

5480206 RETAINING WALL SYSTEMS – BACKFILL MATERIALS  
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

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Sastry Putcha  
414-4148

Comments:(12-17-09)

Recently when you mentioned to me about adding flowable fill to 548 spec, we briefly touched on payment issue (not paying for the flowable fill etc). For quite some time we have been getting questions about the payment for the fill placed in the soil reinforced zone (unrelated to flowable fill). To clarify this item we made changes to 548-10 Basis of Payment in the past couple of days. Please take a look at the attached file.

**548-10 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 normal roadway template, soil reinforcement, leveling pad, footings, copings, fabric material, horizontal joint materials, alignment pins, repairs, labor, equipment, ~~and all fill material placed within the soil reinforcement zone~~ and other materials necessary to complete the wall in an acceptable manner as shown on the Contract drawings. The cost of granular fill for the normal roadway template 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

It so happened that we have seen the changes you are proposing to 548 spec today. We think it is a perfect fit to add this change to the changes you are proposing as once package. Please let me know your thoughts.

**RUDY POWELL RESPONSE TO SASTRY:**

Are you sure this change is needed? The last sentence of 548-10 states the cost of granular fill for the normal roadway template is included in the cost of embankment or borrow excavation. That should include the soil reinforcement zone. “Granular fill” should be clarified to be “compacted select backfill or flowable fill.”

**Response:**

All material placed inside or outside of the reinforced zone will continue to be paid as embankment. No changes made.

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Daniel Henriques  
The Reinforced Earth Company  
770-242-9415  
[DHenriques@reinforcedearth.com](mailto:DHenriques@reinforcedearth.com)

Comment: (Internal Review 12-23-09)

The proposed wording is OK on the first 2 of 3 pages, although the Section 121 specs are mentioned when referencing flowable fill further and I don't have a copy of these immediately

handy. There are some items in the first 2 pages of the spec that still do not comply with AASHTO as follows:

1. Plastic Index less than 6 is acceptable in AASHTO, but the FDOT spec allows no plasticity.
2. The pH range for steel reinforcement is 5 to 9 per FDOT, but in AASHTO it is acceptable between 5 to 10.
3. The pH range for geosynthetic reinforcement is 3 to 10 per FDOT, but in AASHTO it is 3 to 9.
4. The electrochemical table gives limits for “soluble” chlorides, but it does not state that sulfates limits should also be labeled as “soluble” (common lab problems occur when total sulfates are indicated).
5. The 3<sup>rd</sup> page has a final paragraph that needs to clarify the entire steel length will be embedded with flowable fill for new walls so as to differ it from repairs of washouts in walls already constructed. Furthermore, flowable fill needs to be specifically excluded from use with geosynthetic reinforcements where breakdown may occur due to high pH of fresh cement.

Response:

1. You are correct, FDOT requires non-plastic fill. No changes made.
2. You are correct. No changes made.
3. The current AASHTO recommendation for permanent walls is 4.5 to 9. Based on subsequent discussion on the pH range with the State Materials Office, the acceptable pH range will be revised to 5 to 9.
4. In both of these tests, the detailed procedures in FM 5-552 & FM 5-553 describe the method of measuring either the soluble chloride or soluble sulfate, respectively, in the backfill sample. Even though the test method would not change, the text in the Criteria – Test Method table in Article 548-2.6 will be changed from “Sulfate content” to “Soluble sulfate content” to more accurately describe the criteria used.
5. Disagree with the need to designate new walls, the specification does not address wall rehabilitation. No change made  
Agree with the need to exclude uncoated polyester reinforcements when any type of high pH flowable fill is used. 548-6.5.2 has been expanded to include “Do not use uncoated polyester (PET) reinforcements or reinforcements weakened or damaged by high pH environments within the flowable fill.”

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David Sadler  
414-5203  
[david.sadler@dot.state.fl.us](mailto:david.sadler@dot.state.fl.us)

Comments: Internal Review from David Sadler via email 12.22.09.

Suggest modifying the first sentence as follows:

**548-2.6.1 General:** Options available for backfill are either compacted select backfill or flowable fill, ...

**Response: Agree. Change made.**

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Mario Paredes  
352-955-6690  
[mario.paredes@dot.state.fl.us](mailto:mario.paredes@dot.state.fl.us)

Comments:(12-21-09)

Per Larry Jones to Mario: I made the change you requested in 548 (change 30  $\Omega$ -m to 3000  $\Omega$ -cm) and put a comment in the file that the change is per your request. Hopefully Rudy will contact one of us if he wants to remove the change since “cm” is supposed to be used only when the quantity is less than 100.

**Response: (1-5-10)**

**From the Specifications Office as per Larry Jones: From the Specifications Office: This will be changed to “3000 ohm·cm”. (See responses to Joseph Owens and Dan Hurtado.)**

Comment:(03-04-10)

An very important issue was brought up by the very observant and valuable Ivan Lasa. The specification states:

“For walls utilizing non-metallic soil reinforcement, the Engineer may approve using a backfill with a pH value between three and ten, if no metallic structures, such as metallic pipes, are placed within the backfill.”

The pH of 3 will work fine for the Geosynthetic straps, but not for the panels made out of concrete. Concrete dissolves in low pH. The reaction rate will be controlled by other variables like moisture, weak vs. strong electrolytes, and others.

Comment:(03-08-10)

pH of 5 as the minimum is fine.

**Response:**

**The current AASHTO recommendation for permanent walls is 4.5 to 9. The acceptable pH range will be revised to 5 to 9.**

Comment:(04-13-10)

In response to Larry Jones’ forwarding of Comment 4. from Daniel Henriques:

The tests is for water soluble sulfates only. It is not a total sulfate test, since we would not measured sulfates that are bound chemically. For that we would need to introduce an acid. So I am ok with indicating that the test measures soluble sulfates. If you want, you may want to add the “water soluble sulfates” to be even more specific.

**Response:**

The text in the Criteria – Test Method table in Article 548-2.6 will be changed from “Sulfate content” to “Soluble sulfate content” to more accurately describe the criteria used.

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Joseph Owens  
386-740-3487  
[joseph.owens@dot.state.fl.us](mailto:joseph.owens@dot.state.fl.us)

Comments: (2-5-10)

1. In section 548-2.6.1 : “Use backfill for walls using soil reinforcements that meets the following gradation limits determined in accordance with AASHTO T 27 and FM 1-T 011:”

AASHTO T 27 & FM 1-T 011 are Aggregate Tests. In District 5, many times the contractor will choose to use the same material that was used for regular Embankment which is not Aggregate. This section should include verbiage to require using AASHTO T 88 when regular soils are used instead of aggregate materials.

2. In section 548-2.6.1 – In the Table for Criteria: Resistivity: Should be > 3000 .cm not .m

Response:

1. Aggregates are not limited to the sand and gravel approved for use in concrete. All sands and materials suitable for inclusion in our MSE walls and all Index 505 select fill materials suitable for the embankment are fine aggregate materials. Because backfill for MSE walls must be non-plastic (NP) and contain no more than 12% passing the #200 US Standard Sieve, AASHTO T 27 is the appropriate test. T 27-06 requires following T 11 *Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing* for determining the % passing the #200 US Standard Sieve, so a agitation concern should be sufficiently addressed for non-plastic soils. The hydrometer analysis required in AASHTO T 88 is not harmful but it is not necessary either. No changes made.

2. From the Specifications Office as per Larry Jones: This will be changed to “3000 ohm·cm”.

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Dan Hurtado

Comments:(2-5-10)

In the table at the top of page 3, the symbol for Ohms (upper case Omega) should either be defined somewhere in the spec, or the word "Ohm" should be used instead of Omega.

Response:

From the Specifications Office as per Larry Jones: This will be changed to “3000 ohm·cm”.

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John Kilgore  
813-927-0061  
[jkilgore@ace-fla.com](mailto:jkilgore@ace-fla.com)

Comments: (2-10-10)

1. Does flowable fill have the same coefficient of friction as select backfill? The design of MSE walls depends on the weight of the resisting soil: therefore, if a light flowable fill is used, will this require a longer soil reinforcement length?
2. Why is the retaining wall volume definition being removed? Some of the parameters used in the design of the MSE walls are the pullout resistance of the soil (coefficient of friction) and unit weight of the soil. As we both know, the higher the unit weight the better the pullout capacity with normal soil and the phi angle being the same.
3. How do you measure the phi angle of flowable fill? After all, when it cures, It will stand vertically with no load on it but because it has such low strength, what will it do with a load on top. At that point it may fail and exert a horizontal load on the wall; now the phi angle has changed. I have not heard of any pullout tests in flowable fill. Especially such lightweight fill. I hope somebody does some testing of the pullout capacity of the lightweight flowable fills.
4. Have the lightweight flowable fills been tested for pullout capacity and how do you measure the phi angle.
5. Do you measure the phi angle after the fill sets up or do you measure it after it has had a load on it and it may have failed? The more important issue is the fact that select backfill is a free draining A-3 material and flowable fill is basically impermeable. I assume that flowable fill is only allowed where the design does not allow water to flow into the backfill material.

Response:

1. No, flowable fill meeting the requirements of Section 121 is a cementitious material which behaves like low strength concrete. When it is cost effective to use flowable fill in the reinforced zone, it is also may be used behind the reinforcement because it can be placed at the same time. The reinforcement length should not be longer since lateral earth pressures would be less. No changes made.
2. The retaining wall volume definition is not being removed. It is retained in subsection 548-2.6.1 in order to be applicable to both types of backfill materials. No changes made.
3. Please see the response to your comment 1. No changes made.
4. No, lightweight flowable fills have not been tested for pullout capacity. Because flowable fill meeting the requirements of Section 121 is a cementitious material which behaves like low strength concrete, the pullout resistance will be higher than sand, and lateral pressures will be less. The angle of internal friction is not measured for cementitious materials.
5. Flowable fill may not be used in the retaining wall volume unless it is specifically allowed in the plans. Flowable fill is permeable but not free draining, so wall drainage around the flowable fill must be engineered. “When the option for flowable fill is shown in the plans” was inadvertently deleted rather than moved; this language has been restored.

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Ben Watson  
352-955-2935

[ben.watson@dot.state.fl.us](mailto:ben.watson@dot.state.fl.us)

Comments: (2-10-10)

The proposed value for resistivity in the table should be changed from "3000  $\Omega\cdot m$ " to "3000  $\Omega\cdot cm$ " to be consistent with test reporting requirements and the recommended limits.

Response: (2-10-10)

From the Specifications Office as per Larry Jones: This has been changed to "3000 ohm·cm."

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Ken Zinck  
386-740-3471  
[ken.zinck@dot.state.fl.us](mailto:ken.zinck@dot.state.fl.us)

Comments: (3-3-10)

Comments from Jeanie Kozak of Materials & research (386) 740-3489.

1. I have the following addition for Section 548- Retaining Wall Systems – Backfill Materials: 548-2.6.2 Compacted Select Backfill: Use backfill for walls using soil reinforcements that meets the following gradation limits determined in accordance with AASHTO T 27 and FM 1-T 011 or AASHTO T 88:

Response:

1. Aggregates are not limited to the sand and gravel approved for use in concrete. All sands and materials suitable for inclusion in our MSE walls and all Index 505 select fill materials suitable for the embankment are fine aggregate materials. Because backfill for MSE walls must be non-plastic (NP) and contain no more than 12% passing the #200 US Standard Sieve, AASHTO T 27 is the appropriate test. T 27-06 requires following T 11 *Materials Finer Than 75- $\mu m$  (No. 200) Sieve in Mineral Aggregates by Washing* for determining the % passing the #200 US Standard Sieve, so a agitation concern should be sufficiently addressed for non-plastic soils. The hydrometer analysis required in AASHTO T 88 is not harmful but it is not necessary either. No changes made.

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Al Weeks  
813-376-0995  
[al.weeks@cardnotbe.com](mailto:al.weeks@cardnotbe.com)

Comments: (3-7-10)

1. I do not see what type (excavatable, non-excavatable or cellular concrete) flowable fill must be used if the Contractor chooses to use as backfill material for MSE walls. Can he choose either of the types in Spec. Section 121?
2. Which one is better for future maintenance?
3. Can any of these flowable fill types be chosen for any strap type (galvanized steel, plastic, stainless steel)?
4. Is a recommendation by the wall manufacture required?
5. Does effect the wall manufacture certification?

Response:

1. When flowable fill is allowed as backfill for the reinforced portion of the MSE wall, any of the three types may be chosen as long as any minimum or maximum properties for the flowable fill shown in the plans are satisfied. No changes made.
2. It is expected that new walls constructed with flowable fill materials would require less maintenance since the largest maintenance issue with MSE walls is soil loss, and soil loss problems are not expected to occur with cementitious backfills. No changes made.
3. Yes, all of those strap types may be used. However, polyester (PET) reinforcement should not be exposed to high pH fluids due to the potential for weakening of the material. 548-6.5.2 has been expanded to include "Do not use uncoated polyester (PET) reinforcements or reinforcements weakened or damaged by high pH environments within the flowable fill."
4. No. No changes made.
5. I am not sure of the intended question. The manufacturer is expected to be aware of the proposed backfill material and perform its internal stability design calculations based on that material's properties. No changes made.

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