OREGON DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL REQUIREMENTS

Introduction

The Oregon Department of Transportation (ODOT) maintains a list of approved proprietary retaining wall systems. Wall vendor submittal requirements for requesting approval are stated in Chapter 15 of the ODOT Geotechnical Design Manual (GDM) available on ODOT website. There are distinct steps in the application process: (Step A) Initial application submittal by manufacturer, this is an abbreviated, overview application, (Step B) Agency review and notification of acceptance to proceed or notification that the application has not been accepted, (Step C) Manufacturer submits full detailed application, (Step D) Agency performs audit, (Step E) Agency issues approval or rejection. The approval will list the wall categories (Bridge, Highway, Minor) and identify limitations for use.

ODOT differentiates wall systems by type, and a single wall system may include only one wall type. Additionally, for mechanically stabilized earth (MSE) walls a system is may include only one batter, on facing type, and one facing connection type. The list of preapproved proprietary retaining wall systems is located on the ODOT Retaining Structures web page, https://www.oregon.gov/ODOT/GeoEnvironmental/Docs_GeologyGeotech/GDM-15-D_2019.pdf. This listing contains several MSE and prefabricated modular wall systems.

ODOT requires IDEA reports as part of a vendor approval request submittal. Their submittal and 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, ODOT requires submittal of the information listed below to supplement an IDEA report on a particular MSE wall system.

This listing is based upon the ODOT Geotechnical Design Manual, Chapter 15 – Retaining Structures, Version 2.1, dated May 6, 2019, that is available at https://www.oregon.gov/ODOT/GeoEnvironmental/Pages/Geotech-Manual.aspx. ODOT 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.

Items to submit to ODOT to request placement of a wall system on their preapproved proprietary wall system list, in addition to an IDEA Evaluation Report, are listed on the following pages. Additional submittal requirements specific to MSE wall systems, including example design calculations and details, are listed. This is followed by additional submittal requirements specific to prefabricated modular retaining wall systems, including the required example design calculations.

Information that is identical to, and therefore redundant to, IDEA protocol listed items is not listed in this supplemental requirements report. However, items under a topic that the agency requests which are more specific or detailed than the IDEA protocol are listed. The wall system
supplier submittal may address this in their supplemental information or, if fully addressed in their IDEA submittal, refer to their IDEA report.

**ODOT Submittal Requirements**
The following items are to be submitted, in addition to an IDEA Evaluation Report for proprietary retaining wall systems. Provide the following information; following the order and with reference to the numbering system used.

**A. Applicant Identification**
   1. Company name
   2. Name and title of authorized representative
   3. Address
   4. Phone
   5. Fax
   6. Signature and date

**B. Product Identification**
   1. Product or trade name (only one system per application)
   2. Description. As part of the description, identify the retaining wall system type from the list in ODOT GDM Section 15.2.4.2, and describe the system. Indicate batter of the wall face.
   3. Indicate which of the following categories of preapproval is being requested (see ODOT GDM Appendix 15-A General Requirements for Proprietary Retaining Wall Systems).
      a. Bridge Retaining Wall System (also indicate proposed maximum wall height).
      b. Highway Retaining Wall System (also indicate proposed maximum wall height).
      c. Minor Retaining Wall System.
   4. Indicate whether preapproval for tiered wall applications is being requested.

**C. Acknowledgement of ODOT GDM Implementation**
   1. In your application for preapproval, include a statement acknowledging that proprietary retaining wall systems with “preapproved-temporary” status must meet all requirements of the ODOT Geotechnical Design Manual (GDM).

**D. Performance Criteria and History**
1. Please indicate the ODOT “index number” of the retaining wall system used in the ODOT Retaining Structures Manual, and date of preapproval.

2. Please indicate any changes that have been made to the retaining wall system since preapproval.

3. Please describe and explain any performance problems that have occurred with the retaining wall system.

E. Proprietary Rights

1. Does the product involve proprietary technology?

2. Is the product patented, copyrighted, or otherwise protected?

3. If proprietary or patented technology is involved, please provide a summary description of the proprietary/protected features. Also indicate the date patented and the date the patent expires.

4. If there is any specific information regarding your firm, the product, your application for preapproval, or any other matter that you wish to be treated as strictly confidential, please describe by categories or subject of confidential data how you would like the Agency to treat this data. Also, where appropriate, please describe any measures or safeguards that have been applied (or could be applied) to protect the confidentiality of the data.

F. Organizational Structure

1. Please provide a brief description of the size, organizational structure, and technical resources of your company.

G. HITEC or IDEA program

1. Please provide Highway Innovative Technology Evaluation Center (HITEC) Technical Evaluation Report for the retaining wall system, if available. Systems that do not have a HITEC evaluation should pursue FHWA’s new Highway Innovations, Developments, Enhancements, and Advancements (IDEA) program technical review. The IDEA program will be replacing the HITEC program.

MSE Wall Systems

Provide the information for MSE retaining wall system submittals. Provide the following information; following the order and with reference to the numbering system used. Additionally, provide a completed checklist of these submittal items, from ODOT GDM, Appendix 15-B (see https://www.oregon.gov/ODOT/GeoEnvironmental/Pages/Geotech-Manual.aspx); which is attached to this Supplemental Requirements report. On the checklist, note whether yes, this has been provided; no, this has not been provided; or not applicable for each item. The submittal of these specific items and the completed checklist (in addition to the IDEA report) will help
expedite the ODOT evaluation of the MSE retaining wall system. Note that a few of the items are redundant to the IDEA protocol, but should be repeated here to aid and expedite the review and acceptance process.

1. Part One

Identify material specification designations that govern the materials that are used in furnishing the wall system elements and components. Provide product literature that describes the wall system, its elements and components and adequately addresses the checklist items. Identify precast concrete facilities that have experience with fabricating the concrete elements and components of the wall system.

1.1 Concrete Facing Unit
   (a) Standard dimensions and tolerances
   (b) Joint sizes
   (c) Concrete strength
   (d) Wet cast concrete percent air (range)
   (e) Moisture absorption (percent by weight)
   (f) Scaling resistance
   (g) Freeze thaw durability
   (h) Facing unit to facing unit shear resistance
   (i) Bearing pads (joints)
   (j) Spacers (pins, etc.)
   (k) Joint filter requirements: geotextile or graded granular
   (l) Aesthetic choices (texture, relief, color, graffiti treatment)
   (m) Other facing materials

1.2 Earth Reinforcement
   1.2.1 Metallic
      (a) Type identified (welded wire, steel bars, etc.)
      (b) Ultimate and yield strength of steel
      (c) Minimum galvanization thickness
      (d) Corrosion resistance test data
   1.2.2 Geosynthetic
      (a) Polymer type and grade
      (b) HDPE: resin type, class, grade and category
      (c) Minimum intrinsic viscosity correlated to number of average molecular weight and maximum carboxyl end groups
      (d) Weight per unit area
      (e) Minimum average roll value for ultimate strength
(f) Creep reduction factor for 75- and 100-year design life, including effect of temperatures
(g) Durability reduction factor (chemical, hydrolysis, oxidation)
(h) Additional durability reduction factor for high biologically active environments
(i) Installation damage reduction factor for range of backfill (select backfill, coarse aggregate)
(j) UV resistance

1.3 Facing Connection(s)
(a) Mode (structural, frictional or combined)
(b) Connection strength as a percentage of reinforcement strength at various confining pressures for each reinforcement product and connection type submitted
(c) Composition of devices, dimensions, tolerances
(d) Full scale connection test method/results

1.4 Range of Backfill
(a) Soil classification, gradation, unit weight, friction angle for reinforcement method
(b) Soil classification, gradation, unit weight, friction angle for facing type
(Note: Backfill must meet Agency requirements.)

1.5 Leveling Pad
(a) Cast-in-place
(b) Precast
(c) Granular

1.6 Drainage Elements
(a) Modular block core and drainage backfill
(b) Pipe drainage backfill

1.7 Coping
(a) Precast
(b) Precast attachment method/details
(c) Cast-in-place

1.8 Traffic Barrier
(a) Precast
(b) Cast-in-place

1.9 Connections to Appurtenances
(a) Precast
2. Part Two: Design
Clearly identify that the design conforms to the AASHTO LRFD Bridge Design Specifications and the GDM. Identify design assumptions and procedures with specific references (e.g., design code sections) for each of the listed items.

2.1. AASHTO LRFD Provisions
   (a) Sliding
   (b) Overturning (including vehicle collision)
   (c) Bearing resistance
   (d) Compound stability
   (e) Seismic
   (f) Movement at service limit state
   (g) Passive resistance and sliding
   (h) Safety against structural failure
   (i) Drainage

2.2. Performance Criteria
   (a) Erection tolerances
   (b) Horizontal/vertical deflection limits

2.3. Drawings
Provide representative drawings showing all standard details along with any alternate details, as required in ODOT GDM Appendix 15-B.6 and listed below.
   (a) Details
      From Appendix 15-B.6, the following are listed under these three application areas:
      i. Bridge Retaining Wall Systems
         • Wall elements
         • Connection details
         • Details at bridge abutment
         • Appurtenance connection details
         • Obstruction avoidance details
         • Corrosion protection details
         • Basic wall construction details
         • Roadway drainage inlet details
         • Drainage swale at top of wall
         • Typical drainage details behind wall
         • Culverts through wall
         • Sidewalk at top of wall
         • Pedestrian rail at top of wall
         • Fencing at top of wall
         • Traffic barrier at top of wall
• Guardrail at top of wall
• Standard coping
• Barrier coping
• Leveling pad or other base details
• Backfill reinforcement details (MSE walls)

ii. Highway Retaining Wall Systems
• Wall elements
• Connection details
• Appurtenance connection details
• Obstruction avoidance details
• Corrosion protection details
• Basic wall construction details
• Roadway drainage inlet details
• Drainage swale at top of wall
• Typical drainage details behind wall
• Culverts through wall
• Sidewalk at top of wall
• Pedestrian rail at top of wall
• Fencing at top of wall
• Traffic barrier at top of wall
• Guardrail at top of wall
• Standard coping
• Barrier coping
• Sidewalk coping
• Leveling pad or other base details
• Backfill reinforcement details (MSE walls)

iii. Minor Retaining Wall Systems
Basic wall construction details
Typical drainage details at heel of wall

2.4. Specifications
Provide sample specifications for:
(a) Wall system component materials

2.5. Calculations
Provide detailed calculations for the example problems in ODOT GDM Appendix 15-B.5; listed in subsequent section of this Supplemental Requirements report. Explain all
assumptions and calculations. Example problem calculations, including computer assisted analyses, shall be sealed and performed under the responsible charge of a Professional Engineer licensed in the State of Oregon.

2.6. Computer Support
If a computer program is used to support vendor MSE wall designs, it shall be the latest version and latest update of MSEW (Adama Engineering, Inc.).

3. Part Three: Construction
3.1. Fabrication of Facing Units
Provide the following information related to the construction of the system:

(a) Curing methods
(b) Concrete surface finish requirements

3.2. Field Construction Manual
Provide a documented field construction manual describing in detail and with illustrations as necessary the step-by-step construction sequence, including requirements for:

(a) Foundation preparation
(b) Special tools required
(c) Leveling pad
(d) Facing erection
(e) Facing batter for alignment
(f) Steps to maintain horizontal and vertical alignment
(g) Retained and backfill placement/compaction
(h) All equipment requirements

3.3. Contractor or Subcontractor Prequalification Requirements
List any contractor or subcontractor prequalifications.

(a) Contractor prequalifications

4. Part Four: Performance
Provide the following information related to the performance of the system:

4.1 Project Performance History

(a) Oldest
(b) Highest
(c) Projects experiencing maximum measured settlement (total and differential) measurements of lateral movement/tilt
(d) Demonstrated aesthetics
Prefabricated Modular Retaining Wall Systems

Provide the information for proprietary prefabricated modular retaining wall system submittals. Provide the following information; following the order and with reference to the numbering system used. Additionally, provide a completed checklist of these submittal items, from ODOT GDM, Appendix 15-B (see https://www.oregon.gov/ODOT/GeoEnvironmental/Pages/Geotech-Manual.aspx); which is attached to this Supplemental Requirements report. On the checklist, note whether yes, this has been provided; no, this has not been provided; or not applicable for each item. The submittal of these specific items and the completed checklist (in addition to the IDEA report) will help expedite the ODOT evaluation of the MSE retaining wall system. Note that a few of the items are redundant to the IDEA protocol, but should be repeated here to aid and expedite the review and acceptance process.

1. Part One

Identify material specification designations that govern the materials that are used in furnishing the wall system elements and components. Provide product literature that describes the wall system, its elements and components and adequately addresses the checklist items. Identify precast concrete facilities that have experience with fabricating the concrete elements and components of the wall system.

1.1 Concrete Facing Unit
   (a) Standard dimensions and tolerances
   (b) Joint sizes
   (c) Concrete strength
   (d) Wet cast concrete percent air (range)
   (e) Moisture absorption (percent by weight)
   (f) Scaling resistance
   (g) Freeze thaw durability
   (h) Facing unit to facing unit shear resistance
   (i) Bearing pads (joints)
   (j) Spacers (pins, etc.)
   (k) Joint filter requirements: geotextile or graded granular
   (l) Aesthetic choices (texture, relief, color, graffiti treatment)
   (m) Other facing materials

1.2 Leveling Pad
   (a) Cast-in-place
   (b) Precast
   (c) Granular

1.3 Drainage Elements
   (a) Weep holes
1.4 Coping
   (a) Precast
   (b) Precast attachment method/details
   (c) Cast-in-place

1.5 Traffic Barrier
   (a) Precast
   (b) Cast-in-place

1.6 Connections to Appurtenances
   (a) Precast
   (b) Precast attachment method/details
   (c) Cast-in-place

2. Part Two: Design
Clearly identify that the design conforms to the AASHTO LRFD Bridge Design Specifications. Identify design assumptions and procedures with specific references (e.g., design code sections) for each of the listed items.

2.1. AASHTO LRFD Provisions
   (a) Sliding
   (b) Overturning (including vehicle collision)
   (c) Bearing resistance
   (d) Overall stability
   (e) Seismic
   (f) Movement at service limit state
   (g) Passive resistance and sliding
   (h) Safety against structural failure
   (i) Drainage

2.2. Performance Criteria
   (a) Erection tolerances
   (b) Horizontal/vertical deflection limits

2.3. Drawings
Provide representative drawings showing all standard details along with any alternate details, as required in ODOT GDM Appendix 15-B.6 and listed below.
   (a) Details
   From Appendix 15-B.6, the following are listed under these three application areas:
i. Bridge Retaining Wall Systems
   - Wall elements
   - Connection details
   - Details at bridge abutment
   - Appurtenance connection details
   - Obstruction avoidance details
   - Corrosion protection details
   - Basic wall construction details
   - Roadway drainage inlet details
   - Drainage swale at top of wall
   - Typical drainage details behind wall
   - Culverts through wall
   - Sidewalk at top of wall
   - Pedestrian rail at top of wall
   - Fencing at top of wall
   - Traffic barrier at top of wall
   - Guardrail at top of wall
   - Standard coping
   - Barrier coping
   - Leveling pad or other base details
   - Backfill reinforcement details (MSE walls)

ii. Highway Retaining Wall Systems
   - Wall elements
   - Connection details
   - Appurtenance connection details
   - Obstruction avoidance details
   - Corrosion protection details
   - Basic wall construction details
   - Roadway drainage inlet details
   - Drainage swale at top of wall
   - Typical drainage details behind wall
   - Culverts through wall
   - Sidewalk at top of wall
   - Pedestrian rail at top of wall
   - Fencing at top of wall
   - Traffic barrier at top of wall
   - Guardrail at top of wall
• Standard coping
• Barrier coping
• Sidewalk coping
• Leveling pad or other base details
• Backfill reinforcement details (MSE walls)

iii. Minor Retaining Wall Systems
   Basic wall construction details
   Typical drainage details at heel of wall

2.4. Specifications
Provide sample specifications for:
   (a) Wall system component materials

2.5. Calculations
Provide detailed calculations for the example problems in ODOT GDM Appendix 15-B.5; listed in subsequent section of this Supplemental Requirements report. Explain all assumptions and calculations. Example problem calculations, including computer assisted analyses, shall be sealed and performed under the responsible charge of a Professional Engineer licensed in the State of Oregon.
   (a) Calculations

2.6. Computer Support
If a computer program is used for design of Agency projects, provide hand calculations for the required example problems demonstrating the reasonableness of computer results.
   (a) Computer programs used

3. Part Three: Construction

3.1. Fabrication of Facing Units
Provide the following information related to the construction of the system:
   (a) Curing methods
   (b) Concrete surface finish requirements

3.2. Field Construction Manual
Provide a documented field construction manual describing in detail and with illustrations as necessary the step-by-step construction sequence, including requirements for:
   (a) Foundation preparation
   (b) Special tools required
   (c) Leveling pad
   (d) Facing erection
   (e) Facing batter for alignment
   (f) Steps to maintain horizontal and vertical alignment
(g) Retained and backfill placement/compaction  
(h) Erosion mitigation  
(i) All equipment requirements  

3.3. Contractor or Subcontractor Prequalification Requirements  
List any contractor or subcontractor prequalifications.  
  (a) Contractor prequalifications  

4. **Part Four: Performance**  
Provide the following information related to the performance of the system:  

4.1 Project Performance History  
  (a) Oldest  
  (b) Highest  
  (c) Projects experiencing maximum measured settlement (total and differential) measurements of lateral movement/tilt  
  (d) Demonstrated aesthetic possibilities  
  (e) Maintenance history
Example Problems

Introduction

Submit all calculations in LRFD format, in accordance with the AASHTO LRFD Bridge Design Specifications, as modified by the ODOT GDM, unless specified otherwise. Investigate all applicable limit states (load combinations), with load factors selected to produce the total extreme force effects. Loads stated in the example problems are all unfactored loads (unless noted otherwise), and require the Manufacturer to apply appropriate load factors.

Calculations and computer output for each example problem shall include or be accompanied by a design narrative. The design narrative shall define all variables, state and justify all design assumptions and interpretations, describe all design steps performed, show the results of each design step, and show that the results satisfy all applicable design requirements. Include references to all applicable ODOT GDM, AASHTO, and FHWA sections. Also provide dimensioned plans, details, and sectional views showing the retaining wall design for each example problem. Once a proprietary retaining wall system is preapproved, the solved example problems will become the standard for preparation of all project specific proprietary retaining wall submittals, as well as for Agency review of the Manufacturer submittals.

The example problems show an MSE retaining wall system. If the proposed proprietary retaining wall system is not an MSE retaining wall system, the Manufacturer should substitute the proposed wall type, in accordance with the requirements of the example problems.

Unless specified otherwise in the example problems, the Manufacturer shall select the wall height to be used in the example problem calculations (subject to AASHTO and ODOT GDM requirements). The wall height used in the example problems, if preapproved by ODOT, will become the maximum wall height allowed for the specific retaining wall system on Agency projects.

Required Example Problems, by Wall Category

- Highway retaining walls: Submit calculations for Retaining Wall Example Problems #1 and #2. Also submit Example Problem #4 when requesting preapproval for tiered Highway retaining wall applications.

- Bridge retaining walls: In addition to the calculations required for Highway retaining walls, submit calculations for Example Problem #3. Since the GDM does not allow the use of prefabricated modular bridge retaining walls, do not submit Example Problem #3 for proprietary prefabricated modular walls.

- Minor retaining walls: Submit calculations for Retaining Wall Example Problem #5 only. Proprietary minor retaining wall systems shall be one of the following retaining wall types:
  - Dry cast concrete block prefabricated modular retaining wall system;
  - Wet cast concrete block prefabricated modular retaining wall system; or
  - Gabion prefabricated modular retaining wall system.
Retaining Wall Example Problem #1

- See following Figure 1 for Problem #1
- Wall is parallel to roadway
- Wall height: Maximum wall height for which preapproval is requested
- Design life: 75 years
- Backslope: Level
- Foreslope: Level
- EH Lateral earth pressure: Yes
- ES Earth surcharge load: No
- EV Vertical pressure from dead load of earth fill: Yes
- DC Component Dead Loads: Yes
- DW Dead load of future wearing surface: Assume DW = 50 psf
- EQ Earthquake loading:
  - Assume peak ground acceleration coefficient “PGA” = 0.22 g.
  - Assume “Site Class” is “D.”
  - Site adjusted seismic coefficient “A_s” = 0.30 g.
  - Assume the Agency EOR has determined that the M-O method is applicable but that a reduction to A_s is not applicable (i.e., k_h = A_s).
  - Assume the load factor on live load equals 0.50 for the Extreme Event I limit state.
- CT Vehicular collision force for MSE walls. For this example problem:
  - Assume Type “F” (32 in.) traffic barrier coping with self-supporting moment slab (ODOT Standard Drawing BR760).
  - Design MSE walls to ensure soil reinforcements do not rupture or pullout due to vehicle impact loads on traffic railing in accordance with Section 15.6.10.
  - The vehicular collision force shall be as specified in AASHTO LRFD 11.10.10.2 and the ODOT GDM.
  - Assume no load is transferred directly from the traffic barrier coping/moment slab to the wall facing.
- CT Vehicular collision force for prefabricated modular walls. For this example problem:
  - Assume Type 2A Guardrail (see ODOT Standard Drawing RD400) with 5.0 ft. of embedment, and located at least three feet clear from the back of the wall.
  - The vehicular collision force shall be as specified in AASHTO LRFD 11.10.10.2 and the ODOT GDM.
- Assume drained conditions for the reinforced soil, retained soil, and foundation soil.
- Assume reinforced backfill soil friction angle (\( \Phi_2 \)) = 34° (for MSE walls)
- Assume reinforced backfill cohesion (C_2) = 0 psf (for MSE walls)
- Assume reinforced backfill unit weight (\( \gamma_2 \)) = 130 pcf (for MSE walls)
- Assume retained soil friction angle (\( \Phi_1 \)) = 32°
- Assume retained soil cohesion (C_1) = 0 psf
- Assume retained soil unit weight (\( \gamma_1 \)) = 120 pcf
• Assume foundation soil friction angle ($\Phi_3$) = 30°
• Assume foundation soil cohesion ($C_3$) = 0 psf
• Assume foundation soil unit weight ($\gamma_3$) = 120 pcf
• Assume wall embedment = H/20 or 2.0 ft. (whichever is greater)
• Assume bearing resistance and settlement of foundation soils is acceptable for all limit states
• Assume overall stability does not govern reinforcement length (for MSE walls)

Figure 1. Problem 1 cross section (from ODOT GDM).
Retaining Wall Example Problem #2

- See following Figure 2 for Problem # 2.
- Wall is parallel to roadway
- Wall height: Assume the maximum wall height for which preapproval is requested
- Design life: 75 years
- Backslope (β): 1v:2h (assume length of slope is 100 ft.)
- Foreslope: Level
- EH Lateral earth pressure: Yes
- ES Earth surcharge load: No
- EV Vertical pressure from dead load of earth fill: Yes
- DC Component Dead Loads: Yes
- DW Dead load of future wearing surface: No
- LS Live load surcharge: No
- EQ Earthquake load:
  - Assume peak ground acceleration coefficient “PGA” = 0.22 g.
  - Assume “Site Class” is “D”.
  - Site adjusted seismic coefficient “A_s” = “k_{max}” = 0.30 g.
  - Assume the Agency EOR has determined the M-O method is not applicable.
  - Assume the total seismic thrust coefficient (KAE) was obtained using the GLE method in accordance with FHWA, 2009.
  - Assume the total seismic thrust coefficient (K_{AE}) equals 1.00. No reduction to K_{AE} is applicable. Use K_{AE} to calculate the total seismic thrust (P_{AE}), which includes both the active (static) thrust and the dynamic (seismic) thrust.
  - Calculate P_{AE} based on the height H_2 = H + [(0.5H*\tan(\beta))/(1-0.5*\tan(\beta))] , where H is shown in following Figure 2.
  - Assume the total seismic thrust (P_{AE}) is applied at a height of H_2/2 at the same inclination of the backslope (1v:2h).
- CT Vehicular collision force (on barrier): No
- Traffic Barrier at top of wall on barrier coping: No
- Standard cast in place concrete coping at top of wall: Yes
- Assume drained conditions in reinforced soil, retained soil, and foundation soil
- Assume reinforced backfill soil friction angle (\Phi_2) = 34° (for MSE walls)
- Assume reinforced backfill cohesion (C_2) = 0 psf (for MSE walls)
- Assume reinforced backfill unit weight (\gamma_2) = 130 pcf (for MSE walls)
- Assume retained soil and cover friction angle (\Phi_1) = 32°
- Assume retained soil and cover cohesion (C_1) = 0 psf
- Assume retained soil and cover unit weight (\gamma_1) = 120pcf
- Assume foundation soil friction angle (\Phi_3) = 30°
- Assume foundation soil cohesion (C_3) = 0 psf
- Assume foundation soil unit weight (\gamma_3) = 120 pcf
- Assume wall embedment = H/20 or 2.0 ft. (whichever is greater)
- Assume soil bearing resistance and settlement of foundation soils is acceptable for all limit states
- Check compound stability but assume overall stability is acceptable
- Assume overall stability does not govern reinforcement length (for MSE walls)

Figure 2. Problem 2 cross section (from ODOT GDM).

Retaining Wall Example Problem #3
- See following Figure 3 for Problem #3.
- Wall is transverse to upper roadway (not “U” or “L” shaped).
- Assume wall height “H” = 22.0 ft.
- Design life: 75 years
- Backslope: Level
- Foreslope: Level
- EH Lateral earth pressure: Yes
- ES Earth surcharge load: Unfactored bridge reactions on spread footing are as follows:
  - \( P_v \) (dead) = 3.50 k/(ft. of wall)
  - \( P_v \) (live) = 3.50 k/(ft. of wall)
  - Ph. (seismic, normal to wall) = 1.00 k/(ft. of wall)
• EV Vertical pressure from dead load of earth fill: Yes
• DC Component Dead Loads: Yes
• LS Live load surcharge on bridge approach: Yes
• EQ Earthquake load
  o Assume peak ground acceleration coefficient “PGA” = 0.22 g.
  o Assume “Site Class” is “D”.
  o (Site adjusted seismic coefficient “A_s” = 0.30 g).
  o Assume the Agency EOR has determined that the M-O method is applicable but
    that a reduction to A_s is not applicable (i.e., k_h = A_s).
• Assume the load factor on live load equals 0.50 for the Extreme Event I limit state.
• Assume drained conditions in reinforced soil, retained soil, and foundation soil
• Assume reinforced backfill soil friction angle (\(\Phi_2\)) = 34° (for MSE walls)
• Assume reinforced backfill cohesion (\(C_2\)) = 0 psf (for MSE walls)
• Assume reinforced backfill unit weight (\(\gamma_2\)) = 130 pcf (for MSE walls)
• Assume retained soil friction angle (\(\Phi_1\)) = 32°
• Assume retained soil cohesion (\(C_1\)) = 0 psf
• Assume retained soil unit weight (\(\gamma_1\)) = 120 pcf
• Assume foundation soil friction angle (\(\Phi_3\)) = 30°
• Assume foundation soil cohesion (\(C_3\)) = 0 psf
• Assume foundation soil unit weight (\(\gamma_3\)) = 120 pcf
• Assume wall embedment = H/10 or 2.0 ft. (whichever is greater)
• Assume the bearing resistance and settlement of foundation soil is acceptable for all limit
  states
• Check compound stability but assume overall stability is acceptable
• Assume overall stability does not govern reinforcement length (for MSE walls)
Retaining Wall Example Problem #4

- See following Figure 4 for Problem #4.
- Walls are parallel to roadway
- Wall heights:
  - Assume total wall height “H” is the maximum wall heights for which preapproval is requested.
  - Assume H1 = H2 = H/2
- Design life: 75 years
- Backslope (upper wall): Level
- Backslope (lower wall): Level
- Foreslope (lower wall): Level
- EH Lateral earth pressure: Yes
- ES Earth surcharge load: Upper wall on lower wall
- EV Vertical pressure from dead load of earth fill: Yes

Figure 3. Problem 3 cross section (from ODOT GDM).
• DC Component Dead Loads: Yes
• DW Dead load of future wearing surface: Assume DW = 50 psf
• LS Live load surcharge: Yes
• EQ Earthquake load:
  o Assume peak ground acceleration coefficient “PGA” = 0.22 g.
  o Assume “Site Class” is “D”.
  o Site adjusted seismic coefficient “A_s” = 0.30 g.
  o Assume the Agency EOR has determined that the M-O method is applicable but that a reduction to A_s is not applicable (i.e., k_h = A_s).
  o Assume the load factor on live load equals 0.0 for the Extreme Event I limit state.
• CT Vehicular collision force for MSE walls. For this example problem:
  o Assume Type “F” (32 in.) traffic barrier coping with self-supporting moment slab (ODOT Standard Drawing BR760).
  o Design MSE walls to ensure soil reinforcements do not rupture or pullout due to vehicle impact loads on traffic railing in accordance with ODOT GDM Section 15.6.10.
  o The vehicular collision force shall be as specified in AASHTO LRFD 11.10.10.2 and the ODOT GDM.
  o Assume no load is transferred directly from the traffic barrier coping/moment slab to the wall facing.
• CT Vehicular collision force for prefabricated modular walls. For this example problem:
  o Assume Type 2A Guardrail (see ODOT Standard Drawing RD400) with 5.0 ft. of embedment, located at least 3.0 ft. clear from the back of the wall.
  o The vehicular collision force shall be as specified in AASHTO LRFD Section 11.10.10.2 and the ODOT GDM.
• Standard cast in place concrete coping at top of walls: No
• Assume drained conditions for reinforced soil, retained soil, and foundation soil
• Assume reinforced backfill soil friction angle (Φ_2) = 34° (for MSE walls)
• Assume reinforced backfill cohesion (C_2) = 0 psf (for MSE walls)
• Assume reinforced backfill unit weight (γ_2) = 130 pcf (for MSE walls)
• Assume retained soil friction angle (Φ_1) = 32°
• Assume retained soil cohesion (C_1) = 0 psf
• Assume retained soil unit weight (γ_1) = 120 pcf
• Assume foundation soil friction angle (Φ_3) = 30°
• Assume foundation soil cohesion (C_3) = 0 psf
• Assume foundation soil unit weight (γ_3) = 120 pcf
• Assume lower wall embedment = H/20 or 2 ft., whichever is greater
• Assume upper wall embedment = 1.0 ft.
• Assume foundation soil bearing resistance and settlement are acceptable at all applicable limit states.
• Check compound stability, but assume overall stability is acceptable
• Assume overall stability does not govern reinforcement length (for MSE walls)
Figure 4. Problem 4 cross section (from ODOT GDM).

Retaining Wall Example Problem #5

- See following Figure 5 for Problem #5.
- See ODOT GDM Section 15.3.23.
- Wall is parallel to roadway
- Wall height: 4.0 ft.
- Design life: 75 years
- Backslope: Level
- Foreslope: Level
- EH Lateral earth pressure: Yes
- ES Earth surcharge load: No
- EV Vertical pressure from dead load of earth fill: Yes
- EQ Earthquake load: No
- DC Component Dead Loads: Yes
- DW Dead load of future wearing surface: No
- LS Live load surcharge: No
- CT Vehicular collision force: No
- Assume drained conditions in retained and foundation soil
- Assume gravel leveling pad angle of internal friction is equal to 34°
- Assume the foundation soil (below the leveling pad) is noncohesive soil with angle of internal friction equal to 30°
- Assume retained soil friction angle (ϕ₁) = 34°
- Assume retained soil cohesion (C₁) = 0 psf
- Assume retained soil unit weight (γ₁) = 120 pcf
- Assume wall embedment: 0.5 ft.
- Assume foundation soil bearing resistance and settlement are acceptable for all limit states
- Assume overall stability is acceptable
- Assume the active earth pressure coefficient (kₐ) = 0.31
- Base coefficient of friction = 0.45 when designing sliding stability

Figure 5. Problem 5 cross section (from ODOT GDM).
# APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

To expedite the evaluation of the MSE Retaining Wall system, applicants must furnish information as indicated in the Checklist. The Checklist items should be referenced to assure that the submittal package includes all of the listed information. The submittal package should be organized according to the numbered items in the Checklist. The completed Checklist should be included with the submitted package.

**Part One:**

Identify material specification designations that govern the materials that are used in furnishing the wall system elements and components. Provide product literature that describes the wall system, its elements and components and adequately addresses the checklist items. Identify precast concrete facilities that have experience with fabricating the concrete elements and components of the wall system.

## 1.1 Concrete Facing Unit

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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</table>

- (a) Standard dimensions and tolerances
- (b) Joint sizes
- (c) Concrete strength
- (d) Wet cast concrete percent air (range)
- (e) Moisture absorption (percent by weight)
- (f) Scaling resistance
- (g) Freeze thaw durability
- (h) Facing unit to facing unit shear resistance
- (i) Bearing pads (joints)
- (j) Spacers (pins, etc.)
- (k) Joint filter requirements: geotextile or graded granular
- (l) Aesthetic choices (texture, relief, color, graffiti treatment)
- (m) Other facing materials

## 1.2 Earth reinforcement

### 1.2.1 Metallic

<table>
<thead>
<tr>
<th>Yes</th>
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</table>

- (a) Type identified (welded wire, steel bars, etc.)
- (b) Ultimate and yield strength of steel
- (c) Minimum galvanization thickness
- (d) Corrosion resistance test data
## APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

### 1.2.2 Geosynthetic

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<th>Yes</th>
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</table>

- (a) Polymer type and grade
- (b) HDPE: resin type, class, grade and category
- (c) Minimum intrinsic viscosity correlated to number of average molecular weight and maximum carboxyl end groups
- (d) Weight per unit area
- (e) Minimum average roll value for ultimate strength
- (f) Creep reduction factor for 75 and 100 year design life, including effect of temperatures
- (g) Durability reduction factor (chemical, hydrolysis, oxidation)
- (h) Additional durability reduction factor for high biologically active environments
- (i) Installation damage reduction factor for range of backfill (select backfill, course aggregate)
- (j) UV resistance

### 1.3 Facing Connection(s)

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<th>Yes</th>
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</table>

- (a) Mode (structural, frictional or combined)
- (b) Connection strength as a percentage of reinforcement strength at various confining pressures for each reinforcement product and connection type submitted
- (c) Composition of devices, dimensions, tolerances
- (d) Full scale connection test method/results

### 1.4 Range of Backfill

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</table>

- (a) Soil classification, gradation, unit weight, friction angle for reinforcement method
- (b) Soil classification, gradation, unit weight, friction angle for facing type

(Nota: Backfill must meet AGENCY requirements.)

### 1.5 Leveling Pad

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</table>

- (a) Cast-in-place
- (b) Precast
- (c) Granular

---

GEOTECHNICAL DESIGN MANUAL  

Page 107 of 132
### APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

#### 1.6 Drainage Elements
- Yes
- No
- N/A
  - (a) Modular Block Core and Drainage Backfill
  - (b) Pipe Drainage Backfill

#### 1.7 Coping
- Yes
- No
- N/A
  - (a) Precast
  - (b) Precast attachment method/details
  - (c) Cast-in-place

#### 1.8 Traffic Barrier
- Yes
- No
- N/A
  - (a) Precast
  - (b) Cast-in-place

#### 1.9 Connections to Appurtenances
- Yes
- No
- N/A
  - (a) Precast

**Part Two: Design**

Clearly identify that the design conforms to the AASHTO LRFD Bridge Design Specifications and the GDM. Identify design assumptions and procedures with specific references (e.g., design code sections) for each of the listed items.

#### 2.1 AASHTO LRFD Provisions
- Yes
- No
- N/A
  - (a) Sliding
  - (b) Overturning (including vehicle collision)
  - (c) Bearing resistance
  - (d) Compound stability
  - (e) Seismic
  - (f) Movement at service limit state
  - (g) Passive resistance and sliding
  - (h) Safety against structural failure
  - (i) Drainage

#### 2.2 Performance Criteria
- Yes
- No
- N/A
  - (a) Erection tolerances
  - (b) Horizontal/vertical deflection limits
Attachment 4. MSE Wall System Submittal Checklist, Part Two continued and Part Three (from page 109 of ODOT GDM).

APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

2.3 Drawings
Provide representative drawings showing all standard details along with any alternate details, as required in Appendix 15-B.6.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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(a) Details

2.4 Specifications
Provide sample specifications for:

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</table>

(a) Wall system component materials

2.5 Calculations
Provide detailed calculations for the example problems in Appendix 15-B.5. Explain all assumptions and calculations. Example problem calculations, including computer assisted analyses, shall be sealed and performed under the responsible charge of a Professional Engineer licensed in the State of Oregon.

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(a) Calculations

2.6 Computer Support
If a computer program is used to support vendor MSE wall designs, it shall be the latest version and latest update of MSEW (Adama Engineering, Inc.).

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(a) Computer programs used

Part Three: Construction
Provide the following information related to the construction of the system:

3.1 Fabrication of Facing Units

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<th>Yes</th>
<th>No</th>
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(a) Curing methods

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</table>

(b) Concrete surface finish requirements
Attachment 5. MSE Wall System Submittal Checklist, Part Three continued and Part Four (from page 110 of ODOT GDM).

APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

3.2 Field Construction Manual

Provide a documented field construction manual describing in detail and with illustrations as necessary the step-by-step construction sequence, including requirements for:

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</table>

(a) Foundation preparation
(b) Special tools required
(c) Leveling pad
(d) Facing erection
(e) Facing batter for alignment
(f) Steps to maintain horizontal and vertical alignment
(g) Retained and backfill placement/compaction
(h) All equipment requirements

3.3 Contractor or Subcontractor Prequalification Requirements

List any contractor or subcontractor prequalification's.

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<tr>
<th>Yes</th>
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</table>

(a) Contractor prequalification's

Part Four: Performance

Provide the following information related to the performance of the system:

4.1 Project Performance History

Provide a well-documented history of performance (with photos, where available), including:

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(a) Oldest
(b) Highest
(c) Projects experiencing maximum measured settlement (total and differential) measurements of lateral movement/tilt
(d) Demonstrated aesthetics
(e) Maintenance history

15-B.4 SUBMITTAL REQUIREMENTS FOR PROPRIETARY PREFABRICATED MODULAR RETAINING WALL SYSTEMS:

Instructions:

To expedite the evaluation of the Prefabricated Modular Retaining Wall system, applicants must furnish information as indicated in the Checklist. The Checklist items should be referenced to assure that the submittal package includes all of the listed information. The submittal package should be organized according to the numbered items in the Checklist. The completed Checklist should be included with the submitted package.

Part One:
Attachment 7. Prefabricated Modular Wall System Submittal Checklist, Part One (from page 111 of ODOT GDM).

### APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

Identify material specification designations that govern the materials that are used in furnishing the wall system elements and components. Provide product literature or other documentation that describes the wall system, its elements and components and adequately addresses the checklist items. Identify precast concrete facilities that have experience with fabricating the concrete elements and components of the wall system.

1.1 **Concrete Facing Unit**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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<td>(a) Standard dimensions and tolerances</td>
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<td>(b) Joint sizes</td>
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<td>(c) Concrete strength</td>
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<td>(d) Wet cast concrete % air (range)</td>
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<td>(e) Moisture absorption (percent by weight)</td>
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<td>(f) Scaling resistance</td>
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<td>(g) Freeze thaw durability</td>
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<td>(h) Facing unit to facing unit shear resistance</td>
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<td>(i) Bearing pads (joints)</td>
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<td>(j) Spacers (pins, etc.)</td>
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<td>(k) Joint filter requirements: geotextile or graded granular</td>
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<td>(l) Aesthetic choices (texture, relief, color, graffiti treatment)</td>
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<td>(m) Other facing materials</td>
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1.2 **Leveling Pad**

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<tr>
<th>Yes</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td>(a) Cast-in-place</td>
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<td></td>
<td></td>
<td>(b) Precast</td>
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<td>(c) Granular</td>
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1.3 **Drainage Elements**

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<tr>
<th>Yes</th>
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<th>N/A</th>
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<td>(b) Base</td>
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<td></td>
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<td>(c) Backfill</td>
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<td>(d) Surface</td>
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1.4 **Coping**

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<td>(a) Precast</td>
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<td>(b) Precast attachment method/details</td>
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<td></td>
<td>(c) Cast-in-place</td>
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</tbody>
</table>
Attachment 8. MSE Wall System Submittal Checklist, Part One continued and Part Two (from page 112 of ODOT GDM).

APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

1.5 Traffic Barrier

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<th>Yes</th>
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<td>(b) Cast-in-place</td>
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1.6 Connections to Appurtenances

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<td>(a) Precast</td>
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<td>(b) Precast attachment method/details</td>
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<td>(c) Cast-in-place</td>
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**Part Two: Design**

Clearly identify that the design conforms to the AASHTO LRFD Bridge Design Specifications. Identify design assumptions and procedures with specific references (e.g., design code sections) for each of the listed items.

2.1 AASHTO LRFD Provisions

<table>
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<tr>
<td>(a) Sliding</td>
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<td>(b) Overturning (including vehicle collision)</td>
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<td>(c) Bearing resistance</td>
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<td>(d) Overall stability</td>
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<td>(e) Seismic</td>
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<td>(f) Movement at service limit state</td>
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<td>(g) Passive resistance and sliding</td>
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<td>(h) Safety against structural failure</td>
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<tr>
<td>(i) Drainage</td>
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2.2 Performance Criteria

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<tr>
<td>(a) Erection tolerances</td>
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<tr>
<td>(b) Horizontal/vertical deflection limits</td>
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2.3 Drawings

Provide representative drawings showing all standard details along with any alternate details, as required in Appendix 15-B.6.

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<tr>
<td>(a) Details</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.4 Specifications

Provide sample specifications for:
Attachment 9. MSE Wall System Submittal Checklist, Part Two continued and Part Three (from page 113 of ODOT GDM).

APPENDIX 15-B PREAPPROVAL PROCESS AND SUBMITTAL REQUIREMENTS FOR PROPRIETARY RETAINING WALL SYSTEMS

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.5 Calculations

Provide detailed calculations for the example problems in Appendix 15-B.5. Explain all assumptions and calculations. Example problem calculations, including computer assisted analyses, shall be sealed and performed under the responsible charge of a Professional Engineer licensed in the State of Oregon.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

2.6 Computer Support

If a computer program is used for design of Agency projects, provide hand calculations for the required example problems demonstrating the reasonableness of computer results.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
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</tbody>
</table>

Part Three: Construction

Provide the following information related to the construction of the system:

3.1 Fabrication of Facing Units

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Curing methods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Concrete surface finish requirements</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

3.2 Field Construction Manual

Provide a documented field construction manual describing in detail and with illustrations as necessary the step-by-step construction sequence, including requirements for:

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Foundation preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Special tools required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Leveling pad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Facing erection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Facing batter for alignment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Steps to maintain horizontal and vertical alignment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) Retained and backfill placement/compaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) Erosion mitigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) All equipment requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 Contractor or Subcontractor Prequalification Requirements

List any contractor or subcontractor prequalification’s.
Attachment 10. MSE Wall System Submittal Checklist, Part Three continued and Part Four (from page 114 of ODOT GDM).

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(a) Contractor prequalification’s</td>
</tr>
</tbody>
</table>

**Part Four: Performance**

Provide the following information related to the performance of the system:

4.1 Project Performance History

Provide a well-documented history of performance (with photos, where available), including:

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(a) Oldest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) Highest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(c) Projects experiencing maximum measured settlement (total and differential) measurements of lateral movement/tilt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Demonstrated aesthetics possibilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) Maintenance history</td>
</tr>
</tbody>
</table>

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Report Ver 1, December 2020.