



## Earth Retaining Systems – Mechanically Stabilized Embankment

### Revision and Approval

Revision	Date	Nature of Changes	Approved By
0	12-20-2018	Original issue.	Steve Altman

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### Background

This process establishes Structure Construction (SC) responsibilities and procedures to administer mechanically stabilized embankments (MSE), including:

1. Review and authorization of submittals.
2. Acceptance of materials.
3. Quality assurance during construction.

This process applies to MSE. The contract documents may permit the Contractor to propose use of an alternative earth retaining system instead of the MSE shown in the contract documents. If the Contractor proposes to use an alternative earth retaining system, refer to the Standard Specifications (SS)<sup>1</sup>.

### Process Inputs

1. Shop Drawings.
2. Foundation Report.
3. Test Data for button head wire couplers.
4. Structure RE (Resident Engineer) Pending File.
5. Excavation plans, if needed.

### Procedure

1. All work associated with this process is charged as [Project-Direct – Construction](#).

<sup>1</sup> [2018 SS](#), Section 47-6, *Earth Retaining Systems – Alternative Earth Retaining Systems*.

2. Inspection of field work for this process is:
  - a. [Intermittent](#) for placement of leveling pads, soil reinforcement, filter fabric, face panels, and structure backfill.
3. Before construction begins:
  - a. Review MSE submittals. Request assistance from Structure Designer, Geotechnical Services and METS if necessary.
  - b. Review the layout plans and verify the top of wall elevations versus the District grid grades, drainage plans, and underground utility plans. Verify the locations of the soil reinforcement to ensure no conflict with utilities.
  - c. Review *Construction Considerations* section of the Foundation Report and contact report author if there are any questions or unusual geotechnical requirements, such as settlement monitoring, surcharge, etc.
  - d. Check contract documents for Surcharge Loading and monitoring requirements.
  - e. Set up a pre-construction meeting with the Contractor to discuss MSE construction. Invite representatives from METS, Structure Design (SD), Geotechnical Services, MSE wall specialist, District Construction, and the Materials Lab as needed.
  - f. Review and authorize the final texture of the sample facing panel and concrete mix design. The sample panel must be stored for later comparison to the finished product.
  - g. Remind the Contractor to submit the construction staking request for the wall layout line, beginning of the wall, end of the wall, and respective elevations. Coordinate review of District related items with the Resident Engineer (RE).
  - h. Confirm with the Contractor the schedule of material procurement and sampling.
  - i. Review and authorize the erection procedures. Confirm with the Contractor on adequate equipment to lift and set panels.
  - j. Review and authorize the excavation plan, if required. See [BCM 7-1.02K\(6\)\(b\)](#), *Legal Relations and Responsibility to the Public – Occupational Safety and Health Standards – Excavation Safety*.
4. During construction:
  - a. Verify sloping or shoring installation if required.
  - b. Provide QA to verify that the leveling pad is constructed properly. Verify the wall layout line (LOL) is per plan.
  - c. Verify proper material storage and handling. Geosynthetic reinforcement, polyurethane foam, and filter fabric must be stored away from sunlight.
  - d. Upon delivery of materials onsite:
    - i. Check for inspection release tags (Form TL-0624, *Inspection Release Tag*) and match with Form TL-0029, *Report of Inspection of Material*.

- ii. Take photos of release tags that are applied directly onto the system elements, such as, stenciled on panels or etched into concrete block.
  - iii. Document quantities.
  - iv. Check for Certificates of Compliance and Buy America Certification.
  - v. Check for damage incurred during the delivery and request a repair plan from the contractor as needed.
- e. Verify proper material storage and handling. Geosynthetic reinforcement, polyurethane foam, and filter fabric must be stored away from sunlight.
  - f. Sample and test the backfill material for gradation and quality requirements listed in the contract documents. The District Materials Laboratory typically performs gradation, plasticity index (PI), and sand equivalent (SE) tests. Corrosive tests (i.e., chlorides, sulfates, and resistivity) are performed by the Sacramento METS Laboratory. Obtain a copy of test results from the RE.
  - g. Inspect all materials incorporated into the work prior to placement. Once constructed, it is difficult to remove and replace. Check concrete elements for cracks, spalls, surface irregularities, dimensions, and misaligned connections. Check for broken (popped) welds or damage to the galvanized coating on the metallic elements. Check for damage and correct alignment of the machine direction of geosynthetic reinforcement.
  - h. Verify the vertical wall layout line (LOL) is referenced and at the right batter to account for the backfill displacement. Monitor wall alignment and vertical displacement. Check against Standard Specifications<sup>2</sup> and the authorized drawings and notify the Contractor promptly so timely corrections are made.
  - i. Verify all joints are protected with engineering filter fabrics prior to backfilling.
  - j. Verify the Contractor installs the drainage system, if required, per plan before backfilling. Coordinate with the RE.
  - k. Coordinate QA backfill and compaction testing with the District Materials Lab.
  - l. Verify that backfilling is done with proper equipment to avoid damage to the panels:
    - i. Do not allow sheepsfoot rollers for compaction of select granular backfill within the limits of the soil reinforcement. Handheld or hand-guided compacting equipment must be used within three feet of the facing panels.
  - m. Verify facing layout is in proper configuration and at proper spacing prior to backfilling. Verify bearing pads in vertical panel joints or space bars are placed between two adjacent panels to maintain the spacing of the interlocked panels.

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<sup>2</sup> 2018 SS, Section 47-2.03B(3), *Earth Retaining Systems – Mechanically Stabilized Embankment – Earthwork - Face Panels*.

- n. Verify the Contractor correctly connects and uses the correct configuration of soil reinforcement to the facing. The soil reinforcement may vary throughout the length of the wall. It is of utmost importance that the panel type and soil reinforcement coincide with the requirements shown on the authorized plans.
- o. Verify soil reinforcement is placed in the proper alignment and on the level surface, 2-inches higher to avoid down drag by the compaction of the backfill.
  - i. Soil reinforcement must be installed perpendicular to the back of the panel, unless otherwise noted.
  - ii. Verify the condition of the soil reinforcement and tension prior to backfilling.
  - iii. Verify top layer of soil reinforcement is aligned with the profile grade of the top of panels, and when necessary slopes down to avoid a negative super elevation.
- p. Verify that all inspection wires are in place according to the contract documents:
  - i. Verify the locations of wires are centered in the opening of the panels.
  - ii. Verify that the threaded ends of the wires are clean and covered per details.
  - iii. Verify that the panel openings are completed with caps or fill per details.
- q. Verify the Contractor grades the backfill to slope away from the wall face at the end of each shift to keep surface run off away from the panels if a significant rain event is anticipated. Surface water, if not controlled, will migrate the fines from the structure backfill into the pervious material, possibly causing excessive backfill settlement.
- r. Confirm top of wall profile elevations match the cross section and super elevations of the roadway section. Do not allow the Contractor to drive equipment directly on soil reinforcement.
- s. Once any anticipated settlement is complete, the concrete coping can be formed and placed.
- t. Verify all reinforcing steel for the coping, and the slab and barrier when required before concrete placement.
- u. If the Contractor elects to form coping or barrier slabs by attaching the formwork (including, for example, overhang braces) to MSE panels, request the contractor to submit forming plans that show their form system in detail, including calculations, signed by an engineer registered in California.
  - i. Verify that the Contractor has obtained MSE wall designer's concurrence to attach formwork.
  - ii. Verify that the form attachment to the MSE panels has adequate bearing capacity.
  - iii. Do not allow installation of supporting bolts through the panel joints. There have been instances where the overhang forms collapsed because there is not enough bearing area to support the load.

- v. Document all inspection, construction, and quality assurance activities in the Daily Reports per [BCM C-4.04](#), *Daily and Weekly Reports*.
5. Following Construction:
- a. File all submittals in the project records as specified in the [Construction Manual](#).
  - b. Record information necessary for Required Documents:
    - i. Any as-built changes.
    - ii. Report of Completion for Structures.

### **Process Outputs**

- 1. Authorized test reports.
- 2. Written notification of submittal authorization.
- 3. Daily Reports.
- 4. Project Final Records.

### **Attachments**

[Attachment 1](#), *Mechanically Stabilized Embankment Retaining Wall Construction Checklist*.