



Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JARED W. PERDUE, P.E.
SECRETARY

September 24, 2024

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

Re: State Specifications Office
Section: 548
Proposed Specification: **5480200 Retaining Wall Systems**

Dear Ms. Kendall:

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

The changes are proposed by Dino Jameson to remove geotextile type D-5 which was never intended to be within the wall.

Please review and transmit your comments, if any, within two weeks (10 business days). Comments should be sent via email daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on File

Daniel Strickland, P.E.
State Specifications Engineer

DS/dh

Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

RETAINING WALL SYSTEMS (REV 8-8-24)

ARTICLE 548-2 is deleted and the following substituted:

548-2 Materials.

Provide a wall system listed on the Department's Approved Product List (APL) based on the wall type shown in the Plans. Purchase components, soil reinforcement, attachment devices, joint filler, ~~geotextile~~~~filter fabric~~, and all necessary incidentals for each wall from the same wall supplier.

548-2.1 Concrete: Ensure that concrete utilized for all wall components is consistent with the concrete class, environmental classification and admixture requirements for durability as stated in the Contract Documents. Produce and supply concrete for all reinforced concrete wall components meeting the requirements of Section 346.

Produce and supply concrete for the leveling pad meeting the requirements of Section 347. Use Department approved mix designs.

548-2.2 Reinforcing Steel: Meet the requirements of Section 931 for steel reinforcing and Section 932 for FRP reinforcing, as identified in the Contract Documents and APL drawings.

548-2.3 Backfill Reinforcement: For walls utilizing backfill reinforcement, use reinforcement consisting of steel wire mesh, metal strips or structural geosynthetics as required for the wall system chosen. Use backfill reinforcement of the same length from top to bottom of wall at any section. For tiered walls, use backfill reinforcement of the same length within the height of each tier at any section.

Use plain steel wire mesh and embedded loops shop fabricated from cold drawn steel wire and weld into the finished mesh fabric meeting the requirements of ASTM A1064. Use longitudinal and transverse wires of equal and constant diameter within a given piece of mesh reinforcement. Use steel strips hot rolled from bars to the required shape and dimensions with physical and mechanical properties meeting ASTM A572 Grade 65 or as shown in the Contract. Use shop-fabricated hot rolled steel tie straps meeting the minimum requirements of ASTM A1011/A1011 M, Grade 50, or as shown in the Contract.

Ensure that steel reinforcing strips, tie strips, reinforcing mesh and connectors used in permanent walls are galvanized in accordance with ASTM A123 or ASTM A153, as applicable. For typical applications, punch or drill holes in metal items before galvanizing. Field drilled holes for bin walls are permitted. Repair field drilled holes; field cut ends and other damage to galvanized surfaces in accordance with Section 562.

Use Type R-3 structural geosynthetics made of polypropylene, select high density polyethylene or high-tenacity polyester fibers having cross-sections sufficient to permit significant mechanical interlock with the backfill. Use geosynthetics having a high tensile modulus in relation to the backfill. Use geosynthetics having high resistance to deformation under sustained long term design load while in service and resistant to ultraviolet degradation, to damage under normal construction practices and to all forms of biological or chemical degradation normally encountered in the material being reinforced. Do not use uncoated polyester (PET) reinforcements or reinforcements weakened or damaged by high pH environments within any portion of the flowable fill, or within coarse aggregate backfill below the design high water elevation (DHW) shown in the Plans.

Store the geosynthetics in conditions above 20°F and not greater than 140°F. Prevent mud, wet cement, epoxy, and like materials from coming into contact with and affixing to the geosynthetic material. Rolled geosynthetic may be laid flat or stood on end for storage. Cover the geosynthetic and protect from sunlight prior to placement in the wall system.

Carefully inspect all reinforcement, steel and geosynthetics to ensure they are the proper size and free from defects that may impair their strength and durability.

548-2.4 Attachment Devices: Use backfill reinforcement attachment devices as required by the wall system chosen.

548-2.5 Joint Materials and ~~Filter Fabrics~~ Geotextiles:

548-2.5.1 Horizontal Joint Pads: Use elastomeric or polymeric pads in all horizontal joints between precast components as recommended by the wall manufacturer. Ensure that the pads are of sufficient size and hardness to limit vertical stresses on the pad and concrete surface and to prevent concrete to concrete contact at the joints.

548-2.5.2 Joint Covers for Non-SBW Walls: For walls supporting bridge abutments on spread footings, cover joints and other wall openings within a horizontal distance equal to the larger of:

1. the length of the reinforcement under the footing plus 25 feet, or
 2. twice the maximum height of the footing above the leveling pad,
- measured from the nearest edge of the footing, surrounding the reinforced backfill for the abutment with Type D-2 geotextile ~~fabrie~~ meeting the requirements of Section 985-514.

Cover all joints and wall openings in portions of the wall backfilled with coarse aggregate with Type D-2 geotextile ~~fabrie~~ meeting the requirements of Section 985-514. Cover all other joints and wall openings with Type D-2 or D-3 geotextile ~~fabrie~~ with a maximum apparent opening size (AOS) equal to US Sieve No. 70 meeting the requirements of Section 985-514. Apply an adhesive approved by the Engineer to the back of the precast component for attachment of the ~~fabrie-geotextile~~ material.

548-2.5.3 Alignment Pins: Ensure that pins used to align the precast components during construction are of the size, shape and material required for the wall system chosen.

548-2.5.4 Separation Geotextile: Provide a Type D-2 ~~or~~, D-3 ~~or~~ D-5 separation geotextile meeting the requirements of Section 985-514 between the coarse aggregate and the select backfill/embankment at the bottom, top and sides of the coarse aggregate.

548-2.6 Backfill Material:

548-2.6.1 General: Provide compacted select backfill or coarse aggregate backfill within the retaining wall volume as shown in the Plans. For permanent walls, provide coarse aggregate backfill in lieu of compacted select backfill to an elevation at least one foot above the DHW shown in the Plans when the DHW is above the lowest adjacent ground surface. Provide flowable fill within the retaining wall volume in lieu of compacted select backfill or coarse aggregate backfill only when the option for flowable fill is shown in the Plans. The retaining wall volume is defined to extend from the top of the leveling pad or footing, or bottom of walls which do not have footing or leveling pads, to the finish grade line and from the face of the wall to a vertical plane passing through the end of the extreme wall component (straps, counterforts, etc.) plus one foot.

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.

Use backfill material with a pH between 5.0 and 10.0 as determined by FM 5-550. For polyester geosynthetic reinforcement, use backfill material with a pH between 5.0 and 9.0. Sources of select backfill material having a pH low as 4.5 and 5.0 for walls utilizing metallic reinforcement and pH low as 3.0 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, the concrete used in the panels contain either an highly reactive pozzolan or the ternary mix design meets the requirements of Table 346-2 with a surface resistivity equal or greater than 29 kOhm-cm and there are no steel piles and metallic elements/pipes other than metallic reinforcement placed within the backfill.

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: > 3,000 ohm · cm | FM 5-551 |
| Soluble chloride content < 100 PPM | FM 5-552 |
| Soluble sulfate content: < 200 PPM | FM 5-553 |

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 T 90 and the liquid limit as determined by AASHTO T 89 is less than 15.

For walls using soil reinforcement, use backfill that meets the following gradation limits determined in accordance with AASHTO T 27 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 T 27 and FM 1-T 011:

| Table 548-3 Gradation Limits Not Using Soil Reinforcement | |
|--|-----------------|
| Sieve Size | Percent Passing |
| 3-1/2 inches | 100 |
| No. 200 | 0-12 |

548-2.6.3 Flowable Fill: Meet the requirements of Section 121 except as noted within this Section and the Plans.

548-2.6.4 Coarse Aggregate Backfill and Drainage Aggregate: Provide coarse aggregate comprised of natural stones meeting the requirements of Section 901 with a size distribution of any of the listed aggregate gradations from Size No 57 through Size No 89, inclusive, except as noted on the Plans. Have all coarse aggregate backfill materials tested 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 of these tests meet the requirements of 548-2.6.2.

For SBW systems, provide drainage aggregate comprised of coarse aggregate backfill and a drainage geotextile to separate the drainage aggregate from the reinforced backfill as specified for each approved wall system.

ARTICLE 548-3 is deleted and the following substituted:

548-3 Approved Product List (APL).

All proprietary retaining wall systems shall be listed on the APL. Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6, independently certified test reports, and calculations and drawings in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications and the Department's Structures Design Guidelines (SDG) signed and sealed by a Professional Engineer registered in the State of Florida. Submit calculations and drawings showing details, notes, materials, dimensions, sizes, and other information as described below for a complete description of the retaining wall system.

1. Soil reinforcement durability and/or corrosion data;
2. Differential settlement the wall system can tolerate without exceeding normal stress range of the soil reinforcement and wall facing, or the construction tolerances in this Section;
3. The effects of water flow;
4. Applicable environmental classifications as outlined in the SDG;
5. Signed and sealed design calculations. Design calculations may be either by hand or by a wall company program with hand calculations verifying the program output. It is only necessary to include sample hand calculations for a 20 foot height for each soil condition.
6. Corrosion and durability design procedures for soil reinforcement elements;
7. Provide 11 inch x17 inch drawings showing:
 - a. Notes specific to the wall system;
 - b. Panel sizes and reinforcing;
 - c. Soil reinforcement connection to wall facings;

- d. Wall panel abutment interfacing;
 - e. Slip joints;
 - f. Steps in leveling pad;
 - g. Soil reinforcing details around all vertical obstructions;
 - h. ~~Filter fabric~~ Geotextile placement at panel joints and around all obstructions;
 - i. Details for skewing soil reinforcement (15 degrees maximum) without cutting;
 - j. Corner elements (required at all angle breaks greater than 5 degrees);
 - k. Bin wall details for acute corners (required at all acute corners where interior corner angle is less than 70 degrees);
 - l. Details showing how to accommodate long term (post construction) wall settlement in excess of four inches without attaching soil reinforcement to the abutment; and,
 - m. Details of how to ground the wall system.
8. Pull-out test data for the proposed wall/reinforcement connection, and size and type of soil reinforcement for wall system. Testing shall be done by an independent soil testing laboratory or testing agency certified by the Department. Ensure test data includes all sizes and types of soil reinforcement to be utilized on Department projects. Default AASHTO values may be used for conventional soil reinforcement. For soil reinforcement grids, include all various configurations and combinations of longitudinal and transverse wires.
9. Other information pertinent to the design and performance of the wall system as necessary.
10. A field construction manual describing construction requirements and sequencing for the wall system. Submit manual in 8-1/2 inch x 11 inch format in either pdf or MS Word format.

ARTICLE 548-4 is deleted and the following substituted:

548-4 Shop Drawings.

Submit 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 finished graded surface 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.

8. For SBW systems, include details for the placement of drainage aggregate, drainage pipes and separation geotextile. Drawings should be similar to details for Type II or Type III underdrains in Standard Plans, Index 440-001. Do not directly cover perforated drainage pipes with a geotextile ~~filter fabric~~ (such as a filter sock).

9. When SBW systems use friction or semi-friction connections between geosynthetic reinforcement and the facing blocks, include the results of connection capacity testing. Tests must be performed using the materials to be used on the project and tested in accordance with ASTM D6638 to justify the short-term ultimate connection strength reduction factor (CR_u) used to determine the long-term connection strength reduction factor (CR_{cr}) value in the design calculations for each wall height increment detailed in the shop drawings.

SUBARTICLE 548-8.3 is deleted and the following substituted:

548-8.3 Foundation Preparation: Grade the foundation for the structure level for a width equal to or exceeding the limits of the retaining wall volume or as shown in the Contract. Prepare the foundation in conformance with Section 125.

In addition to the compaction requirements of Section 125, compact the graded area with an appropriate vibratory roller weighing a minimum of eight tons for at least five passes or as directed by the Department's District Geotechnical Engineer. Remove and replace any soft or loose foundation subsoils incapable of sustaining the required compaction to the Engineer's satisfaction.

For permanent MSE wall systems, provide an unreinforced concrete leveling pad as shown in the Contract Documents. Cure the leveling pad a minimum of 12 hours before placement of precast wall components.

For SBW MSE wall systems, a geogrid reinforced, geotextile wrapped, compacted aggregate leveling pad may be used in lieu of the unreinforced concrete leveling pad. The compacted aggregate leveling pad must be at least 24 inches wide and at least 8 inches thick after compacting, and the geogrid must be at least 6 inches below the top of the leveling pad. Wrap the aggregate leveling pad with a D-2 ~~or~~ D-3 ~~or~~ D-5 separation geotextile. The geotextile may run up the front and back of the first block course or between the aggregate leveling pad and the first block course.

SUBARTICLE 548-8.4 is deleted and the following substituted:

548-8.4 Wall Erection: Assemble, connect and support wall components as recommended by the wall supplier. As backfill material is placed behind the wall face of MSE

wall systems utilizing reinforced concrete panels, maintain the wall in the vertical position or slightly battered into the backfill to provide a final vertical alignment (by means of bracing, temporary wooden wedges placed in the joint at the junction of the two adjacent precast components on the external side of the wall or other alignment aids). Remove wooden wedges as soon as the precast component above the wedged precast component is completely erected and backfilled. External bracing is required for the initial lift of MSE systems.

For SBW systems, carefully place the first course of concrete block units on the leveling pad. Up to 1/2 inch of sand may be placed between the concrete leveling pad and the buried first course of blocks to provide a level and stable base. A one inch gap between the first course of facing units is allowed, provided a suitable ~~geotextile filter fabric~~ is placed behind the foundation units as specified for each approved wall system. Each unit must be in full contact with the base and checked for level and horizontal alignment. Voids must be kept to a minimum to prevent point loading and cracking, unless otherwise indicated in the shop drawings. Place units side by side for the full length of wall alignment. Fill the hollow cores or cells and the space within blocks with drainage aggregate. Sweep away excess material from top of units and install the next course.

Place soil reinforcement normal to the face of the wall, unless otherwise shown in the Contract or as directed by the Engineer. Do not cut or kink soil reinforcement. Do not connect soil reinforcement to piles or allow soil reinforcement to bear against piles. Field cut soil reinforcement only at locations as shown in the approved shop drawings. Prior to placement of the reinforcement, compact the backfill in accordance with 548-8.5.

For SBW systems, shims made of non-degradable materials may be used as specified for each approved wall system. The shim thickness per course of block must not exceed 1/8 inch and must not be installed on reinforcement elevations when the reinforcement connection relies on any friction.

548-8.4.1 Tolerances for Permanent Walls: Walls that do not meet the following tolerances will not be accepted by the Department and must be removed and reconstructed at no cost to the Department.

548-8.4.1.1 Reinforced Concrete MSE Wall Systems: Vertical tolerances (plumbness) and horizontal alignment tolerances must not exceed 3/4 inch when measured with a 10 foot straightedge. The maximum allowable offset in the joint between precast components is 3/4 inch. The final overall vertical tolerance of the completed wall (plumbness from top to bottom) must not exceed 1/2 inch per 10 feet of wall height. Horizontal and vertical joints between precast components must not be less than 1/2 inch or more than 1-1/4 inches.

548-8.4.1.2 SBW Systems: Horizontal alignment tolerances must not exceed 3/4 inch per 10 feet of wall length. The maximum allowable gap between segmental retaining wall blocks above the first course must not exceed 1/16 inch. The final overall vertical tolerance of the completed wall (deviation from plumbness from top to bottom or batter shown in the Plans) must not exceed 1/2 inch per 10 feet of wall height.

548-8.4.2 Tolerances for Temporary Walls: Vertical tolerances (plumbness) and horizontal alignment tolerances must not exceed three inches when measured with a 10 foot straightedge. The final overall vertical tolerance of the completed wall (plumbness from top to bottom) must not exceed one inch per three feet of wall height, not to exceed a total of six inches.

SUBARTICLE 548-9.1 is deleted and the following substituted:

548-9 Acceptance Program.

548-9.1 General Requirements: Meet the requirements of 120-10 except ~~exclude~~delete the requirements of ~~120-10.1.4.1, 120-10.1.4.3, 120-10.1.6,~~120-10.2 and 120-10.43.

SUBARTICLE 548-9.3 is deleted and the following substituted:

548-9.3 Density Testing Requirements: ~~Meet the requirements of 120-10.1.4.2 except as modified herein.~~ Determine the in-place wet density by Nuclear Density testing in accordance with FM 1-T310. Determine the in-place moisture content for each density test in accordance with FM 1-T310, FM 5-507 (Speedy Moisture), or ASTM D-4643 (Microwave Oven), whichever is applicable. Calculate the dry density using the measured in-place wet density and moisture content. 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 notepads or worksheets to record data for later transfer to the ERS section of the Department's database. Notify the Engineer upon successful completion of QC testing on each LOT.

SUBARTICLE 548-9.6 has the following Administrative change:

548-9.6 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 Table 548-4 below.

| Test Name | Quality Control (QC) | Verification |
|---------------------|--|--|
| Maximum Density | One per soil type | One per soil type |
| Density | One per LOT | One 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 |
| pH | One per soil type | One per soil type |
| Direct Shear | Three per soil type when required by 548-9.5 | One per soil type |

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.

SUBARTICLE 548-9.7.1 is deleted and the following substituted:

548-9.7 Verification Comparison Criteria and Resolution Procedures:

548-9.7.1 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 120-10.46.1 except replace FM 1-T099 with FM 1-T180. If the Contractor selects the Optional Acceptance Criteria, the Engineer will verify the QC results of FM 1-T099 in accordance with 120-10.46.1.

SUBARTICLE 548-9.7.2 is deleted and the following substituted:

548-9.7.2 Density Testing: Meet the requirements of 120-10.46.2.

SUBARTICLE 548-9.7.3 is deleted and the following substituted:

548-9.7.3 Soil Classification: The Engineer will meet the requirements of 120-10.46.3 except test the sample retained in 548-9.7.1 instead of taking the additional one.

ARTICLE 548-12 is deleted and the following substituted:

548-12 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including the design of the wall system, excavation required specifically for wall construction below the finished graded surface, backfill reinforcement, leveling pad, footings, copings, light pole pedestals, ~~fabric material~~ geotextile, horizontal joint materials, alignment pins, repairs, labor, equipment, and other materials necessary to complete the wall in an acceptable manner as shown in the Contract. The cost of backfill for the finished graded surface will be included in the cost of embankment or borrow excavation, as applicable.

Payment will be made under:

- | | |
|-------------------|--|
| Item No. 548- 12- | Retaining Wall System (Permanent) - per square foot. |
| Item No. 548- 13- | Retaining Wall System (Temporary) - per square foot. |

RETAINING WALL SYSTEMS (REV 8-8-24)

ARTICLE 548-2 is deleted and the following substituted:

548-2 Materials.

Provide a wall system listed on the Department's Approved Product List (APL) based on the wall type shown in the Plans. Purchase components, soil reinforcement, attachment devices, joint filler, geotextile, and all necessary incidentals for each wall from the same wall supplier.

548-2.1 Concrete: Ensure that concrete utilized for all wall components is consistent with the concrete class, environmental classification and admixture requirements for durability as stated in the Contract Documents. Produce and supply concrete for all reinforced concrete wall components meeting the requirements of Section 346.

Produce and supply concrete for the leveling pad meeting the requirements of Section 347. Use Department approved mix designs.

548-2.2 Reinforcing Steel: Meet the requirements of Section 931 for steel reinforcing and Section 932 for FRP reinforcing, as identified in the Contract Documents and APL drawings.

548-2.3 Backfill Reinforcement: For walls utilizing backfill reinforcement, use reinforcement consisting of steel wire mesh, metal strips or structural geosynthetics as required for the wall system chosen. Use backfill reinforcement of the same length from top to bottom of wall at any section. For tiered walls, use backfill reinforcement of the same length within the height of each tier at any section.

Use plain steel wire mesh and embedded loops shop fabricated from cold drawn steel wire and weld into the finished mesh fabric meeting the requirements of ASTM A1064. Use longitudinal and transverse wires of equal and constant diameter within a given piece of mesh reinforcement. Use steel strips hot rolled from bars to the required shape and dimensions with physical and mechanical properties meeting ASTM A572 Grade 65 or as shown in the Contract. Use shop-fabricated hot rolled steel tie straps meeting the minimum requirements of ASTM A1011/A1011 M, Grade 50, or as shown in the Contract.

Ensure that steel reinforcing strips, tie strips, reinforcing mesh and connectors used in permanent walls are galvanized in accordance with ASTM A123 or ASTM A153, as applicable. For typical applications, punch or drill holes in metal items before galvanizing. Field drilled holes for bin walls are permitted. Repair field drilled holes; field cut ends and other damage to galvanized surfaces in accordance with Section 562.

Use Type R-3 structural geosynthetics made of polypropylene, select high density polyethylene or high-tenacity polyester fibers having cross-sections sufficient to permit significant mechanical interlock with the backfill. Use geosynthetics having a high tensile modulus in relation to the backfill. Use geosynthetics having high resistance to deformation under sustained long term design load while in service and resistant to ultraviolet degradation, to damage under normal construction practices and to all forms of biological or chemical degradation normally encountered in the material being reinforced. Do not use uncoated polyester (PET) reinforcements or reinforcements weakened or damaged by high pH environments within any portion of the flowable fill, or within coarse aggregate backfill below the design high water elevation (DHW) shown in the Plans.

Store the geosynthetics in conditions above 20°F and not greater than 140°F. Prevent mud, wet cement, epoxy, and like materials from coming into contact with and affixing

to the geosynthetic material. Rolled geosynthetic may be laid flat or stood on end for storage. Cover the geosynthetic and protect from sunlight prior to placement in the wall system.

Carefully inspect all reinforcement, steel and geosynthetics to ensure they are the proper size and free from defects that may impair their strength and durability.

548-2.4 Attachment Devices: Use backfill reinforcement attachment devices as required by the wall system chosen.

548-2.5 Joint Materials and Geotextiles:

548-2.5.1 Horizontal Joint Pads: Use elastomeric or polymeric pads in all horizontal joints between precast components as recommended by the wall manufacturer. Ensure that the pads are of sufficient size and hardness to limit vertical stresses on the pad and concrete surface and to prevent concrete to concrete contact at the joints.

548-2.5.2 Joint Covers for Non-SBW Walls: For walls supporting bridge abutments on spread footings, cover joints and other wall openings within a horizontal distance equal to the larger of:

1. the length of the reinforcement under the footing plus 25 feet, or
2. twice the maximum height of the footing above the leveling pad,

measured from the nearest edge of the footing, surrounding the reinforced backfill for the abutment with Type D-2 geotextile meeting the requirements of Section 514.

Cover all joints and wall openings in portions of the wall backfilled with coarse aggregate with Type D-2 geotextile meeting the requirements of Section 514. Cover all other joints and wall openings with Type D-2 or D-3 geotextile with a maximum apparent opening size (AOS) equal to US Sieve No. 70 meeting the requirements of Section 514. Apply an adhesive approved by the Engineer to the back of the precast component for attachment of the geotextile material.

548-2.5.3 Alignment Pins: Ensure that pins used to align the precast components during construction are of the size, shape and material required for the wall system chosen.

548-2.5.4 Separation Geotextile: Provide a Type D-2 or D-3 separation geotextile meeting the requirements of Section 514 between the coarse aggregate and the select backfill/embankment at the bottom, top and sides of the coarse aggregate.

548-2.6 Backfill Material:

548-2.6.1 General: Provide compacted select backfill or coarse aggregate backfill within the retaining wall volume as shown in the Plans. For permanent walls, provide coarse aggregate backfill in lieu of compacted select backfill to an elevation at least one foot above the DHW shown in the Plans when the DHW is above the lowest adjacent ground surface. Provide flowable fill within the retaining wall volume in lieu of compacted select backfill or coarse aggregate backfill only when the option for flowable fill is shown in the Plans. The retaining wall volume is defined to extend from the top of the leveling pad or footing, or bottom of walls which do not have footing or leveling pads, to the finish grade line and from the face of the wall to a vertical plane passing through the end of the extreme wall component (straps, counterforts, etc.) plus one foot.

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.

Use backfill material with a pH between 5.0 and 10.0 as determined by FM 5-550. For polyester geosynthetic reinforcement, use backfill material with a pH between 5.0 and 9.0. Sources of select backfill material having a pH low as 4.5 and 5.0 for walls utilizing metallic reinforcement and pH low as 3.0 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, the concrete used in the panels contain either an highly reactive pozzolan or the ternary mix design meets the requirements of Table 346-2 with a surface resistivity equal or greater than 29 kOhm-cm and there are no steel piles and metallic elements/pipes other than metallic reinforcement placed within the backfill.

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: > 3,000 ohm -cm | FM 5-551 |
| Soluble chloride content < 100 PPM | FM 5-552 |
| Soluble sulfate content: < 200 PPM | FM 5-553 |

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 T 90 and the liquid limit as determined by AASHTO T 89 is less than 15.

For walls using soil reinforcement, use backfill that meets the following gradation limits determined in accordance with AASHTO T 27 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 T 27 and FM 1-T 011:

| Table 548-3 Gradation Limits Not Using Soil Reinforcement | |
|--|-----------------|
| Sieve Size | Percent Passing |
| 3-1/2 inches | 100 |
| No. 200 | 0-12 |

548-2.6.3 Flowable Fill: Meet the requirements of Section 121 except as noted within this Section and the Plans.

548-2.6.4 Coarse Aggregate Backfill and Drainage Aggregate: Provide coarse aggregate comprised of natural stones meeting the requirements of Section 901 with a size distribution of any of the listed aggregate gradations from Size No 57 through Size No 89, inclusive, except as noted on the Plans. Have all coarse aggregate backfill materials tested 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 of these tests meet the requirements of 548-2.6.2.

For SBW systems, provide drainage aggregate comprised of coarse aggregate backfill and a drainage geotextile to separate the drainage aggregate from the reinforced backfill as specified for each approved wall system.

ARTICLE 548-3 is deleted and the following substituted:

548-3 Approved Product List (APL).

All proprietary retaining wall systems shall be listed on the APL. Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6, independently certified test reports, and calculations and drawings in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications and the Department's Structures Design Guidelines (SDG) signed and sealed by a Professional Engineer registered in the State of Florida. Submit calculations and drawings showing details, notes, materials, dimensions, sizes, and other information as described below for a complete description of the retaining wall system.

1. Soil reinforcement durability and/or corrosion data;
2. Differential settlement the wall system can tolerate without exceeding normal stress range of the soil reinforcement and wall facing, or the construction tolerances in this Section;
3. The effects of water flow;
4. Applicable environmental classifications as outlined in the SDG;
5. Signed and sealed design calculations. Design calculations may be either by hand or by a wall company program with hand calculations verifying the program output. It is only necessary to include sample hand calculations for a 20 foot height for each soil condition.
6. Corrosion and durability design procedures for soil reinforcement elements;
7. Provide 11 inch x17 inch drawings showing:
 - a. Notes specific to the wall system;
 - b. Panel sizes and reinforcing;
 - c. Soil reinforcement connection to wall facings;

- d. Wall panel abutment interfacing;
 - e. Slip joints;
 - f. Steps in leveling pad;
 - g. Soil reinforcing details around all vertical obstructions;
 - h. Geotextile placement at panel joints and around all obstructions;
 - i. Details for skewing soil reinforcement (15 degrees maximum) without cutting;
 - j. Corner elements (required at all angle breaks greater than 5 degrees);
 - k. Bin wall details for acute corners (required at all acute corners where interior corner angle is less than 70 degrees);
 - l. Details showing how to accommodate long term (post construction) wall settlement in excess of four inches without attaching soil reinforcement to the abutment; and,
 - m. Details of how to ground the wall system.
8. Pull-out test data for the proposed wall/reinforcement connection, and size and type of soil reinforcement for wall system. Testing shall be done by an independent soil testing laboratory or testing agency certified by the Department. Ensure test data includes all sizes and types of soil reinforcement to be utilized on Department projects. Default AASHTO values may be used for conventional soil reinforcement. For soil reinforcement grids, include all various configurations and combinations of longitudinal and transverse wires.
9. Other information pertinent to the design and performance of the wall system as necessary.
10. A field construction manual describing construction requirements and sequencing for the wall system. Submit manual in 8-1/2 inch x 11 inch format in either pdf or MS Word format.

ARTICLE 548-4 is deleted and the following substituted:

548-4 Shop Drawings.

Submit 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 finished graded surface 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.

8. For SBW systems, include details for the placement of drainage aggregate, drainage pipes and separation geotextile. Drawings should be similar to details for Type II or Type III underdrains in Standard Plans, Index 440-001. Do not directly cover perforated drainage pipes with a geotextile (such as a filter sock).

9. When SBW systems use friction or semi-friction connections between geosynthetic reinforcement and the facing blocks, include the results of connection capacity testing. Tests must be performed using the materials to be used on the project and tested in accordance with ASTM D6638 to justify the short-term ultimate connection strength reduction factor (CR_u) used to determine the long-term connection strength reduction factor (CR_{cr}) value in the design calculations for each wall height increment detailed in the shop drawings.

SUBARTICLE 548-8.3 is deleted and the following substituted:

548-8.3 Foundation Preparation: Grade the foundation for the structure level for a width equal to or exceeding the limits of the retaining wall volume or as shown in the Contract. Prepare the foundation in conformance with Section 125.

In addition to the compaction requirements of Section 125, compact the graded area with an appropriate vibratory roller weighing a minimum of eight tons for at least five passes or as directed by the Department's District Geotechnical Engineer. Remove and replace any soft or loose foundation subsoils incapable of sustaining the required compaction to the Engineer's satisfaction.

For permanent MSE wall systems, provide an unreinforced concrete leveling pad as shown in the Contract Documents. Cure the leveling pad a minimum of 12 hours before placement of precast wall components.

For SBW MSE wall systems, a geogrid reinforced, geotextile wrapped, compacted aggregate leveling pad may be used in lieu of the unreinforced concrete leveling pad. The compacted aggregate leveling pad must be at least 24 inches wide and at least 8 inches thick after compacting, and the geogrid must be at least 6 inches below the top of the leveling pad. Wrap the aggregate leveling pad with a D-2 or D-3 separation geotextile. The geotextile may run up the front and back of the first block course or between the aggregate leveling pad and the first block course.

SUBARTICLE 548-8.4 is deleted and the following substituted:

548-8.4 Wall Erection: Assemble, connect and support wall components as recommended by the wall supplier. As backfill material is placed behind the wall face of MSE

wall systems utilizing reinforced concrete panels, maintain the wall in the vertical position or slightly battered into the backfill to provide a final vertical alignment (by means of bracing, temporary wooden wedges placed in the joint at the junction of the two adjacent precast components on the external side of the wall or other alignment aids). Remove wooden wedges as soon as the precast component above the wedged precast component is completely erected and backfilled. External bracing is required for the initial lift of MSE systems.

For SBW systems, carefully place the first course of concrete block units on the leveling pad. Up to 1/2 inch of sand may be placed between the concrete leveling pad and the buried first course of blocks to provide a level and stable base. A one inch gap between the first course of facing units is allowed, provided a suitable geotextile is placed behind the foundation units as specified for each approved wall system. Each unit must be in full contact with the base and checked for level and horizontal alignment. Voids must be kept to a minimum to prevent point loading and cracking, unless otherwise indicated in the shop drawings. Place units side by side for the full length of wall alignment. Fill the hollow cores or cells and the space within blocks with drainage aggregate. Sweep away excess material from top of units and install the next course.

Place soil reinforcement normal to the face of the wall, unless otherwise shown in the Contract or as directed by the Engineer. Do not cut or kink soil reinforcement. Do not connect soil reinforcement to piles or allow soil reinforcement to bear against piles. Field cut soil reinforcement only at locations as shown in the approved shop drawings. Prior to placement of the reinforcement, compact the backfill in accordance with 548-8.5.

For SBW systems, shims made of non-degradable materials may be used as specified for each approved wall system. The shim thickness per course of block must not exceed 1/8 inch and must not be installed on reinforcement elevations when the reinforcement connection relies on any friction.

548-8.4.1 Tolerances for Permanent Walls: Walls that do not meet the following tolerances will not be accepted by the Department and must be removed and reconstructed at no cost to the Department.

548-8.4.1.1 Reinforced Concrete MSE Wall Systems: Vertical tolerances (plumbness) and horizontal alignment tolerances must not exceed 3/4 inch when measured with a 10 foot straightedge. The maximum allowable offset in the joint between precast components is 3/4 inch. The final overall vertical tolerance of the completed wall (plumbness from top to bottom) must not exceed 1/2 inch per 10 feet of wall height. Horizontal and vertical joints between precast components must not be less than 1/2 inch or more than 1-1/4 inches.

548-8.4.1.2 SBW Systems: Horizontal alignment tolerances must not exceed 3/4 inch per 10 feet of wall length. The maximum allowable gap between segmental retaining wall blocks above the first course must not exceed 1/16 inch. The final overall vertical tolerance of the completed wall (deviation from plumbness from top to bottom or batter shown in the Plans) must not exceed 1/2 inch per 10 feet of wall height.

548-8.4.2 Tolerances for Temporary Walls: Vertical tolerances (plumbness) and horizontal alignment tolerances must not exceed three inches when measured with a 10 foot straightedge. The final overall vertical tolerance of the completed wall (plumbness from top to bottom) must not exceed one inch per three feet of wall height, not to exceed a total of six inches.

SUBARTICLE 548-9.1 is deleted and the following substituted:

548-9 Acceptance Program.

548-9.1 General Requirements: Meet the requirements of 120-10 except exclude the requirements of 120-10.2 and 120-10.4.

SUBARTICLE 548-9.3 is deleted and the following substituted:

548-9.3 Density Testing Requirements: Determine the in-place wet density by Nuclear Density testing in accordance with FM 1-T310. Determine the in-place moisture content for each density test in accordance with FM 1-T310, FM 5-507 (Speedy Moisture), or ASTM D-4643 (Microwave Oven), whichever is applicable. Calculate the dry density using the measured in-place wet density and moisture content. 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 notepads or worksheets to record data for later transfer to the ERS section of the Department's database. Notify the Engineer upon successful completion of QC testing on each LOT.

SUBARTICLE 548-9.6 has the following Administrative change:

548-9.6 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 Table 548-4 below.

| Table 548-4 Minimum Frequency Testing | | |
|--|--|--|
| Test Name | Quality Control (QC) | Verification |
| Maximum Density | One per soil type | One per soil type |
| Density | One per LOT | One 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 |
| pH | One per soil type | One per soil type |
| Direct Shear | Three per soil type when required by 548-9.5 | One per soil type |

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.

SUBARTICLE 548-9.7.1 is deleted and the following substituted:

548-9.7 Verification Comparison Criteria and Resolution Procedures:

548-9.7.1 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 120-10.6.1 except replace FM 1-T099 with FM 1-T180. If the Contractor selects the Optional Acceptance Criteria, the Engineer will verify the QC results of FM 1-T099 in accordance with 120-10.6.1.

SUBARTICLE 548-9.7.2 is deleted and the following substituted:

548-9.7.2 Density Testing: Meet the requirements of 120-10.6.2.

SUBARTICLE 548-9.7.3 is deleted and the following substituted:

548-9.7.3 Soil Classification: The Engineer will meet the requirements of 120-10.6.3 except test the sample retained in 548-9.7.1 instead of taking the additional one.

ARTICLE 548-12 is deleted and the following substituted:

548-12 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including the design of the wall system, excavation required specifically for wall construction below the finished graded surface, backfill reinforcement, leveling pad, footings, copings, light pole pedestals, geotextile, horizontal joint materials, alignment pins, repairs, labor, equipment, and other materials necessary to complete the wall in an acceptable manner as shown in the Contract. The cost of backfill for the finished graded surface will be included in the cost of embankment or borrow excavation, as applicable.

Payment will be made under:

- | | |
|-------------------|--|
| Item No. 548- 12- | Retaining Wall System (Permanent) - per square foot. |
| Item No. 548- 13- | Retaining Wall System (Temporary) - per square foot. |