



Florida Department of Transportation

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605 Suwannee Street
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ERIK FENNIMAN
INTERIM SECRETARY

January 15, 2019

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **548**
Proposed Specification: **5480206 Retaining Wall Systems.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Larry Jones of the State Structures Design Office to modify the language.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to dan.hurtado@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 414-4130.

Sincerely,

Signature on file

Dan Hurtado, P.E.
State Specifications Engineer

DH/dt

Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

RETAINING WALL SYSTEMS.**(REV ~~10-24-18~~ ~~11-28-18~~ ~~11-19-19~~)**

SUBARTICLE 548-2.6.2 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. Submit a certification, signed and sealed by a Professional Engineer registered in the State of Florida, that the results have met the requirements of this Section.

The pH, as determined by FM 5-550, shall not be lower than 5.0 and not higher than 9.0: when metallic elements or pipes are placed within the backfill. Sources of select backfill material having a pH between 4.5 and 5.0 for walls utilizing metallic reinforcement and between 3.0 and 5.0 for walls utilizing geosynthetic reinforcement ~~with no metallic elements or pipes placed within the backfill, as determined by FM 5-550~~, may be used provided the interior face of the MSE wall panels have three 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.

In lieu of the mix design described above, a mix design with a fast pozzolanic material meeting the requirements of 346-2.3(6) silica fume, metakaolin and ultrafine fly ash, can be substituted. Examples of mix designs meeting this requirement are:

1. 8% silica fume plus 20% fly ash
2. 10% metakaolin plus 20% fly ash.

Provide proper curing for these materials to prevent surface cracking.

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

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 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-T267 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.

For walls using soil reinforcement, use backfill that meets the following gradation limits determined in accordance with AASHTO T27 and FM 1-T011:

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

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

~~SUBARTICLE 548-2 is expanded by the following:~~

~~**548-2.7 Compressible Free Draining Seal:** Provide a UV stabilized compressible free draining material of sufficient strength, and size to remain secure until uninstalled. The seal must be comprised of materials with the following properties:~~

UVA & UVB Resistance (ASTM G154 500hrs)	Total weight loss \leq 0.05%
Permittivity (ASTM D4491)	\geq .05 /sec

SUBARTICLE 548-6.1 is deleted and the following substituted:

548-6.1 Reinforced Concrete Components: For precast concrete wall components that have not been installed, evaluate cracks, spalls and other deficiencies in accordance with 450-12. Repair deficiencies in accordance with 450-13 or the plant's approved repair methods that are included as part of the Producer Quality Control Plan. The original performance and durability of repaired wall components must be maintained. Use materials for concrete repair that meet or exceed the strength requirement for the class of concrete used. Materials meeting the requirements of Section 930 may be substituted for non shrink grout when required by 450-13.

For precast concrete wall components that have been installed, the disposition of concrete cracks will be determined in accordance with 400-21.

The Department will reject all precast concrete wall components not meeting the quality standard of this Section and referenced Specifications. In addition, any of the following defects will be sufficient cause for rejection by the Department:

1. Defects that indicate unsatisfactory molding.
2. Defects indicating honeycombed or open texture concrete.
3. Defects in the physical characteristics such as:
 - a. Signs of aggregate segregation
 - b. Broken or cracked corners
 - c. Soil reinforcement attachment devices improperly

installed/damaged

- d. Lifting inserts not useable
- e. Exposed reinforcing steel
- f. Insufficient cover over reinforcing steel
- g. Cracks at the alignment pipe or pin
- h. Insufficient concrete compressive strength
- i. Precast component thickness in excess of plus or minus 3/16 inch

from that shown in the Contract ~~Documents~~ Documents

j. Stained front face, due to excess form oil or other reasons. If the face of the precast component is stained or discolored to the point of rejection, the stain or discoloration may be removed, or a Department approved stain or a Class 5 finish may be applied to attain a uniform appearance for the entire structure, to the satisfaction of the Engineer.

SUBARTICLE 548-8.5 is deleted and the following substituted:

548-8.5 Backfill Placement:

548-8.5.1 Compacted Select and Coarse Aggregate Backfill: 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 three feet from the panels and backfill beyond three feet from the panels are separate LOTs. Overlapping retaining wall volumes may be considered one LOT, excluding the three feet width behind the panels. Strips up to eight 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. When bridge abutments on spread footings are shown in the Plans, the material within three feet behind the wall face and within the limits defined in 548-9.4.2 are considered as separate LOTs.

Remove wrinkles in geotextile ~~synthetic~~ reinforcement prior to covering with backfill. 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 eight tons closer than three 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.

Compact coarse aggregate backfill with a minimum of three passes of a vibratory compactor weighing between 600 and 1000 pounds or two passes of vibratory compactor weighing over 1000 pounds. Use the highest vibration level that does not cause

excessive fracture of the aggregate in the opinion of the Engineer. Continue compaction until there is no additional movement. Sheepsfoot, grid rollers or other types of equipment employing a foot are not allowed for any backfill type. Achieve compaction of all backfill types within three 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 three 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. For select backfill, a smooth wheel or rubber tire roller is considered adequate. For walls employing geosynthetic reinforcement, limit the weight of compaction equipment to 25,000 pounds. Ensure that the maximum lift thickness after compaction does not exceed six inches. Decrease the lift thickness if necessary, to obtain specified density.

All transitions from coarse aggregate backfill to select backfill must occur at least six inches above and below any layers of backfill reinforcement. Place a separation geotextile in accordance with 548-2.5.4 between the coarse aggregate backfill and select backfill and embankment.

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 three feet behind the wall face toward the end of the soil reinforcement element.

When placing select backfill, the moisture content of the backfill material prior to and during compaction must be 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 transport excessively moist backfill materials to the site for any reason. Determine the optimum moisture content in accordance with the test method used to determine maximum density in 548-9.

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 runoff away from the wall such as temporary pipe.

548-8.5.2 Thick Lift Option for Compacted Select Backfill: If, through field tests, the Contractor can demonstrate that the compaction equipment can achieve density for the full depth of a thicker lift, and if approved by the Engineer, the backfill may be constructed in successive courses of not more than 10 inches compacted thickness.

The Engineer will base approval on results of a test section of full height test wall constructed using the Contractor's specified compaction effort. The length of the test wall shall be the length required to produce one LOT of not less than 500 feet at the top of the wall. The height of the test wall shall be at least 20 feet or the highest wall in the project, whichever is less. Notify the Engineer prior to beginning construction of a test section wall. Construct a test section of the length of one LOT.

Perform ~~five~~ one set of QC density tests per thick lift of the test wall on the backfill within three feet behind the wall face and one set of QC density tests per thick lift of the test wall on the backfill placed beyond three feet behind the wall face, at random locations ~~the~~ test section within each LOT. At each QC density test site, ~~test the~~ bottom 6 inches in addition ~~to~~ set will include testing the entire lift thickness and a "dig down test" of the bottom 6 inches. Excavate materials as needed to allow testing of the bottom 6 inches, at no expense to the Department. Maintain the exposed surface as close to "undisturbed" as possible; no further compaction will be permitted during the test preparation. The Department will perform

verification testing of density for the bottom 6 inches and the entire lift thickness at the frequency indicated in 548-9.6. All QC tests and a Department Verification test must meet the density required by 548-9.4.

Identify the test ~~section~~ wall with the compaction effort and thickness in the Logbook. ~~Remove~~ For the materials ~~above~~ within three feet behind the ~~bottom 6 inches, at no expense to~~ wall face, ~~Department~~, the minimum density required on the thicker lift will be the average of all the ~~five~~ passing QC results obtained on the thick lifts ~~in~~ of the ~~passing test section~~ wall within the three feet behind the wall face. ~~Maintain the exposed surface as close to undisturbed as possible, no further compaction will be permitted during the test preparation. If unable to achieve the required density, remove and replace or repair the test section to comply with the Specifications at no additional expense to the Department.~~ For the material placed beyond three feet behind the wall face, the minimum density required will be the average of all the passing QC results obtained on the thick lifts of the test wall beyond three feet behind the wall face. The Contractor may elect to place material in 6 inches compacted thickness at any time. Once approved, a change in the source of backfill material will require the construction of a new test ~~section~~ wall. Do not change the compaction effort once the test ~~section~~ wall is approved. The Engineer will periodically verify the density of the bottom 6 inches during thick lift operations. If unable to achieve the required density, remove and replace or repair the test wall to comply with the specifications at no additional expense to the Department. The Engineer may terminate the use of thick lift construction and instruct the Contractor to revert to the 6 inches maximum lift thickness if the Contractor fails to achieve satisfactory results or meet ~~applicable~~ the requirements of this ~~Specifications~~.

548-8.5.3 Flowable Fill: Metallic wall components (including metallic soil reinforcements) must not be in partial contact with the flowable fill. If the metallic components contact the flowable fill, the metallic components must be completely encapsulated by the flowable fill.

548-8.6 Compressible Free Draining Seal: ~~After the application of all coatings and treatments to the wall panels,~~ Seal all joints between panels of reinforced concrete panel MSE walls with compressible free draining material to prevent plant growth from seeds or spores that may be in the joints or transported to the joints by wind or rain. Install the seal at least one and one-half inches from both the front and rear faces of the panel. Protect the free draining seal during the application of coatings and sealants. Should the seal become coated or clogged, remove and replace the coated or clogged free draining seal. The installation must be secure and free draining to keep the seal securely in place until uninstalled and to prevent hydrostatic forces from building up behind the panel.

RETAINING WALL SYSTEMS.**(REV 1-11-19)**

SUBARTICLE 548-2.6.2 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. Submit a certification, signed and sealed by a Professional Engineer registered in the State of Florida, that the results have met the requirements of this Section.

The pH, as determined by FM 5-550, shall not be lower than 5.0 and not higher than 9.0 when metallic elements or pipes are placed within the backfill. Sources of select backfill material having a pH between 4.5 and 5.0 for walls utilizing metallic reinforcement and between 3.0 and 5.0 for walls utilizing geosynthetic reinforcement, may be used provided the interior face of the MSE wall panels have three 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.

In lieu of the mix design described above, a mix design with a fast pozzolanic material meeting the requirements of 346-2.3(6) silica fume, metakaolin and ultrafine fly ash, can be substituted. Examples of mix designs meeting this requirement are:

1. 8% silica fume plus 20% fly ash
2. 10% metakaolin plus 20% fly ash.

Provide proper curing for these materials to prevent surface cracking.

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

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
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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-T267 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.

For walls using soil reinforcement, use backfill that meets the following gradation limits determined in accordance with AASHTO T27 and FM 1-T011:

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

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
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For precast concrete wall components that have been installed, the disposition of concrete cracks will be determined in accordance with 400-21.

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1. Defects that indicate unsatisfactory molding.
2. Defects indicating honeycombed or open texture concrete.
3. Defects in the physical characteristics such as:
 - a. Signs of aggregate segregation
 - b. Broken or cracked corners
 - c. Soil reinforcement attachment devices improperly
 - d. Lifting inserts not useable
 - e. Exposed reinforcing steel
 - f. Insufficient cover over reinforcing steel
 - g. Cracks at the alignment pipe or pin

installed/damaged

- h. Insufficient concrete compressive strength
- i. Precast component thickness in excess of plus or minus 3/16 inch from that shown in the Contract Documents
- j. Stained front face, due to excess form oil or other reasons. If the face of the precast component is stained or discolored to the point of rejection, the stain or discoloration may be removed, or a Department approved stain or a Class 5 finish may be applied to attain a uniform appearance for the entire structure, to the satisfaction of the Engineer.

SUBARTICLE 548-8.5 is deleted and the following substituted:

548-8.5 Backfill Placement:

548-8.5.1 Compacted Select and Coarse Aggregate Backfill: 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 three feet from the panels and backfill beyond three feet from the panels are separate LOTs. Overlapping retaining wall volumes may be considered one LOT, excluding the three feet width behind the panels. Strips up to eight 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. When bridge abutments on spread footings are shown in the Plans, the material within three feet behind the wall face and within the limits defined in 548-9.4.2 are considered as separate LOTs.

Remove wrinkles in geosynthetic reinforcement prior to covering with backfill. 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 eight tons closer than three 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.

Compact coarse aggregate backfill with a minimum of three passes of a vibratory compactor weighing between 600 and 1000 pounds or two passes of vibratory compactor weighing over 1000 pounds. Use the highest vibration level that does not cause excessive fracture of the aggregate in the opinion of the Engineer. Continue compaction until there is no additional movement. Sheepsfoot, grid rollers or other types of equipment employing a foot are not allowed for any backfill type. Achieve compaction of all backfill types within three 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 three 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. For select backfill, a smooth wheel or rubber tire roller is considered adequate. For walls employing geosynthetic reinforcement, limit the weight of compaction equipment to 25,000 pounds. Ensure that the maximum lift thickness after compaction does not exceed six inches. Decrease the lift thickness if necessary, to obtain specified density.

All transitions from coarse aggregate backfill to select backfill must occur at least six inches above and below any layers of backfill reinforcement. Place a separation geotextile in accordance with 548-2.5.4 between the coarse aggregate backfill and select backfill and embankment.

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 three feet behind the wall face toward the end of the soil reinforcement element.

When placing select backfill, the moisture content of the backfill material prior to and during compaction must be 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 transport excessively moist backfill materials to the site for any reason. Determine the optimum moisture content in accordance with the test method used to determine maximum density in 548-9.

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 runoff away from the wall such as temporary pipe.

548-8.5.2 Thick Lift Option for Compacted Select Backfill: If, through field tests, the Contractor can demonstrate that the compaction equipment can achieve density for the full depth of a thicker lift, and if approved by the Engineer, the backfill may be constructed in successive courses of not more than 10 inches compacted thickness.

The Engineer will base approval on results of a full height test wall constructed using the Contractor's specified compaction effort. The length of the test wall shall be the length required to produce one LOT of not less than 500 feet at the top of the wall. The height of the test wall shall be at least 20 feet or the highest wall in the project, whichever is less. Notify the Engineer prior to beginning construction of a test wall.

Perform one set of QC density tests per thick lift of the test wall on the backfill within three feet behind the wall face and one set of QC density tests per thick lift of the test wall on the backfill placed beyond three feet behind the wall face, at random locations within each LOT. At each QC density test, the set will include testing the entire lift thickness and a "dig down test" of the bottom 6 inches. Excavate materials as needed to allow testing of the bottom 6 inches, at no expense to the Department. Maintain the exposed surface as close to "undisturbed" as possible; no further compaction will be permitted during the test preparation. The Department will perform verification testing of density for the bottom 6 inches and the entire lift thickness at the frequency indicated in 548-9.6. All QC tests and a Department Verification test must meet the density required by 548-9.4.

Identify the test wall with the compaction effort and thickness in the Logbook. For the material within three feet behind the wall face, the minimum density required on the thick lift will be the average of all the passing QC results obtained on the thick lifts of the test wall within the three feet behind the wall face. For the material placed beyond three feet behind the wall face, the minimum density required will be the average of all the passing QC results obtained on the thick lifts of the test wall beyond three feet behind the wall face. The Contractor may elect to place material in 6 inches compacted thickness at any time. Once approved, a change in the source of backfill material will require the construction of a new test wall. Do not change the compaction effort once the test wall is approved. The Engineer will periodically verify the density of the bottom 6 inches during thick lift operations. If unable to

achieve the required density, remove and replace or repair the test wall to comply with the specifications at no additional expense to the Department. The Engineer may terminate the use of thick lift construction and instruct the Contractor to revert to the 6 inches maximum lift thickness if the Contractor fails to achieve satisfactory results or meet the requirements of this Section.

548-8.5.3 Flowable Fill: Metallic wall components (including metallic soil reinforcements) must not be in partial contact with the flowable fill. If the metallic components contact the flowable fill, the metallic components must be completely encapsulated by the flowable fill.

548-8.6 Compressible Free Draining Seal: Seal all joints between panels of reinforced concrete panel MSE walls with compressible free draining material to prevent plant growth from seeds or spores that may be in the joints or transported to the joints by wind or rain. Install the seal at least one and one-half inches from both the front and rear faces of the panel. Protect the free draining seal during the application of coatings and sealants. Should the seal become coated or clogged, remove and replace the coated or clogged free draining seal. The installation must be secure and free draining to keep the seal securely in place until uninstalled and to prevent hydrostatic forces from building up behind the panel.