

5480000 – RETAINING WALL SYSTEMS
COMMENTS/RESPONSES FROM INDUSTRY REVIEW

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Comments:

I would like to point out that Section 548 Retaining Wall Systems 548-4 is in need of review, because in the real world concrete chips will occur as well as minor shrinkage cracks, and it needs to spell out acceptable broken corner size and crack depth and width. What cosmetic repairs are allowed, etc. This spec is causing us in the industry for Inspectors on the field to refuse any panel if during transit or during unloading if a small chip of a corner occurs they are refusing the panel. They are also refusing the panel if the contractors chip off or break small areas during installation, which are easy to repair. How does a chip or a small broken corner piece define that the integrity of the structure of the panel has been compromised. In the precast industry repairs have always been a major part of the manufacturing process, concrete chips and spalls will occur, and cosmetic repairs need to be done. I need for you to work with me so that minimal repairs can be done to precast work. Also alignment pins have been eliminated years ago, they would always break off and the contractors asked that they be eliminated, and they are not in the shop drawings. I do understand that when a panel is broken and the steel is exposed we discard it, and I have thrown away many panels that I know I would not accept if I was the customer. But if it is just a small broken edge or corner from lets say 1/4" to up 1" by 3" or even larger so long as it does not go in to the steel we should be able to repair it. I also think that an approved patching procedure needs to be part of the specification that spells out what really is an acceptable method and the approved materials for in house and field repairs from cosmetic repairs to an acceptable size of a large chip, break or spall.

Response:

548-4. Your comments will be thoughtfully considered for the next revision to 548.

Sastry Putcha
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Comments:

The only problem I have is the proposed frequency of gradation test...one per eight consecutive Lots for QC and one per sixteen consecutive Lots for Verification. I feel these are unnecessary because we are proposing LL&PI to be done one per Maximum Density in addition to the Soil Classification one for Maximum Density. Also there is no valid reason that anything untoward has happened before any projects due to gradation problems. The proposed frequency while being unnecessary will cause too many practical problems. These test results will not be issued for at east a day if not more...etc.

Suggestion: Make Gradation testing frequency one per Maximum Density for QC and Verification.

548-7.5 Frequency: Conduct sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification sampling and tests at a minimum frequency listed

in the table below.

Test Name	Quality Control	Verification
Maximum Density	One per soil type	One per soil type
Density	One set of tests per LOT per Section	One set of tests per four LOTS for each type of QC test.
Gradation	One per eight consecutive LOTS	One per sixteen consecutive LOTS
LL&PI	One per Maximum Density	One per Maximum Density
Soil Classification	One per Maximum Density	One per Maximum Density

Response:

The Gradation frequency was changed to One per Maximum Density

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Comments:

I disagree with the philosophy of moving away from Lots and calling them "Sections". It most likely will cause more problems than it fixes. Lots are standard term and need to be understood by those working in this industry. It is the basis of statistically based acceptance specifications and those in the field are more than capable of understanding these concepts. I have been teaching these basic statistical concepts for years in the CTQP courses and never get questions on what a Lot is, but rather what is the size of the Lot? Changing the terms mid-stream will cause confusion in the field, especially between different material areas. A Lot is a Lot is a Lot, whether it is in linear feet, cubic yards or tons depending on the type of material.

Also, there needs to be provision for accepting shorter segments. In changing the Lots to consecutive feet and increasing the distance/total number of tests - how does one handle a project that is built in short segments? Specifically, if the phasing of the project calls for building an area up that is less than the consecutive footage requirement, how do you accept lower lowers of embankment, sub base or base? The same situation applies to areas that in the interest of getting the project built faster – the contractor wants to work smaller sections – is the contractor then placed at high risk in covering up lower layers? Why can't the layers be accepted as they are completed regardless of the length – if it will get the project done faster? If we can reduce the risk to both the contractor and the agency, the projects will undoubtedly be built right (quality) and faster and cheaper in the process. Seems the way that is proposed will be a paperwork nightmare.

There appears to be a push toward larger Lots and longer consecutive distances before reduced testing is an option. My question to the Department is how many projects are actually phased this way anymore, or is the trend to have projects built in shorter sections? Any specification that is developed must be flexible enough to work in both long continuous runs of production and short discontinuous runs of production. I'd go further to recommend to the Department that they consider looking at how they are doing business now (compared to 10 years ago) in terms of the type/scope/phasing of projects to see if the current specifications are applicable to the majority of that type of work.

Response:

- 1. The lot language is reinstated*
- 2. Lot lengths will remain a minimum of 300 feet or the full length of the embankment. Non-traffic construction areas will be allowed to extend up to a Day's Production. The purpose of this specification change is to remove restrictions that do not add value to construction.*
- 3. Larger sections of construction are allowed in Non-Traffic construction to reduce testing requirements. Traffic construction sections are not expanded.*

D2 MATERIALS & RESEARCH
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Comments:

SECTION 7.3 REFERENCES 120-10 WHICH REDEFINES THE TEST UNIT FROM LOT TO SECTION. SHOULD SUBSEQUENT SECTIONS OF 548 BE MODIFIED TO STRIKE THE USE OF LOT?

Response: The proposed modification of 120-10 which redefines the test unit from LOT to section has been retracted.

J. Kozak
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Comments:

I have the following comments concerning the Proposed Specification Revisions for Section 548 Retaining Wall Systems

- 1. 548-2.6 Backfill Material:** For constructing..., as determined by FM 1-T 267 and by averaging the test results for three randomly selected samples from each stratum or stockpile of a particular material. If an individual test value of the three samples exceeds 3%, the stratum or

stockpile will not be suitable for constructing the retaining wall volume. The test method of FM 1-T 267 only requires one sample to be tested and LIMS only allows for one result to be entered. Either the requirement for the three randomly selected sample from each stratum needs to be changed to one sample or LIMS needs to be revised to allow for three results. This is confusing to the testing personnel.

Ensure that the material is non-plastic as determined by FM1 1-T 90 AASHTO T 90 and the liquid limit as determined by FM 1-T 089 AASHTO T 89. We use the AASHTO standards for LL & PI.

2. 548-7.5 Frequency: Conduct sampling and testing at a minimum frequency listed in the table below. the Engineer will perform Verification sampling and tests at a minimum frequency listed in the table below. The gradation is needed in order to classify the soil so the Gradation should have the same frequency as the Soil Classification.

Test Name	Quality Control	Verification
Gradation	One per eight consecutive LOTS	One per sixteen consecutive LOTS
Soil Classification	One per Maximum Density	One per Maximum Density

3. 548-7.6.5 LL&PI: The material will be sampled and tested in accordance with FM 1-T 090 AASHTO T 90 and FM 1-T 089 AASHTO T 89 respectively. We use the AASHTO standards for LL & PI.

Response:

- 1. The organic content will have to be thoughtfully considered and any modifications will be incorporated in the next modification. FM -1 T 89 and 90 were changed to the AASHTO designations;*
- 2. The Gradation frequency has been changed to match the Soil Classification frequency.*
- 3. AASHTO test designation has been incorporated for LL & PI*

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Comments:

I would suggest changing the references to LOTS in the specification to SECTIONS to be consistent with the proposed changes in Section 120, 125, 160 and 200.

Response:
The section language was removed from the other proposed changes

Bob Graham
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Comments:

The backfill material under the current spec is very difficult to obtain. The reduction in the ph upper limit and the 200 sieve will futher compound the already existing problem. Why is the change necessary? Does the Dept. understand that the currently escalating embankment price may continue to rise because of this change?

Response:
The department has researched the properties of soil materials in Florida and have determined that the changes in PH and gradation requirements are necessary to ensure the stability of MSE walls.

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Comments:

1. Section 548-2.3: The reference to hot rolled steel tie strips under ASTM A570 should be replaced by the revised standard now identified as ASTM A1011.

2. Section 548-2.6 3rd paragraph: This specification should remain as it was originally stated when referencing MSE structures using steel reinforcements.

- The plasticity index determined by FM 1-T 090 not exceeding six is an acceptable and recommended limit. A small blend of slightly plastic fines actually may provide better structural performance by binding the mostly granular backfill while still not significantly affecting drainage. Furthermore, the other physical requirements of the specifications for structural backfill work together to allow acceptable and wider range use of backfill sources.
- Steel soil reinforcements may be installed in a backfill with a pH range from 5 to 10. There is a substantial amount of background available on this subject range. Therefore the allowable backfill should not be limited to a revised maximum pH of 9. A maximum pH limit of 9 is usually identified with geosynthetic reinforcements and should be differentiated from steel reinforcements.

- The percent passing the No. 200 sieve should remain at 0-15. Lowering the limit would increase the possibility of the backfill becoming a uniformly graded material, which would reduce the structural performance of the backfill. Instead of changing the existing percent passing limits, RECo recommends that a coefficient of uniformity be introduced and should be set at $C_u > 4$ (C_u being defined as the ratio of particle size at D_{60}/D_{10}).

It is noted that the originally stated specifications are consistent with current AASHTO guidelines for MSE walls using steel reinforcements. By making the added revision for a limit on C_u in Section 548-2.6 and leaving the rest of the section in its current format, the specifications would be setting the standard for a high quality backfill that provides a satisfactorily performing MSE wall.

3. Section 548-4:

Minor cracks, spalls or chips in a precast concrete panel, particularly the back face, should not be cause for outright panel rejection. Panels can be repaired with a method that is approved by the wall supplier and the FDOT. Repairing minor defects through an accepted method will produce a panel that achieves the required strength and performance set in FDOT specifications. RECo recommends that defects in a precast panel be evaluated on a case-by-case basis with the proper analysis provided by both the MSE wall supplier and FDOT. The review basis should conclude whether a repair procedure will produce an acceptable panel or that the panel should be rejected if found to be unacceptable. A suggested addition to specification may include a product repair classification as provided below.

Product Repair Classification & Methods:

- a. Bug Hole: "A void caused by air that is trapped against the form and that has an area up to 3.0 sq. in. and a depth up to 1.5 inches."
- b. Honeycombing: "Voids in the concrete, loss of fines or other material from between the aggregate particles, the inclusion of air pockets between aggregate particles, or larger volumes of lost material."
 - Minor: Voids no deeper than 1.5 inches to sound concrete and no larger than 1.0 sq. ft. in area that results after the removal of unsound material.
 - Major: Voids deeper than 1.5 inches to sound concrete or larger than 1.0 sq. ft. in area that results after the removal of unsound material.
- c. Spall: "A depression resulting when fragment is detached from a larger mass by impact, action of weather, by pressure or by expansion within the larger mass."
 - Cosmetic: "Spall with a circular or oval depression not greater than 1.0 inch in depth no greater than 3.0 sq. inches in area.
 - Minor: "A spall no larger than 1.0 sq. ft. and no deeper than 1.5 inches."
 - Major: "A spall larger than 1.0 sq. ft. or deeper than 1.5 inches."
- d. Chip: "The local breaking of corners or edges of the concrete with the resulting void containing angular surfaces."
 - Cosmetic: Chips where the sum of the two lateral dimensions perpendicular to the length does not exceed 2.0 inches.

- Minor: Chips where the sum of the two lateral dimensions perpendicular to the length exceeds two inches, but does not exceed 4.0 inches, and with a length no more than 12 inches.”
- Major: Chips where the sum of the two lateral dimensions perpendicular to the length exceeds 4.0 inches, and with a length greater than 12 inches.”

Repair procedures and products for Cosmetic and Minor defects will be as listed in the FDOT QPL. Defects defined as Major will be deemed non-repairable.

Stained Front Face:

We are concerned that there may be unrealistic expectations as to how the finished precast concrete products are viewed for compliance. It has been our experience that panel finishes with a rather smooth nature and having plain concrete gray color have a tendency to exemplify discolorations inherent with cast concrete. It is not unusual to have discoloration or a variety of gray shades in cast concrete. This is primarily due to the use of form release agents and the differences in color of today's cement and fly ash sources. In many instances, these gray tones soften due to the natural bleaching process of concrete being exposed to the elements and sun.

However, there are still some instances, where this continues to be a cause for considerable disagreements on the wall acceptance among the proprietary wall companies, contractors and owners. We suggest further clarification of “stained” face to include permanent discolorations not resulting from inherent components used in the course of normal precasting operations.

4. Section 548-6.4.1: The limits stated in this section are generally acceptable, but should be considered as a point of reference for in-progress construction. It is recommended to revise the plumbness tolerance to $\frac{3}{4}$ ” in 10 feet to meet typical MSE criterion. If the construction limits are exceeded, then field conditions should be re-evaluated by the wall supplier to verify whether internal stability of the wall is an issue or by FDOT in the event that external (global) stability issues exist. It is noted that the joint tolerances have some range of flexibility to adjust to prevailing site conditions. With approval from the wall supplier and the FDOT, the wall may continue to be constructed or left in place as is determined by review. RECo has found through experience that minor variations of the specifications in this section are still acceptable and should not be the case for immediate wall rejection or removal.

5. Section 548-6.5 3rd paragraph: Reaching the required density in the backfill is critical to the performance of an MSE wall; however, it is RECo's experience that this required density can be reached with a maximum compacted lift thickness of 10 inches. Attaining the required density throughout the entire lift should be the emphasis of this section.

The intent of the comments in this letter is to address a specification that will continue to take advantage of the best aspects of steel-reinforced MSE technology. Maintaining existing language or making small modifications to the wording as indicated will be beneficial not only to FDOT but to all parties involved in the design and construction of MSE walls.

Response:

1. This has been modified
2. We have modified the Article 548-6 based on experimental data using soils typically found in Florida soils. No Change made
3. Article 548-4 was not modified and we cannot thoughtfully evaluate these comments at this time. This comment will be evaluated for a later revision
4. Article 548-6.4.1 was not modified and we cannot thoughtfully evaluate these comments at this time. This comment will be evaluated for a later revision
5. Article 548-6.5 was not modified and we cannot thoughtfully evaluate these comments at this time. This comment will be evaluated for a later revision
