# MICHIGAN DEPARTMENT OF TRANSPORTATION SUPPLEMENTAL REQUIREMENTS[i]

## Introduction

The Michigan Department of Transportation (MDOT) maintains a list of approved retaining wall systems. Wall vendor submittal requirements for requesting approval are stated in their MDOT Policy for Evaluation of Mechanically Stabilized Earth Wall (MSEW) Systems, date February 8, 2012; and is available on the MDOT website. The following listing of supplemental requirements is based upon this policy. MDOT should contact the IDEA webmaster and update their report when their policies, etc. change. This supplemental requirements report is readily updateable, and a revision number and date should be noted.

MDOT accepts IDEA reports as a vendor approval request submittal. Their submittal approval process does require some additional or variation of the information listed on the IDEA protocols (available at https://www.geoinstitute.org/special-projects/idea). Specifically, MDOT requires submittal of the information listed below to supplement an IDEA report on a particular wall system. Note that MDOT requires the submission of a New Materials Evaluation Request (Form 1022N) to initiate a review.

Note that MDOT does have limitation and acceptable uses for MSE wall systems.

1. MSE wall systems are not to be used for support of vertical bridge loads (i.e. spread footing foundations bearing on MSE).
2. MSE wall systems with SRW units may not be used for critical retaining walls or connected to critical retaining walls. Critical retaining walls are defined as MSEW with design heights of greater than 25 feet (with or without a backslope), or walls that support or are adjacent to railroads, interstate highways or bridge abutments. The design height is defined as the difference between the grade elevation and the top of the leveling pad. The grade elevation is measured from where the finished grade intersects the back of a MSEW or front of a concrete barrier with moment slab.

Additional submittal items are listed under three topics; (a) system and facing details; (b) reinforcement materials, connection design, and test results; and (c) design examples. Generally, the agency requested items under a topic are more specific or detailed than the IDEA protocol specifically requests. However, in some cases the information may be identical to, and therefore redundant to, an IDEA report. In such cases, the wall system supplier submittal may wish to refer to specific sections (or page numbers) in their IDEA report.

## Submittal Requirements for Wall Systems

In addition to an (1.) **IDEA technical evaluation report**, the following items must be submitted.

2. **System and Facing Details**:
    a. Precast concrete panel dimensions, tolerances, textures, colors and concrete compressive strength, slump and air content

b. SRW unit dimensions, tolerances, textures, colors and shear strength between block units, compressive strength, absorption and durability testing data.
c. Joint sizes, details and materials (spacers, filter materials, etc.) including bearing pad calculations and testing in accordance with Section 3.6.1a of the *FHWA Manual "Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes"* (Publication No. FHWA-NHI-10-024)
d. Connection devices such as pins, dowels and fasteners (e.g. clips, bolts, nuts, etc.
e. Wall drainage system, separation fabric, leveling pad and coping details including coping attachment methods
f. Obstruction calculations and details including those for foundations in the reinforced zone for MSE wall systems with panels
g. Any other miscellaneous materials and components such as corner and slip joint elements
h. Manufacture's quality control/assurance programs
i. Material suppliers and MSE wall vendor approved or licensed precasters covering Michigan
j. Plan sheets (11x17) showing all standard and alternate MSE retaining wall typical details including those for wall elements, connections and construction.
k. MSE wall system construction quality control/installation manual.
l. DOT project history of MSE wall system including design parameters and current contact information for projects completed within the last 5 years.
m. Additional MSE wall system reports including case histories, problems, failures, studies, research or additional testing.
n. Other miscellaneous information as requested by MDOT's Geotechnical Services Section.

3. **Reinforcement materials, connection design, and test results**:

    a. Laboratory Test results for Shear Strength between SRW units (ASTM D6916), connection strength (ASTM D6638), and Pullout (ASTM D6706). All testing data must be for the exact components submitted.
        i. Testing must be performed by one or more of the following approved laboratories:
            1. Bathurst Clarabut Geotechnical Testing, Kingston, Ontario
            2. National Concrete Masonry Association, Herndon, Virginia
            3. SGI Testing Services, Atlanta, Georgia
            4. TRI/Environmental, Austin, Texas
        ii. $CR_{CR}$ defined with either long-term or short-term testing in accordance with Section 4.4.7.i of the FHWA-NHI-10-024 manual
    b. Steel reinforcement
        i. Type, sizes, tolerances, grade, corrosion protection, corrosion loss calculations for 75 and 100 year design life, and design factors for aggregate.

c. Geosynthetic reinforcement
    i. Manufacturers, product lines, types, classes, grades, categories, reduction and design factors for aggregate including pullout testing data.
    ii. Most recent NTPEP evaluation report for each geogrid product line submitted.
    iii. Splice details and splice testing data

4. **Design Examples**:

a. Submit MSEW analyses examples for the design criteria and inputs specified below. Design package must provide hand calculations and be sealed by a Registered Professional Engineer with licensure in Michigan:
    i. 100 year design life;
    ii. 30 foot design height;
    iii. Factored Bearing Resistance 6,000 psf;
    iv. Level slope in front of MSE wall;
    v. Design cases shown in Table 1;
    vi. Soil parameters shown in Table 2.

Table1. Design geometry and loading.

| Design Case | Backslope | Live Load Surcharge* | Traffic Load on Barriers |
|---|---|---|---|
| 1 | 2:1 (H:V) | No | No |
| 2 | 2:1 (H:V) | No | No |
| 3 | None | AASHTO 3.11.6.4 | Yes |
| 4 | None | AASHTO 3.11.6.4 | Yes |

* Minimum required live load surcharge is 360 psf for cases requiring surcharge.

Table 2. Soil parameters.

| Material Type | Unit Weight (pcf) | Friction Angle (deg) | Cohesion (psf) |
|---|---|---|---|
| Select Backfill | 120 | 34 | 0 |
| Retained Backfill and Grade | 120 | 30 | 0 |

b. Submit reinforcement design input parameters in either Table 3 or 4

Table 3. Steel reinforcement input parameters for 100 year design life.

| Reinforcement | $F_y$ (ksi) | b (in) | $A_c$ ($in^2$) | $R_c$ | $F^*_{top}$ | $F^*_{20ft}$ | α |
|---|---|---|---|---|---|---|---|
| (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) |
| (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) |

where,

$F_y$ = yield strength of steel (ksi)

b = unit width of reinforcement (in)
$A_c$ = area of reinforcement corrected for corrosion loss ($in^2$)
$R_c$ = reinforcement coverage ratio
$F^*_{top}$ = pullout friction factor at depth 0 ft
$F^*_{20ft}$ = pullout friction factor at depth 20 ft
α = scale effect correction factor

Table 4. Geogrid reinforcement input parameters for 100 year design life.

| Reinforcement | $T_{ult}$ (k/ft) | $RF_{CR}$ | $RF_D$ | $RF_{ID}$ | $T_{al}$ (k/ft) | F* | α | ρ | $CR_{CR}$ | $T_{alc}$ (k/ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) |
| (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) | (insert) |

where,

$T_{ult}$ = MARV ultimate tensile strength of geogrid (k/ft)
$RF_{CR}$ = long-term creep rupture of reinforcement reduction factor
$RF_D$ = durability rupture of reinforcement reduction factor
$RF_{ID}$ = installation damage reinforcement reduction factor
$T_{al}$ = nominal long-term reinforcement design strength (k/ft)
$F^*$ = pullout friction factor
α = scale effect correction factor
ρ = soil-reinforcement interface friction angle
$CR_{cr}$ = long-term connection strength reduction factor
$T_{ac}$ = nominal long-term reinforcement/facing connection design strength (k/ft)

[i] Report Ver 1, December 2020.