concrete reinforcement shall be placed downward as required. See Reinforcement in other drawings for details.
- C.I.P. Concrete Parapet shall be cast in place. See Reinforcement in other drawings for details.
- When cross size of connecting elements or as shown in the wall drawings.

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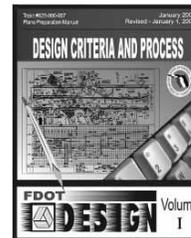


## Design Standards - 05300



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## Plans Preparation Manual Chapter 30



- Outlines plan requirements for retaining walls
- Revised Sections 30.2.3 & 30.2.4
  - New flow chart
  - New Table of FDOT Wall Types

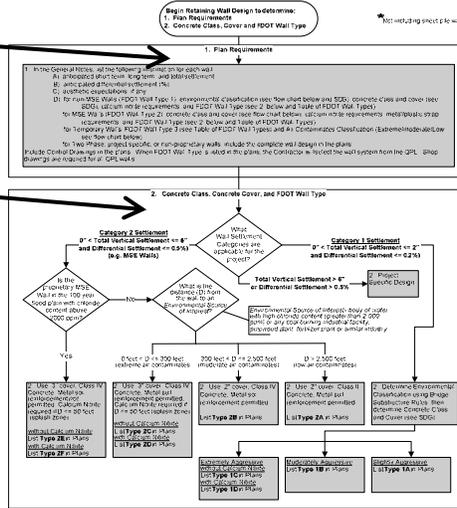
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# Plans Preparation Manual

## Flowchart for Retaining Wall Design\*

Plan Requirements

Concrete Class, Cover, and FDOT Wall Type



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# Plans Preparation Manual

FDOT Wall Type    Settlement Limits    Durability    Substitutions

Wall Type <sup>1</sup>	Proprietary QPL Item	Settlement Category	Design Settlement Limitations			Typical Wall Construction	Durability Category	Durability Factors			Soil Strap Type	Other Allowable Wall Types <sup>7</sup>										
			Total Settlement <sup>2</sup>	Differential Settlement <sup>3</sup>				Concrete Cover	Concrete Class	Calcium Nitrate		1A	1B	1C	1D	2A	2B	2C	2D	2E	2F	
Type 1	No	1	<= 2'	and	<= 0.2%	Cantilever, Gravity, and Counterfort Walls	Project Specific			n/a	Project Specific											
Type 1A							A	2"	II		No	X	X	X	X	X	X	X	X	X	X	
Type 1B	Yes						B	2"	IV		No	X	X	X	X	X	X	X	X	X	X	
Type 1C							C	3"	IV		No	X	X	X	X	X	X	X	X	X	X	
Type 1D <sup>4</sup>							D	3"	IV	Yes		X	X	X	X	X	X					
Type 2	No	2	<= 6"	and	<= 0.5%	MSE Walls	Project Specific			metal	Project Specific											
Type 2A							A	2"	II		No					X	X	X	X	X	X	
Type 2B							B	2"	IV <sup>5</sup>		No					X	X	X	X	X	X	
Type 2C	Yes						C	3"	IV <sup>5</sup>		No					X	X	X	X	X	X	
Type 2D							D	3"	IV <sup>5</sup>		Yes					X	X	X	X	X	X	
Type 2E							E	3"	IV <sup>5</sup>		No										X	X
Type 2F <sup>4</sup>							F	3"	IV <sup>5</sup>		Yes											X
Type 3	Yes	3	n/a		<= 2.0%	Temporary Walls	n/a			metal/plastic	n/a											

1 - Listed in the Plans; Wall Type combines both Settlement Limitations and Durability Factors  
 2 - Amount of wall settlements that will occur in its design life and includes both short and long term settlements. Short term settlements occur during wall construction and may contain elastic deformation and densification settlement. Long term se  
 3 - Settlements along the alignment of and perpendicular to the wall face; usually are not uniform. Expansion joints for the cast-in-place walls and slip joints for MSE walls are provided to control wall and wall panel cracks, respectively.  
 4 - Includes all underground walls and walls submerged in water  
 5 - For concrete requirements, see Specification Section 346 using slightly aggressive environment  
 6 - For concrete requirements, see Specification Section 346 using extremely aggressive environment  
 7 - "Other Allowable Wall Types" listed with an "X", have Settlement Limitations and Durability Factors greater than those required by the "Wall Type" (Column 1)

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# Design Standards & Plans Preparation Manual: State Roadway Design Office



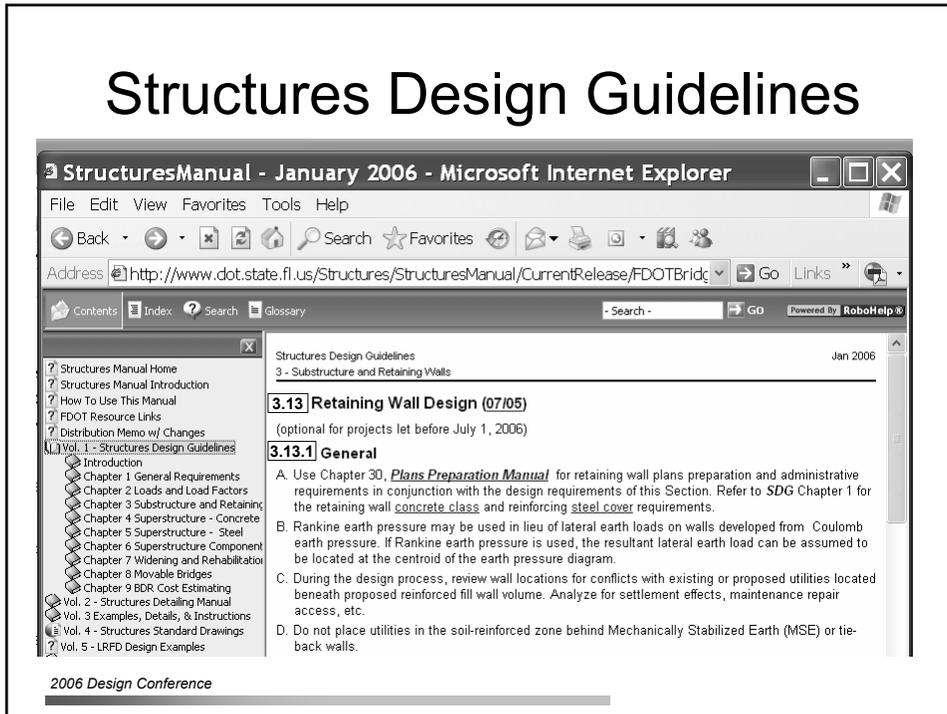
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## Structures Design Guidelines

- AASHTO LRFD Bridge Design Specification
- FDOT Design Criteria includes:
  - Concrete Class
  - Concrete Cover
  - Use of plastic soil reinforcement
  - Use of Calcium Nitrite
  - Minimum Soil Reinforcement Lengths
  - Corrosion Rate of Metallic Reinforcement

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# Structures Design Guidelines



## Qualified Products List Acceptance Criteria



- QPL
  - List of Pre-approved Products that meet FDOT Specifications
  - Includes drawings, calculations, & manuals
- Retaining Wall Acceptance Criteria
  - Proprietary Retaining Walls
  - Published in Vol. 6, Ch. 3 of the Structures Manual
  - Outlines the FDOT requirements that fabricators must follow to be approved (4 pages)

# Qualified Products List Acceptance Criteria

StructuresManual - January 2006 - Microsoft Internet Explorer

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Address <http://www.dot.state.fl.us/Structures/StructuresManual/CurrentRelease/FDOTBridg>

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Vol. 6 - QPL Acceptance Criteria  
Chapter 1 Introduction  
Chapter 2 Sound Barriers  
Chapter 3 - Proprietary Wall Systems  
Vol. 7 - Design Aids

QPL Acceptance Criteria  
Proprietary Retaining Wall Systems  
July 2005

### Chapter 3 Proprietary Retaining Wall Systems

#### 3.1 General

A. These acceptance criteria cover two different types of QPL approvals:

- 1.) Permanent proprietary retaining wall systems used as structural retaining walls.
- 2.) Temporary proprietary retaining wall systems used as structural retaining walls.

B. These criteria do not apply to modular block walls.

#### 3.2 Definitions

The following definitions are provided for commonly used terms in these criteria (for additional definitions, see Section 1 of the FDOT Standard Specifications for Road and Bridge Construction).

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# Structure Design Guidelines & MSE Wall QPL Acceptance Criteria: Structures Design Office

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By Functional Area

Welcome to the FDOT Structures Design Office  
William N. Nickas, P.E. State Structures Design Engineer

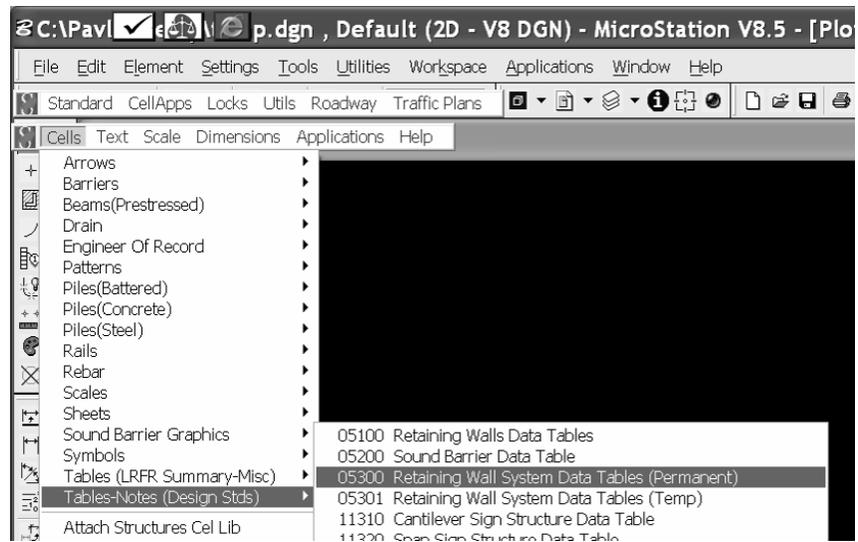
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# Wall Data Table

- Formerly Structures Semi-standard S-1410
- Currently a CADD Cell distributed in the **FDOT 2004 CADD Software**
- Revised to work with LRFD and new FDOT Wall Categories

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# Wall Data Table



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# Wall Data Table

**PERMANENT RETAINING WALL SYSTEM DATA TABLES**

GEOTECHNICAL INFORMATION						
		Reinforced Soil / Random Backfill	Loose / Fine Sand	Firm / Fine Sand	Loose Over / Fine Sand	Firm / Fine Sand
Depth Below Existing Ground Line (ft.)	Wall No. 1	---	*	*	*	*
	Wall No. 2	---	*	*	*	*
Unit Weight (pcf)		*	*	*	*	*
Cohesion (psf)		*	*	*	*	*
Internal Friction Angle		*	*	*	*	*

NOTE: If the unit weight and/or internal friction angle of the fill proposed by the Contractor differs from that shown above, the Project Engineer will contact both the District Geotechnical Engineer and the Wall Designer for a possible redesign.

RETAINING WALL VARIABLES				
WALL NO.	Wall System		Wall Curvature	Concrete Properties
	Long Term Settlement (ft.)	Short Term Settlement (ft.)	Category	Class / $f_c$ (ksi)
1	*	*	*	*
2	*	*	*	*

NOTE: Design walls for the settlements noted in the table. Long term settlement is measured from the beginning of wall construction.

SOIL REINFORCEMENT LENGTHS FOR EXTERNAL STABILITY									
WALL NO.	REINFORCEMENT TYPE	Reinforced Soil / Random Backfill		Loose / Fine Sand		Firm / Fine Sand		Loose Over / Fine Sand	
		Min. Length (ft.)	Max. Length (ft.)	Min. Length (ft.)	Max. Length (ft.)	Min. Length (ft.)	Max. Length (ft.)	Min. Length (ft.)	Max. Length (ft.)
1	Reinforcement Length (ft.)	*	*	*	*	*	*	*	*
	Bearing Pressure (psf)	*	*	*	*	*	*	*	*
2	Reinforcement Length (ft.)	*	*	*	*	*	*	*	*
	Bearing Pressure (psf)	*	*	*	*	*	*	*	*

NOTE: The reinforcement strip lengths shown above are the minimum lengths required for external stability. The reinforcement lengths used in the construction of the retaining walls will be the longer of that required for external or internal stability (determined by proprietary wall computer).

**INSTRUCTIONS TO DESIGNER:**

- Fill Notes and add/modify/delete as necessary.
- List each wall in Note 3 separately, showing applicable wall system.
- Fill the "Geotechnical Information" table based on soil conditions for this project. See Structures Design Guidelines, Chapter 3 for required design based internal friction angle and unit weight of Backfill/Random Backfill.
- Fill "Retaining Wall Variables" and "Soil Reinforcement Lengths for External Stability" tables based on requirements for this project. The wall lengths to be filled in for the "Soil Reinforcement Lengths for External Stability" table refer to the mechanical length,  $L$ , of the retaining wall. See Structures Design Guidelines Chapter 3 Figures in the Structures Manual for details.
- Match this table with Design Standards Table No. 5200.

**PLEASE DELETE THIS NOTE UPON COMPLETION OF THIS DRAWING**

**NOTES:**

- Concrete facing panel/face treatment will be -----
- If required, the soil reinforcement and fasteners for the abutment back wall will be designed and furnished by the proprietary wall company. The soil reinforcement will be designed to resist a horizontal/vertical ----- lb/ft. of back wall width. The cost of soil reinforcement and fasteners will be included in the cost of the Retaining Wall System.
- Applicable FDOT Wall Types for each wall/section are listed below. See the Qualified Products List for approved Wall Systems and Design Standards Index No. 5200 for allowable Wall Type notations.  
Wall No. 1 = FDOT Wall Type -----  
Wall No. 2 = FDOT Wall Type -----
- Steepest Slope below the 100 year flood elevation will be Type -----
- See Design Standards Index No. 5200 for General Notes and Details.

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# Wall Data Table

GEOTECHNICAL INFORMATION						
		Reinforced Soil & Random Backfill	Medium Dense Fine Sand	Stiff to Very Stiff Clayey Sand	Medium Dense to Very Dense Fine Sand	Firm Clayey Fine Sand
Depth Below Existing Ground Line (ft.)	Wall B2W1	---	0'-15'	15'-35'	>35'	---
	Wall B2W2	---	0'-23'	23'-37'	>37'	---
Unit Weight (pcf)		105 pcf Moist-in-place	110 pcf Saturated	115 pcf Saturated	120 pcf Saturated	---
Cohesion (psf)		0	0	750 psf	0	---
Internal Friction Angle		30°	30°	0	30°	---

NOTE: If the unit weight and/or internal friction angle of the fill proposed by the Contractor differs from that shown above, the Project Engineer will contact both the District Geotechnical Engineer and the Wall Designer for a possible redesign.

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# Wall Data Table

RETAINING WALL VARIABLES						
Wall No.	Wall Settlement			Durability Category	Concrete Properties	
	Long Term Settlement (in.)	Short Term Settlement (in.)	Differential Settlement (in.)		Precast Wall Panels	
					Class	f'c (psi)
B2W1	4.5"-5.5"	4.0"-5.0"	0.05"/12"	A	II	3400
B2W2	4.5"-5.5"	4.0"-5.0"	0.05"/12"	A	II	3400

NOTE: Design walls for the settlements noted in the table.  
 Long term settlement is measured from the beginning of wall construction.

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# Wall Data Table

SOIL REINFORCEMENT LENGTHS FOR EXTERNAL STABILITY											
Wall B2W1	Wall Height (ft.)	28	25	21	18	15	12	—	—	—	—
	Reinforcement Length (ft.)	21	18	16	14	12	10	—	—	—	—
	Bearing Pressure (psf)	4400	4000	3500	3100	3000	3000	—	—	—	—
Wall B2W2	Wall Height (ft.)	28	25	21	18	15	12	—	—	—	—
	Reinforcement Length (ft.)	21	18	16	14	12	10	—	—	—	—
	Bearing Pressure (psf)	4400	4000	3500	3100	3000	3000	—	—	—	—

NOTE: The reinforcement strap lengths shown above are the minimum lengths required for external stability.  
 The reinforcement lengths used in the construction of the retaining walls will be the longer of that required for external or internal stability (determined by proprietary wall companies).

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## Wall Data Table

*3. Applicable FDOT Wall Types for each wall  
See the Qualified Products List for applicable  
Index No. 5300 of the Design Standard  
Wall No. 1 & 2 - FDOT Wall Type 2A*

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## Wall Data Table & FDOT 2004 CADD Software: Maps and Publications



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# Standard Specification

## 548 RETAINING WALL SYSTEMS.

(REV 9-16-05) (FA 12-20-05) (7-06)

Unless otherwise noted in the plans, provide a wall system listed on the Qualified Products List (QPL) based on the FDOT Wall Type shown in the plans.

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## Qualified Products List Approved Walls

### Qualified Products List (QPL)

#### Specification 548 Retaining Wall Systems

#### 548 Retaining Wall System

<i>QPL Number</i>	<i>Other References</i>	<i>Product ID</i>	<i>Manufacturer</i>	<i>App Date</i>
S548-0001 Old #	<u>S548</u> <u>Vendor Drawing</u>	Reinforced Earth Wall	Reinforced Earth Company 8614 Westwood Center Drive Vienna, VA 22182 (703) 821-1175	7/7/2006  Last Recert
Comments and Limitations	FDOT Wall Types 2A and 2B (Permanent)			
S548-0002 Old #	<u>S548</u> <u>Vendor Drawing</u>	Reinforced Terratrel Wire Wall	Reinforced Earth Company 8614 Westwood Center Drive Vienna, VA 22182 (703) 821-1175	7/7/2006  Last Recert
Comments and Limitations	FDOT Wall Type 3 (Temporary)			

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## 548 Standard Specification & Qualified Products List: State Specifications Office

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## New FDOT Retaining Wall Policies

- Read Structures Design Bulletin C05-16
- Effective for Lettings beginning July 2006
- Includes revision to:
  - Revised Structures Design Guidelines
  - Revised Plans Preparation Manual Chapter 30
  - New QPL Acceptance Criteria
  - New table for Design Standard Index 5300
- Works with new 548 Specification

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Thank You

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