Florida Department of Transportation

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

ANANTH PRASAD
SECRETARY

STRUCTURES DESIGN BULLETIN 13-06

(FHWA Approved: June 5, 2013)

DATE: June 5, 2013

TO: District Directors of Operations, District Directors of Production, District Design Engineers, District Construction Engineers, District Geotechnical Engineers, District Structures Design Engineers

FROM: Robert V. Robertson, P. E., State Structures Design Engineer

COPIES: Tom Byron, Brian Blanchard, Duane Brautigam, David Sadler, Larry Jones, Charles Boyd, Rodrigo Herrera, Jeffrey Ger (FHWA)

SUBJECT: Spread Footing Abutments on MSE Walls and MSE Walls Below the Design High Water Elevation

REQUIREMENTS

1. Replace ***Structures Design Guidelines***, Section 3.13.2.N with the following:

N. Spread Footing Abutments behind MSE Walls:

1. Size the spread footing so that the bearing pressure due to service loading does not exceed 4,000 psf.
2. Locate the edge of the spread footing a minimum of 1 foot behind the back of the wall panel.
3. Size and locate the spread footing so that the distance between the centerline of bearing on the footing and the back of the wall panel is a minimum of 4 feet.
4. Include the vertical and horizontal design loads per square foot and show limits of loading in the plans such that the MSE wall system can be designed by the proprietary wall vendor. Provide both service and factored loads.
5. Except as permitted below, spread footing abutments behind MSE walls are only allowed for single span structures or for multi-simple-span structures where the deck is made discontinuous over the first interior support. Spread Footing Abutments behind MSE Walls may be permitted for continuous superstructures, but only when the superstructure has been designed for the worst-case boundary conditions utilizing the following design assumptions:
   a) Zero settlement of the interior supports.
   b) Initial settlement of the spread footing due to weight of bridge deck and approach slab.
   c) Long term settlement of spread footing up to day 10,000.

6. Include details, e.g. troughs, gutters and/or pipes, that will capture all water from a potentially failed bridge deck expansion joint and convey it to a Stormwater Management Facility.

2. Insert ***Structures Design Guidelines***, Section 3.13.2.P as follows:

P. MSE walls constructed with select backfill (sand or limerock) may border Stormwater Management Facilities and in other locations where the Design High Water Elevation (DHW) is above the adjacent ground surface.

3. Add the following new paragraphs, commentary and figures to ***Structures Detailing Manual***, Section 19.1:

I. Provide slope pavement and joints sealed with low modulus silicone sealant adjacent to end bents as shown in Figure 19.1-1. Show similar details for similar joints between walls and end bents with or without slope pavement.

J. Provide joints sealed with low modulus silicone sealant between spread footing abutments and adjacent retaining wall copings as shown in Figure 19.1-2. Show complete details of troughs, gutters and/or pipes required per ***SDG*** 3.13.2.

Commentary: Providing an easy-to-maintain joint seal between retaining walls and adjacent end bents or spread footings is critical to the long term performance and preservation of the wall and bridge foundation.

Figure 19.1-1 Slope Pavement Details at End Bents

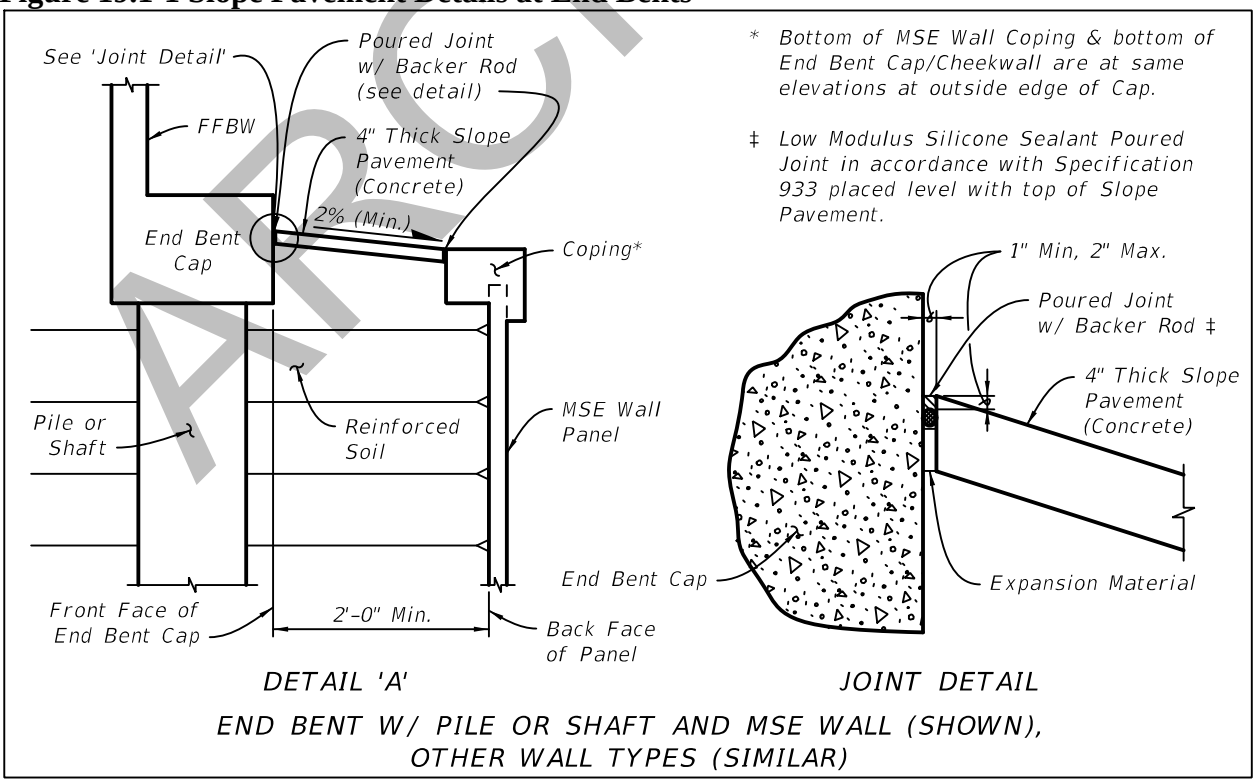
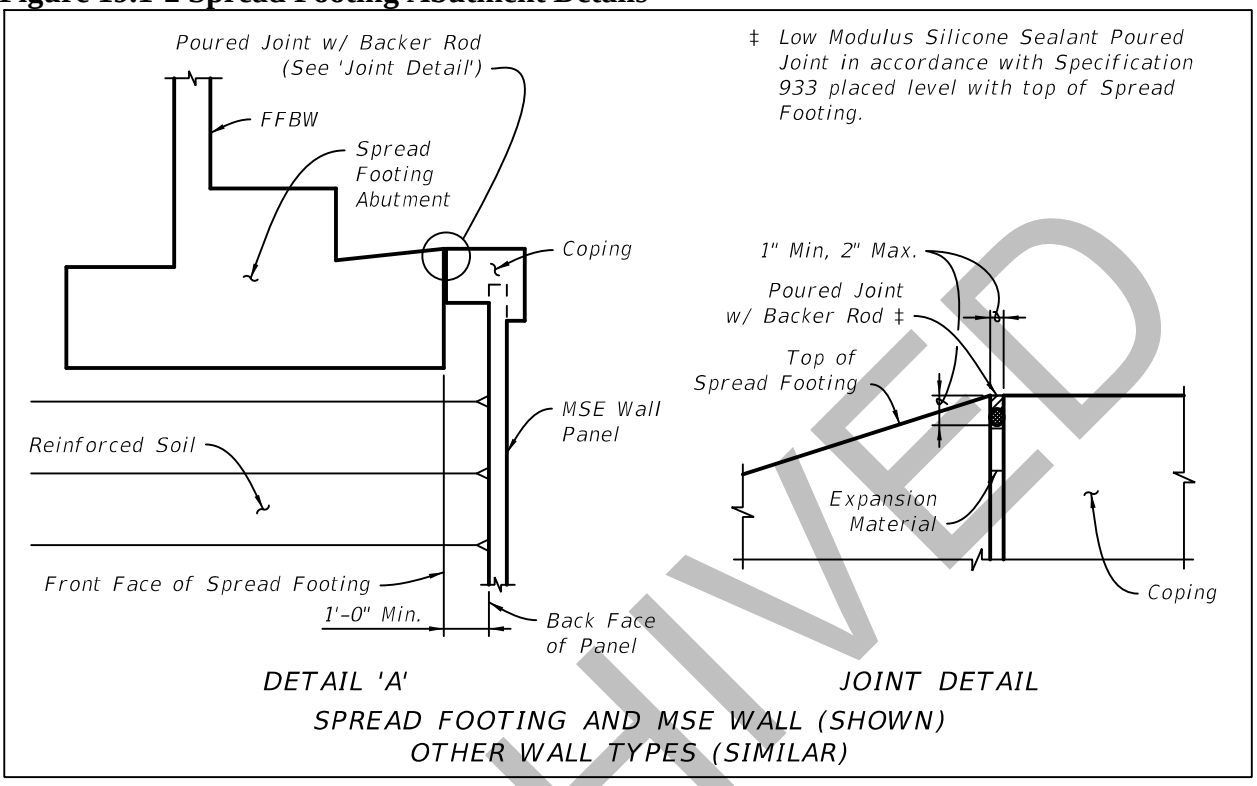


Figure 19.1-2 Spread Footing Abutment Details



4. Delete ***Structures Detailing Manual***, Section 19.6.N and Figure 19.6-5.

COMMENTARY

Localized compaction and containment of soil within MSE walls supporting bridge abutments on spread footings is more critical than that for regular MSE walls. Thus, ***Specification*** 455 is being revised to include special compaction requirements for the backfill supporting spread footing abutments. In addition, ***Design Standards***, Index No. 199 and relevant portions of ***Specification*** 548 are being revised to require the use of Type D-2 geotextile fabric to cover wall joints and other openings near spread footings at bridge abutments. Type D-2 geotextile fabric is more robust than Type D-5 geotextile fabric and is expected to provide for better containment of the soil supporting the bridge abutment during the 100 year design service life of the wall.

For permanent walls, ***Specification*** 548 is also being revised to require the use of coarse aggregate meeting the requirements of ***Specification*** 901 for that the portion of the reinforced backfill between the leveling pad and the elevation one foot above Design High Water. At these locations a geotextile meeting the requirements of ***Specification*** 985 and ***Design Standards*** Index No. 199, Type D-2 geotextile will be required to cover the wall joints and openings. Also, a separation geotextile meeting the requirements of ***Specification*** 985 and ***Design Standards*** Index No. 199, Type D-2 or D-3 will be required between the coarse aggregate and the select backfill/embankment at the bottom, top and sides of the coarse aggregate.

The "Retaining Wall Variables" Data Tables for ***Design Standards*** Index 6020 is being revised to include a column for the "Design High Water Elevation" to be shown. The ***Instructions for Design Standards*** Index 6020 is also being revised to include instructions for completing the table.

Draft versions of ***Design Standards*** Index 199 and ***Instructions for Design Standards*** Index 6020 are attached for reference.

BACKGROUND

Spread footing abutments on MSE walls have been allowed for years. The referenced Specifications are being revised due to increased interest in the use of these footings and the Department's desire to improve the related requirements for backfill compaction and containment.

IMPLEMENTATION

These requirements are effective immediately on all design-bid-build projects in Phase I design development (less than 30% complete). These requirements may be implemented immediately on all design-bid-build projects in Phase II, III or IV at the discretion of the District.

These requirements are effective immediately on all design build projects that have yet to release the final RFP. Design build projects that have had the final RFP released are exempt from these requirements unless otherwise directed by the District.

Specifications 455 and 548, ***Design Standards*** Index 199, ***Instructions for Design Standards*** Index 6020 and ***Design Standards*** Index 6020 Data Table CADD cell will be revised to address the use of geotextile fabric and coarse aggregate as described above. The revised ***Specification***s 455 and 548 will be included in the January 2014 Workbook. ***Design Standards*** Index 199 and ***Instructions for Design Standards*** and Data Table CADD cell for Index 6020 will be released July 2013 and will be effective January 2014.

Modified Special Provisions for ***Specifications*** 455 and 548 are required for projects that will be let prior to January 2014 that utilize a spread footing bridge abutment supported by an MSE wall, or if the Design High Water Elevation will be above the lower ground surface adjacent to a permanent MSE wall. Contact the SDO for assistance in developing the required Modified Special Provisions.

CONTACT

Larry Jones
State Geotechnical Engineer & Assistant State Structures Design Engineer
Florida Department of Transportation
605 Suwannee Street, MS 33
Tallahassee, FL 32399-0450
Phone (850)-414-4305
Larry.Jones@dot.state.fl.us

RVR/CEB

Attachments

STANDARD CRITERIA

CLASS	TYPE (1)	APPLICATION DESCRIPTION	INDEX NO.	PERMITTIVITY (sec^{-1})	AOS SIEVE#	MIN. GRAB TENSILE STRENGTH (lb)	MIN. SEWN STRENGTH (lb/in)	MIN. PUNCTURE (lb)	MIN. TRAPEZOIDAL TEAR (lb)	MIN. WIDE WIDTH TENSILE STRENGTH (lb/in)	UV RESISTANCE (Min. Allowed) %	UV RESISTANCE (Min. Allowed) Time (Hrs.)	COMMENTS
DRAINAGE (D)	D-1	Revetment (Special)		(See D-2)	(See D-2)	315	7.2	113	113		50	500	Woven Monofilament Geotextiles only (Elongation <50%) Provide 12" thick bedding stone layer.
	D-2	Revetment (Standard) Articulating Block**** Gabions Rock, Rubble, Broken Concrete Mechanical Stabilized Retaining Wall Supporting Spread Footing Foundations	281	% SOIL PASSING No. 200 SIEVE <15% 0.7 15% to 50% 0.2 >50% 0.1	% SOIL PASSING No. 200 SIEVE <15% 40 15% to 50% 60 >50% 70*	Woven Monofilament 248 Other Geotextiles: Elongation <50% 315 ≥50% 203	Woven Monofilament 5.7 Other Geotextiles: Elongation <50% 6.9 ≥50% 4.7	Woven Monofilament 90 Other Geotextiles: Elongation <50% 113 ≥50% 79	Woven Monofilament 57 Other Geotextiles: Elongation <50% 113 ≥50% 79		50	500	Woven Geotextiles only. No Slit Film Geotextiles allowed. Provide 12" thick bedding stone layer for revetment (standard). The bedding layer may be omitted if a D-1 fabric is used with revetment (standard). ****Bedding Stone not required for Articulating Block. *For cohesive soils with a plasticity index >7, maximum average roll value for AOS is number 50 sieve.
	D-3	Underdrain *** French Drain Sheet Piling Filter Filter Fabric Jacket (Culvert) Concrete Pavement Subdrainage	286 285 280 287	% SOIL PASSING No. 200 SIEVE <15% 0.5 15% to 50% 0.2 >50% 0.1	% SOIL PASSING No. 200 SIEVE <15% 40 15% to 50% 60 >50% 70*	Elongation <50% 248 ≥50% 158	Elongation <50% 5.7 ≥50% 3.6	Elongation <50% 90 ≥50% 57	Elongation <50% 90** ≥50% 57		50	500	No woven slit film fabrics allowed. *For cohesive soils with a plasticity index >7, maximum average roll value for AOS is number 50 sieve. **Required Trapezoidal tear for woven monofilament is 250. ***See Index No. 286 for the permittivity and AOS values of the internal filter fabric of Type V Underdrain.
	D-4	Slope Pavement (Sand-Cement) Ditch Pavement (Sand-Cement)	281	0.5	40	180	4.2	50	35		50	500	Non-woven, needle-punch only. Elongation ≥50%
	D-5	Mechanical Stabilized Retaining Wall Cast-In-Place Retaining Wall		0.5	40	180	4.2	50	40		50	500	
	D-6	Slope Pavement (Concrete) Ditch Pavement (Concrete)	281	0.5	40	180	4.2	50	35		50	500	Non-woven, needle-punch only. Elongation ≥50%
EROSION (E)	E-1	Staked Silt Fence		0.05	NA	90	2.1	NA	35		80	500	Min. Filtration Efficiency of 75% & min. flow rate of 0.3 gal.
	E-2	Wind Screen		0.05	NA	90	2.1	NA	NA		80	150	
	E-3	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 1)		NA	NA	NA	NA	NA	NA	12 x 6	80	500	Use where design shear stress is ≤2.1 psf
	E-4	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 2)		NA	NA	NA	NA	NA	NA	23 x 12	80	500	Use where design shear stress is ≤3.6 psf
	E-5	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 3)		NA	NA	NA	NA	NA	NA	46 x 23	80	500	Use where design shear stress is ≤5.0 psf

(1) Type refers to FDOT class and application.

TABLE I

Test	Unit	Test Method
Permittivity	sec^{-1}	ASTM-D-4491
AOS	US Sieve No.	ASTM-D-4751
Elongation	%	ASTM-D-4632
Grab Tensile Strength	lb	ASTM-D-4632
Wide Width Tensile Strength	lb/in	ASTM-D-4595
Maximum Design Velocity	fps	See Design Note 3
Sewn Strength	lb/in	ASTM-D-4884
Puncture	lb	ASTM-D-4833
Trapezoidal Tear	lb	ASTM-D-4533
Ultraviolet Resistance	% Retained In Strength	ASTM-D-4355
Filtration Efficiency	%	ASTM-D-5141
Flow Rate	gal^3/min	ASTM-D-5141

GENERAL NOTES

1. Specifications for geotextiles are in Section 985. Physical criteria for each application is provided by this standard, in conjunction with those sections.
2. All values except AOS are MINIMUM AVERAGE ROLL values in the weakest principal direction. Values for AOS are MAXIMUM AVERAGE ROLL values.
3. Test soil or fill material adjacent to the geotextile for gradation to select values for permittivity and AOS.
4. Unless specifically restricted in COMMENTS column, any type of material meeting specification 985 may be used.
5. Wide width tensile strength is expressed in units of measure of lb./in., in machine direction and cross direction, as MD x CD.
6. The Manufacturer shall provide results in English Units.

DESIGN NOTES

1. The Designer shall review this criteria and adjust the values as necessary to satisfy project requirements. These adjustments shall be called for in the plans or contained in the project special provisions.
2. UV Resistance: The value represents the percent minimum textile strength retained (ASTM-D-4632) after weathering per ASTM-D-4355 for the test period (hours).
3. Shear stress limits for plastic erosion mats determined by 30 minutes sustained flow in unvegetated state as determined by tests performed by Utah State University, Texas Transportation Institute or an independent testing laboratory approved by the State Drainage Engineer.
4. The Designer shall specify the type of filter fabric needed in the plan's summary table.

LAST REVISION	REVISION	DESCRIPTION:
07/01/13		

FDOT 2014 DESIGN STANDARDS

GEOTEXTILE CRITERIA

INDEX NO. 199

SHEET NO. 1 of 1

Index 6020 Permanent MSE Retaining Wall Systems

Design Criteria

AASHTO LRFD Bridge Design Specifications, 6th Edition; ***Structures Design Guidelines (SDG)***; AASHTO-AGC-ARTBA Task Force 27 (Ground Modification Techniques), ***Insitu Soil Improvement Techniques***, January 1990.

Design Assumptions and Limitations

See the "Design Criteria" note on the Standard.

Plan Content Requirements

In the Structures or Roadway Plans:

Prepare Control Plans in accordance with the requirements of ***PPM*** Vol. 1, Chapter 30, and include them in the plans.

Complete the following Data Tables using the following instructions and include the Data Tables on the retaining wall supplemental detail sheets. See Introduction I.3 for more information regarding use of Data Tables.

1. Complete the Notes and add/modify/delete as necessary.
2. List each wall in Note 3 separately, showing applicable wall systems.
3. Complete the "Geotechnical Information" table based on project soil conditions. See ***SDG*** Chapter 3 for required design based internal friction angle and unit weight of Reinforced Soil and Random Backfill.
4. Complete the "Retaining Wall Variables" and "Soil Reinforcement Lengths for External Stability" tables based on project requirements. If the Design High Water Elevation (DHW) is above the adjacent ground surface, include the elevation in the "Retaining Wall Variables" table. Otherwise include "N/A" in the appropriate column in the table. DHW refers to the Mean High Water, Normal High Water or other controlling high water elevation adjacent to the wall. The Wall Heights in the "Soil Reinforcement Lengths for External Stability" table refer to the height above the leveling pad, measured to the top of the wall coping. See ***SDG*** Chapter 3 Figures for details.
5. Transverse Differential Settlement is only applicable for widening of existing embankments.

PERMANENT MSE RETAINING WALL SYSTEM DATA TABLES

GEOTECHNICAL INFORMATION						Table Date 1-01-11
		Reinforced Soil & Random Backfill	Loose Fine Sand	Firm Fine Sand	Loose Clayey Fine Sand	Firm Clayey Fine Sand
Depth Below Existing Ground Line (ft.)	Wall No. 1	—				
	Wall No. 2	—				
Effective Unit Weight (pcf)						
Cohesion (psf)		0				
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					Table Date 7-01-13
Wall No.	Wall Settlement				Design High Water Elevation (ft.)
	Long Term Settlement (in.)	Short Term Settlement (in.)	Differential Settlement		
			Longitudinal (%) (ft./100ft.)	Transverse (in.)	
1				N/A	
2				N/A	

NOTE:
Design walls for the settlements noted in the table.
Long term settlement is measured from the end of wall fill placement.
Transverse differential settlement is measured from the face of wall to the end of the soil reinforcement.

SOIL REINFORCEMENT LENGTHS FOR EXTERNAL STABILITY											Table Date 1-01-11
Wall No. 1	Wall Height (ft.)										
	Reinforcement Length (ft.)										
	Factored Bearing Resistance (psf)										
Wall No. 2	Wall Height (ft.)										
	Reinforcement Length (ft.)										
	Factored Bearing Resistance (psf)										

NOTES:
1. 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).
2. The Factored Bearing Resistances shown above are the critical (lowest) values from all the load cases analyzed using LRFD methodology.

NOTES:

1. Concrete facing panel surfaces treatment will be _____ .
2. 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 factored horizontal load of _____ kips/ft. of back wall width. The cost of soil reinforcement and fasteners will be included in the cost of the Retaining Wall System.
3. Applicable FDOT Wall Types for each wall location are listed below. See the Qualified Products List for approved Wall Systems and Design Standards Index No. 6020 for allowable Wall Type substitutions.
   Wall No. 1 – FDOT Wall Type _____
   Wall No. 2 – FDOT Wall Type _____
4. Concrete for Coping and/or Junction Slab shall be Class _____ (f'c = _____ psi) with/without silica fume, metakaolin or ultrafine fly ash.
5. See Design Standards Index. No. 6020 for General Notes and Details.

Payment

Item number	Item description	Unit Measure
548-12	Retaining Wall System, Permanent, Excluding Barrier	SF
548-14	Retaining Wall System, Permanent - Widening, Attached To Existing Wall	SF

Commentary: See Instructions for Design Standards Index 6100 Series for Traffic Railing/Junction Slab Pay Items as required.