CHAPTER 8 — PROCUREMENT AND CONSTRUCTABILITY ISSUES

This chapter provides an overview of issues with regard to procurement of wall materials and project constructability for SMSE wall systems.

8.1 PROCUREMENT ISSUES

Within the FHWA procurement process, SMSE applications pose some initial challenges. This section identifies potential issues and provides suggestions to assist in the implementation of SMSE wall systems.

8.1.1 General

SMSE retaining walls are a recent innovation for public transportation projects. Initially, most agencies, including FHWA, will have limited experience in their application. Similarly, general contractors, specialty contractors, and consultants will have limited or no experience with procurement, bidding, and installation of SMSE wall systems as complete packages. It is recommended that agencies procuring SMSE wall systems in accordance with this guideline initially procure these retaining walls as follows:

- The procuring agency will decide to implement an SMSE wall system in accordance with these guidelines.

- The procuring agency will develop roadway and wall geometry, and conduct necessary field and laboratory investigations in accordance with the recommendations presented in this report, and their experience.

- The agency will provide the contractor with the location of the proposed SMSE wall system, and specify requirements for materials (i.e., facing type, reinforcement type, fill properties) and requirements for stability of the MSE wall component and shoring wall component. The current Special Contract Requirements (SCRs) (section 255) and FP-O3 section 255 (available at www.cflhd.gov/design) should be modified in accordance with these recommendations.[10]

- The agency will provide preliminary global stability analysis to demonstrate SMSE feasibility. This should be included in the geotechnical report or memorandum.

- Using the guidelines presented in this report and other methods as necessary, the contractor will design the MSE wall component for internal stability, as a result obtaining the geometry of the shoring wall component.

- The agency will design the shoring wall component for internal stability.

- The contractor will provide design (analyses and shop drawings) of the MSE wall component to the agency for review and subsequent global stability evaluation.

- Shop drawing review for compliance with project SCRs will be conducted by the agency.

Ultimately, with greater experience and confidence in SMSE wall applications, FHWA and other agencies may desire to implement SMSE wall systems as complete systems, where a specification is developed either specifying the use of SMSE wall systems or explicitly allowing their construction. It is recommended that deployment of this technology in this manner be deferred until greater experience is developed, which will support development of appropriate specifications. With appropriate experience and specification tools in place, the agency may elect to either require an SMSE wall system to be bid in accordance with the plans and SCRs, or explicitly allow an SMSE wall system to bid in competition with other acceptable and approved retaining wall systems.

8.1.2 SCR Considerations

In procuring SMSE wall systems for projects, the following paragraphs should be included in section 255 (www.cflhd.gov/design/scr.cfm) of the Supplemental Contract Requirements (SCR)[71]:

> *"The contractor is responsible for design of the MSE wall component of the SMSE wall system. The contractor shall refer to FHWA Publication No. FHWA-CFL/TD-06-001 [this document] for design methodology and general design requirements. FLH will design the shoring wall system. Design analyses and shop drawings for the MSE wall component will be issued by the contractor to FLH for subsequent global stability analyses."*
>
> *"The factor of safety against reinforcement pullout should be increased to 2.0 for wall aspect ratios of 0.4 and less. For aspect ratios greater than 0.4, reinforcements may be designed for a pullout factor of safety of 1.5."*

Additional items to provide in the SCR for SMSE wall systems include:

- Construction tolerances (discussed in section 8.2.4).
- Specifications for high quality reinforced backfill (discussed in section 3.3.1).
- Recommendations for performance monitoring (discussed in section 9.2.3).

The SMSE wall system should be constructed to the tolerances provided in table 4, which were modified from Section 255 of the SCR for wire faced wall construction. Table 4 should be reproduced, as provided herein, in the SCR.

Reinforced backfill for the MSE wall component shall consist of high quality backfill, as discussed in section 3.3.1 and presented in table 1. Table 1, which provides the recommended gradation specification for SMSE select granular fill, should be reproduced in the SCR.

The SCR should provide details for a wall monitoring program, including instrumentation to be installed and identification of the monitoring periods. Monitoring should be conducted during the installation and construction phases, and post-construction initial readings should be obtained. Upon completion of construction, instrumentation should be monitored periodically (i.e., quarterly) until satisfactory wall performance is confirmed.

8.2 CONSTRUCTABILITY ISSUES

Constructability issues for SMSE wall systems include, among others, confined space for fill placement, connections, overlaps, and difficult excavation, as described in this section.

8.2.1 Confined Space for MSE Fill

SMSE wall systems with narrow MSE wall components pose constructability concerns with regard to proper compaction of the reinforced fill zone. Reinforcement lengths less than 2.4 m may pose access difficulties for construction equipment. Contractors should use appropriate equipment for work in tight spaces and anticipate the effects on earthwork productivity.

8.2.2 Reinforcement Connections and Overlaps

Mechanical connections between the MSE and shoring wall components of an SMSE system may prove challenging for contractors to construct. It is recommended that mechanical connections be avoided and the upper two layers of MSE reinforcements be overlapped over the shoring wall, where feasible.

Construction of the recommended MSE reinforcement overlap (over the top of the shoring wall) will likely pose issues with regard to construction sequencing and maintenance of traffic. To address this issue, the shoring wall component may be constructed with a steep temporary slope above the top of the wall, and then construction of the MSE wall component may begin from bottom upward. Once the contractor is at the level ready to construct the MSE reinforcement overlap, the contractor may close the traffic lane to excavate the cut, and then may run traffic over the cut until ready to place the reinforcement and backfill, temporarily close the traffic lane again, and construct a lift of the MSE wall. This sequence can be repeated for the two (or more) layers of MSE reinforcement overlap. Generally, for roads with light traffic, 15- to 20-minute lane closures may be acceptable. However, heavily traveled roadways may render this technique inapplicable. Also, experience with this technology may dictate a decrease in the recommended length of MSE reinforcement overlap, currently proposed as 60 percent of the wall height ($0.6H$) or a minimum of 1.5 meters, whichever is greater.

8.2.3 Rock or Difficult Excavation

In some cases, the shoring wall installation and related excavation may encounter rock or other difficult excavation conditions. The engineer should evaluate the situation in regard to potential impacts to stability. It is likely acceptable to eliminate the shoring wall when rock is encountered and where the engineer judges the rock to be of sufficient strength. The MSE component of the wall should then be constructed to the design geometry, within the tolerances

indicated in table 4, even if rock excavation is necessary.[71] Where such excavation would have unacceptable impacts to the project, at the discretion of the engineer, re-evaluation of the retaining wall geometry, with consideration to the geometric requirements of these guidelines, may be in order.

Table 4. Recommended SMSE wall construction tolerances.

Description	Requirement
Wall Batter	±50 mm per 3.0 m of wall height and 1 percent for the overall wall height.
Wall Height	±25 mm per 3.0 m of wall height and a maximum of 100 mm.
Horizontal and Vertical Alignment	±50 mm at any point in the wall when measured with a 3.0-m straightedge.
Separation of Facing Mat	Outside of facing mat shall be within 40 mm from MSE facing fill at all locations.
Reinforcement Elevation	Within 50 mm above the design elevation and within 50 mm above the corresponding connection elevation at the wall face. Reinforcement shall not be placed below corresponding connection elevation.
Reinforcement Inclination	Within 2 percent from horizontal.
MSE Reinforcement to Shoring Wall Face	±50 mm

8.2.4 Geometric Tolerances

The finished construction of the MSE portion of the SMSE wall system should meet the construction tolerances provided in table 4. The length of the MSE reinforcing elements should extend to within 50 mm of the shoring wall, as indicated. MSE reinforcing layers may be bent upwards where they otherwise would conflict with the shoring wall. The length of the reinforcing elements should not be less than shown on the approved drawings. Where irregularities occur in the shoring wall face (i.e., due to potential over-break, etc.), MSE reinforcing elements longer than shown on the plans may be required. If so, they should be furnished at no additional cost to the procuring agency.

8.2.5 Foundation Preparation

Foundation preparation should be directed by the engineer and should conform to typical practice for MSE walls. Where foundation conditions differ from those anticipated by the engineer, the engineer may direct foundation improvement measures in accordance with the contract documents.

8.2.6 Interface Friction

Avoid smooth shoring wall faces that achieve a lower interface friction than assumed by the engineer in design. Engineers should consider conservative interface friction angles (coefficients) to account for potential variability in shoring wall face installations.

8.2.7 Groundwater

Groundwater may be encountered during construction of the shoring wall. The engineer should specify internal drainage elements in the shoring wall face, drained to a suitable outlet, for all permanent shoring walls incorporated in SMSE wall systems, as discussed in chapter 3. In some cases, groundwater seeps may come through the shoring wall face and be encountered during construction of the MSE wall portion of the SMSE wall system. In such cases, the contractor or the agency shall notify the engineer. The engineer may elect to require additional drainage measures in accordance with the contract documents.