ORIGINATION FORM

Date: 31 October 2012
Originator: Larry Jones
Contact Information: Larry.Jones@dot.state.fl.us

Specification Title: Retaining Wall Systems
Specification Section, Article, or Subarticle Number: 548-2.6.2, 548-4 & 548-9

Why does the existing language need to be changed? To document the set of conditions where MSE walls may be constructed utilizing sand backfill with pH = 4.5 to 4.99. To document the laboratory testing procedure to be followed when MSE shop drawings are optimized for soil friction angle.

Summary of the changes: MSE wall backfill may be as low as 4.5 under certain circumstances. Incorporation in the Specification of the current lab testing protocol required when the friction angle depicted in the shop drawings exceeds 30 degrees for sand backfill or 34 degrees for limerock backfill.

Are these changes applicable to all Department jobs? Yes
If not, what are the restrictions?

Will these changes result in an increase or decrease in project costs? If any change, the changes should result in a decrease due to the availability of backfill meeting the lower pH limit. If yes, what is the estimated change in costs?

With who have you discussed these changes? Industry, SMO, Construction

What other offices will be impacted by these changes? SMO, Construction & Maintenance

Are changes needed to the PPM, Design Standards, SDG, CPAM or other manual? No

Is a Design Bulletin, Construction Memo, or Estimates Bulletin needed? Yes, if implemented before the July 2013 workbook.

Contact the State Specifications Office for assistance in completing this form.
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M E M O R A N D U M

DATE: December 10, 2012

TO: Specification Review Distribution List

FROM: Trey Tillander, State Specifications Engineer

SUBJECT: Proposed Specification: **5480206 Retaining Wall Systems.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Larry Jones of the State Structures Design Office to clarify the conditions where MSE walls may be constructed using backfill with a pH as low as 4.5 and to include the testing procedure when MSE shop drawings are optimized for soil friction angle.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965TT or trey.tillander@dot.state.fl.us. Comments received after **January 4, 2013,** may not be considered. Your input is encouraged.

TT/dt
Attachment

RETAINING WALL SYSTEMS.
(REV ~~10~~11*12*-~~8~~15-12)

SUBARTICLE 548-2.6.2 (Page 708) is deleted and the following substituted:

548-2.6.2 Compacted Select Backfill: Meet the requirements of Sections 105 and 120 except as noted within this Section. Have the backfill material tested for every soil type for pH, resistivity, sulfate and chloride content by a Department approved independent testing laboratory prior to placement. Provide certification to the Engineer that the results have met the requirements of this Section and are signed and sealed by a Professional Engineer, registered in the State of Florida.

For constructing the retaining wall volume, do not use backfill material containing more than 2.0% by weight of organic material, as determined by FM 1-T 267 and by averaging the test results for three randomly selected samples from each stratum or stockpile of a particular material. If an individual test value of the three samples exceeds 3%, the stratum or stockpile will not be suitable for constructing the retaining wall volume.

Ensure that the material is non-plastic as determined by AASHTO T90 and the liquid limit as determined by AASHTO T89 is less than 15. The pH, as determined by FM 5-550, shall not be lower than 5.0 and not higher than 9.0. ~~*For wall systems utilizing geosynthetic backfill reinforcement, concrete panels with at least 3 inches of concrete cover over the panel reinforcement, and if no metallic structures, such as metallic pipes are placed within the backfill, the pH as determined by FM 5-550, shall not be lower than 4.5 and not higher than 9.0.*~~*Sources of select backfill material having a pH between 4.5 and 5.0, as determined by FM 5-550, may be used provided the interior face of the MSE wall panels have 3 inches of concrete cover over the reinforcement and the concrete used in the panels contains the following ingredients and proportions:*

1. The quantity of cement replaced with Type F fly ash is 10% to 20% by weight.

2. The quantity of cement replaced with slag is 50% to 60% by weight.

3. Portland cement is 30% by weight of total cementitious material.

4. The total weight of the Type F fly ash and slag does not exceed 70% of total cementitious material.

Do not place metallic pipe in backfill materials having a pH less than 5.0.

Use backfill for walls using soil reinforcements that meets the following gradation limits determined in accordance with AASHTO T27 and FM 1-T 011:

Sieve Size	Percent Passing
3-1/2 inches	100
3/4 inch	70-100
No. 4	30-100
No. 40	15-100
No. 100	0-65
No. 200	0-12

In addition, for permanent walls utilizing metallic soil reinforcement, use backfill that meets the following electro-chemical test criteria for determining corrosiveness:

Criteria	Test Method
Resistivity: > 3000 ohm -·cm	FM 5-551
Soluble sulfate content: < 200 PPM	FM 5-553
Soluble chloride content < 100 PPM	FM 5-552

For walls not using soil reinforcement, use backfill that meets the following gradation limits determined in accordance with AASHTO T27 and FM 1-T 011:

Sieve Size	Percent Passing
3-1/2 inches	100
No. 200	0-12

ARTICLE 548-4 (Page 710) is deleted and the following substituted:

548-4 Shop Drawings.

Provide shop drawings and calculations in accordance with Section 5. Provide calculations and drawings showing details, notes, materials, dimensions, sizes and other information necessary for the complete fabrication and erection of the retaining wall system. As a minimum, provide the following:

1. Elevation view showing the final ground line and elevations of the top and bottom of wall at the begin and end of wall, all breaks in vertical alignment and all whole stations and 25 foot station increments.

2. Sections showing the length, size and designation of soil reinforcement.

3. Plan view showing the horizontal alignment and offsets from the horizontal control line to the exterior face of the wall; the location of utilities, drainage structures and other items that impact the wall; the limits of the reinforced soil volume; and, the location of piles within the reinforced earth volume.

4. Details for construction around utilities, drainage structures and other items that impact the wall; for placement of soil reinforcement at acute corners; for addressing conflicts between soil reinforcement and obstructions in the reinforced soil volume; for addressing different wall types intersecting and impacting each other.

5. General notes and design parameters including design soil characteristics; factored bearing resistance and factored bearing pressure for each wall height increment and other notes required for construction of the walls.

6. Design calculations for each wall height increment detailed in the shop drawings.

7. When the friction angle depicted in the shop drawings exceeds 30 degrees for sand backfill or 34 degrees for limerock backfill, provide laboratory test results in accordance with 548-9.5 verifying the backfill to be used for the wall meets the design soil characteristics for the shop drawings.

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SUBARTICLE 548-8.5.1 (Page 713) is deleted and the following substituted:

548-8.5.1 Compacted Select Backfill: Perform work in accordance with an approved QC Plan meeting the requirements of 105-3. A LOT is defined as a single lift of finished embankment not to exceed 500 feet in length or cumulative length of continuous, interconnected walls. Backfill within 3 feet from the panels and backfill beyond 3 feet from the panels are separate LOTs. Overlapping retaining wall volumes may be considered one LOT, excluding the 3 feet width behind the panels. Strips up to 8 feet wide between two retaining wall volumes constructed with the same material in one operation may be considered as one LOT with the retaining wall volumes. Isolated compaction operations will be considered as separate LOTs. For multiple phase construction, a LOT will not extend beyond the limits of the phase.

Place the backfill closely following the erection of each course of precast components or soil reinforcement layers and spread by moving the machinery parallel to the wall face. Do not allow equipment heavier than 8 tons closer than 3 feet behind the wall face. Place backfill in a manner to avoid any damage or disturbance to the wall materials or misalignment of the facing materials. Remove and replace any wall materials which become damaged or disturbed during backfill placement at no cost to the Department, or correct as directed by the Engineer. Remove and reconstruct any misalignment or distortion of the wall facing due to placement of backfill outside the limits of this specification at no cost to the Department.

Sheepsfoot, grid rollers or other types of equipment employing a foot are not allowed. Achieve compaction within 3 feet of the back of the wall face using a power operated roller or plate weighing less than 1,000 pounds. At a distance greater than 3 feet from the back of the wall, a vibratory roller may be used, provided that the frequency and amplitude combined with bulk weight of the roller has performed satisfactorily at a trial section of the same type of wall. A smooth wheel or rubber tire roller is considered adequate. Ensure that the maximum lift thickness after compaction does not exceed 6 inches. Decrease the lift thickness if necessary, to obtain specified density.

Perform backfill compaction in a way that the compactor moves in a direction parallel to the wall face and proceeds from a distance not less than 3 feet behind the wall face toward the end of the soil reinforcement element.

Ensure that the moisture content of the backfill material prior to and during compaction is uniformly distributed throughout each layer of material. Use backfill material having a placement moisture content at the dry side of the optimum moisture content. To achieve the required compaction moisture content, use water that meets the requirements of Section 923. Do not use saltwater. Do not transport excessively moist backfill materials to the site for any reason. The Engineer will determine the optimum moisture content in accordance with FM 5-521.

At the end of each day’s operation, shape the last level of backfill to permit runoff of rainwater away from the wall face or provide a positive means of controlling run off away from the wall such as temporary pipe, etc.

ARTICLE 548-9 (Page 714 - 716) is deleted and the following substituted:

548-9 Acceptance Program.

548-9.1 General Requirements: Meet the requirements of 120-10 except delete the requirement of 120-10.1.4.1, 120-10.1.4.3, 120-10.2 and 120-10.3.

548-9.2 Maximum Density Determination: Determine the maximum QC density in accordance with FM 1 T-180. Determine the maximum density in accordance with AASHTO T99, Method C.

Perform gradation tests on the sample collected in accordance with AASHTO T27 and FM 1-T 011. Classify soils in accordance with AASHTO M145 in order to determine compliance with embankment utilization requirements.

548-9.3 Density Testing Requirements: Ensure compliance with the requirements of nuclear density testing in accordance with FM 1-T 238. Determine the in-place moisture content for each density test. Use FM 1-T 238, FM 5-507 (Determination of Moisture Content by Means of a Calcium Carbide Gas Pressure Moisture Tester), or FM 5-535 (Laboratory Determination of Moisture Content of Granular Soils by Use of a Microwave Oven) for moisture determination.

Perform these tests at a minimum frequency of one set of tests per LOT.

Determine test locations including stations and offsets, using the random number generator provided by the Engineer. Do not use note pads or work sheets to record data for later transfer to the density log book. Notify the Engineer upon successful completion of QC testing on each LOT.

548-9.4 Acceptance Criteria: Obtain a minimum density of 90% of the maximum dry density as determined by FM 1 T-180 within 3 feet behind the wall face and obtain a minimum density of 95% of the maximum dry density as determined by FM 1 T-180 from beyond 3 feet behind the wall face.

548-9.4.1 Optional Acceptance Criteria for A-3 and A-2-4 Materials: Obtain a minimum density of 95% of the maximum dry density as determined by AASHTO T99 within 3 feet behind the wall face and obtain a minimum density of 100% of the maximum dry density as determined by AASHTO T99 beyond 3 feet behind the wall face.

The combined width from both MSE wall backfill (excluding the 3 feet zone from the panels) and embankment material may be considered the same LOT if the same material is used; the material in both wall backfill and embankment is compacted with the same procedure, equipment and compacting effort; and the maximum lift thickness after compaction in both wall backfill and embankment is 6 inches.

548-9.5 Friction Angle: *When the friction angle depicted in the shop drawings exceeds 30 degrees for sand backfill or 34 degrees for limerock backfill, ensure the friction angle of the backfill material tested in accordance with FM 1-T 236 equals or exceeds the backfill friction angle depicted in the shop drawings.*

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548-9.~~5~~ *6* Frequency: Conduct sampling and testing at a minimum frequency listed in the table below. The Engineer will perform verification sampling and tests at a minimum frequency listed in the table below.

Test Name	Quality Control (QC)	Verification
Maximum Density	One per soil type	One per soil type
Density	One set of tests per LOT	One set of tests per four LOTs for each type of QC test.
Gradation	One per Maximum Density	One per Maximum Density
LL&PI	One per Maximum Density	One per Maximum Density
Soil Classification	One per Maximum Density	One per Maximum Density
Organic Content	One per soil type	One per soil type
Direct Shear	*Three per soil type when required by 548-9.5*	*One per soil type*

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In addition, for permanent walls utilizing metallic soil reinforcement, test for corrosiveness at a minimum frequency of one test per soil type at point of placement according to the electro-chemical table in 548-2.6. The Engineer will collect enough material to split and create two separate samples and retain one for resolution at point of placement until LOTs represented by the samples are accepted. The Engineer will perform verification tests for corrosiveness at a minimum frequency of one test per soil type.

548-9.~~6~~*7* Verification Comparison Criteria and Resolution Procedures:

548-9.~~6~~*7*.1 Maximum Density Determination: The Engineer will collect enough material to split and create two separate samples and retain one for resolution until LOTs represented by the samples are accepted.

The Engineer will meet the requirements of 120-10.4.1 except replace AASHTO T99, Method C with FM 1-T 180, Method D. If the Contractor selects the Optional Acceptance Criteria, the Engineer will verify the QC results of AASHTO T99, Method C in accordance with 120-10.4.1.

548-9.~~6~~*7*.2 Density Testing: Meet the requirements of 120-10.4.2.

548-9.~~6~~*7*.3 Soil Classification: The Engineer will meet the requirements of 120-10.4.3 except test the sample retained in 548-9.~~6~~*7*.1 instead of taking the additional one.

548-9.~~6~~*7*.4 Gradation: The Engineer will verify the QC results if the verification result meets the gradation limits set forth in the gradation table of 548-2.6. Otherwise, the Engineer will test the sample retained in 548-9.~~6~~*7*.1. The State Materials Office *(SMO)* or an AASHTO accredited laboratory designated by the ~~State Materials Office~~*SMO* will perform resolution testing. The material will be sampled and tested in accordance with AASHTO T27 and FM 1-T 011.

If the resolution test result satisfies the required gradation limits, the LOTS will be verified. If the resolution test results do not meet the required gradation limits, reconstruct the LOTS with acceptable material. The Engineer will perform new verification testing.

548-9.~~6~~*7*.5 Liquid Limit and Plasticity Index (LL&PI): The Engineer will verify the QC results if the verification result satisfies the plasticity index and liquid limit criteria set forth in 548-2.6. Otherwise, the Engineer will test the sample retained in 548-9.~~6~~*7*.1. The

State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform resolution testing. The material will be sampled and tested in accordance with AASHTO T90 and AASHTO T89, respectively.

If the resolution test result satisfies the required criteria, LOTS of that soil type will be verified. If the resolution test results do not meet the required criteria, reconstruct the corresponding LOTS with acceptable material. The Engineer will perform new verification testing.

548-9.67.6 Corrosiveness: The Engineer will verify the QC results if the verification result satisfies the electro-chemical test criteria set forth in 548-2.6. Otherwise, the Engineer will test the sample retained in 548-9.57.1. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform resolution testing. The material will be sampled and tested in accordance with FM 5-550, FM 5-551, FM 5-552 and FM 5-553.

If the resolution test result satisfies the required criteria, material of that soil type will be verified and accepted. If the resolution test results do not meet the required criteria, reject the material and reconstruct with acceptable material.

548-9.67.7 Organic Content: The Engineer will verify the QC results if the verification result satisfies the organic content test criteria set forth in 548-2.6. Otherwise, the Engineer will collect three additional samples. The material will be sampled and tested in accordance with FM 1-T 267 and by averaging the test results for three randomly selected samples from at least one lift per soil type. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform resolution testing.

If the resolution test result satisfies the required criteria, material of that soil type will be verified and accepted. If the resolution test results do not meet the required criteria, reject the material and reconstruct with acceptable material.

548-9.7.8 Friction Angle: *When the friction angle depicted in the shop drawings exceeds 30 degrees for sand backfill or 34 degrees for limerock backfill, the Engineer will take a verification sample at the point of placement to perform a direct shear verification test in accordance with FM 1-T 236. The State Materials Office or a Cconsultant qualified to perform Geotechnical Specialty Lab Testing (Type of Work 9.5), under the per Rule 14-75 of the Florida Administrative Code will perform the verification testing. If the test verifies the material has a friction angle greater than or equal to the friction angle depicted in the shop drawings, the material in the LOTs will be verified. If the verification test does not meet the required friction angle, reconstruct the LOTs with acceptable material.*

The Contractor may request to redesign the wall and resubmit the shop drawings with the lower friction angle indicated by the verification test. Employ a Professional Engineer to redesign and submit signed and sealed drawings and computations. Do not begin any reconstruction until the proposed redesign has been reviewed and approved by the Engineer. The Contractor shall bear the costs of the redesigning and any work resulting from the design changes.

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