# INDIANA DEPARTMENT OF TRANSPORTATION

***Driving Indiana's Economic Growth***

## Design Memorandum No. 21-02

February 4, 2021

**TO:** **All Design, Operations, and District Personnel, and Consultants**

**FROM:** ***/s/ Athar Khan***
**Athar Khan**
**Director Geotechnical Services Division**
**Engineering Department**

**SUBJECT:** **Mechanically Stabilized Earth (MSE) Walls**

**REVISES:** ***Indiana Design Manual*** **Sections 14-2.01(04), 14-2.01(12), 14-2.02(03), 14-2.04(03), 14-2.04(09), 14-2.05(03), 14-2.05(04), 410-2.03(01), 410-2.03(03), 410-5.01(05), 410-5.01(06), 410-5.01(07), 410-5.02(01), 410-5.03, 410-6.05(01), 410-6.07(01), 410-6.07(03), 410-7.01(01), 410-7.01(02), 410-7.02(03), 410-7.04(01), 410-7.05(01), Figs. 410-5(0)A thru C, MSE Wall Design Review Checklist (new)**

**SUPERSEDES:** **17-03 Mechanically Stabilized Earth (MSE) Walls**

**EFFECTIVE:** **As noted.**

The MSE wall suitability review that was introduced with Design Memo 17-03 has been renamed the MSE Wall Initial Feasibility Review, and the submittal requirements have been incorporated into Chapter 14 of the IDM. MSE Wall Initial Feasibility Review replaces the MSE Wall Suitability Review that was required by Design Memo 17-03. **The MSE Wall Initial Feasibility Review is effective immediately, as shown in Chapter 14.**

A new editable document titled MSE Wall Design Review Checklist has been created to assist designers and reviewers in ensuring that the requirements of the *Standard Specifications* and the *Indiana Design Manual* have been incorporated. The Engineer of Record (EOR) will be responsible for completing this document. The submittal requirements of this new checklist have been incorporated into Chapter 14 of the IDM. The MSE Wall Design Review Checklist can be found on the Editable Documents webpage, under the Geotechnical category. **MSE Wall Design Review Checklist is to be included with all Stage 3 submittals on or after May 1, 2021.**

Chapter 410 of the IDM has been updated for revised and added MSE Wall detailing requirements, and to reflect the renaming of the Office of Geotechnical Services to the Geotechnical Services Division.

A summary of IDM revisions and a copy the MSE Wall Design Review Checklist can be found at the end of this memo.

For question related to this design memo please contact Geotechnical Services Division: MSEWallShopDrawings@indot.in.gov.

**Summary of Revisions for Chapter 14**

**14-2.01(04) Geotechnical Investigation Request and MSE Wall Initial Feasibility Review Submittal [Rev. Feb. 2021]**

Upon approval of the Stage 1 review submission, the Geotechnical Investigation will be requested. Anticipated pavement sections and intended treatment should be provided. If the project includes MSE walls, the Stage 1 plans are required to be submitted to the Geotechnical Services Division for the initial feasibility review of MSE walls at MSEWallShopDrawings@indot.IN.gov. The sheets to be included with this request are as follows:

1. Title sheet;
2. Typical cross sections;
3. Roadway plan and profile;
4. Bridge General Plan;
5. Layout;
6. Details. This should show approximate location of a noise wall, retaining wall, or high-mast lighting tower; and
7. Cross sections.

**14-2.01(12) Stage 3 Review Submission [Rev. Feb. 2012, Feb. 2021]**

Plans should be approximately 95% complete at this stage.

The purpose of this submittal is to ensure that the plans are complete and satisfy the criteria provided in the Engineering Assessment studies. The following should be completed and reviewed for quality assurance. Include responses to Final Field Check questions.

For a project that requires only a Stage 3 Submission, all documentation required for Stages 1 and 2, if not previously submitted, must be included in the Stage 3 submittal. Documentation will include the abbreviated Engineer's Assessment, geotechnical report, and pavement-design approval.

1. Previous Reviews. Include the marked-up plans from the Stage 2 submittal and changes made from the Final Field Check meeting with this submission. Right-of-way changes made after Final Right-of-Way Plans are submitted should be processed in accordance with Section 85-3.03.

2. Conformance. Review the plans for conformance with the Level One controlling design criteria listed in Section 40-8.02(01) and indicate approved dates for design exceptions.

3. Plans Set. If a Final Field Check meeting is not held at the discretion of the project manager, all of the milestone requirements should still be review and incorporated.

   a. Erosion Control Plan. Include the completed set.

   b Road Summary Sheets. The content and requirements are described below. For a large project for which the standard-sized Summary tables cannot accommodate all of the items, multiple custom Summary sheets should be used to accommodate all the necessary information. The Summary sheet frames, in DGN and XLS format, can be downloaded from http://www.in.gov/indot/div/cad/_v8i_downloads.htm. The Pavement Quantities and Approach Table, Structure Data, Paved Side Ditch Summary, Riprap Ditch and Sodding Table, Underdrain Table, Guardrail Summary Table with guardrail-related pay items, Sign Summary Table, Pipe Material Selection, and mailbox approaches information including required HMA quantities should be completed.

   a. Cross Sections. The project engineer or supervisor will require the elevations for existing cross sections in order to calculate the final earthwork quantities.

      If the project was designed from an electronic survey, the design calculations should include a data table created from the electronic cross-sections which indicates all existing cross-section elevations.

      An example data table is shown as Figure 14-2A.

4. Quantities. Finalize all quantities.

5. Reports. Ensure that the recommendations from the Geotechnical Report and other reports regarding peat, hazardous waste, special waste, etc. have been incorporated into the plans, specifications, and cost estimate.

6. Cost Estimate. Conduct a detailed review to ensure that all necessary pay items have been included. Finalize the construction cost estimate using the current pay item submittal system.

7. Level One Checklists and Design Computations. If there are no changes to the plans which affect Level One criteria since the prior submission, it is acceptable to copy the previous Level One Checklist and add a statement that no changes have been made to the plans that affect Level One criteria. The statement should be initialed and dated for the current submission.

8. Special Provisions. Complete the special provisions menu, and include special provisions for non-standard pay items.

9. Rule 5. If required, and not previously submitted in accordance with Section 9-1.02, complete the Rule 5 Submission as described in Chapter 205.

10. Underground Storage Tanks Removal. If this work is required, the designer should coordinate such activity with the Office of Environmental Services manager. The designer should complete Figure 14-2B, Underground Storage Tanks Removal information request. If a final field check is not required, the coordination should take place six months prior to the Ready for Contracts date.

    This coordination is to ensure that required pay items such as excavation and handling of contaminated soil are included in the contract.

11. INDOT All Project Commitments Report. This should include all known resolutions.

12. Proprietary Material. If a proprietary material is specified that is either not listed the Department's Approved Materials List or is on Department's list of Approved Programmatic Proprietary Material, the designer must submit for approval a certification or a public-interest finding request. Editable versions of these documents appear on the Department's website, at http://www.in.gov/dot/div/contracts/design/dmforms/, under Proproprietary Material.

13. Environmental Consultation Form. Summarization 7-3C should be completed at this submission. An editable version of this document appears on the Department's website, at www.in.gov/dot/div/contracts/design/dmforms/, under Environmental.

14. Traffic Control Plan Checklist. See Section 14-1.02(03) for Traffic Control Plan Checklist information.

15. MSE Wall Design Review Checklist. If the project includes MSE walls, the relevant plan sheets and the completed MSE Wall Design Review checklist are required to be submitted to the Geotechnical Services Division for review at MSEWallShopDrawings@indot.IN.gov. The checklist is available for download from the Department's Editable Documents webpage, under Geotechnical, and needs to be signed by the EOR and Geotechnical EOR prior to submission.

**14-2.02(03) Geotechnical Investigation Request and MSE Wall Initial Feasibility Review Submittal [Rev. Feb. 2021]**

See Section 14-2.01(04).

**14-2.04(03) Geotechnical Investigation Request and MSE Wall Initial Feasibility Review Submittal [Rev. Feb. 2021]**

Upon approval of the Stage 1 Review Submission, the Geotechnical Investigation will be requested. If the project includes MSE walls, the Stage 1 plans are required to be submitted to the Geotechnical Services Division for the initial feasibility review of MSE walls at MSEWallShopDrawings@indot.IN.gov. The plans sheets to be included with this request are as follows:

1. Title sheet;

2. Typical Sections sheet, including tabulation of subgrade-treatment information;

3. Details sheets. If the project requires a MSE wall, include a preliminary wall layout;

4. Roadway plan and profile sheets;

5. Layout sheet;

6. General Plan sheet. Include the anticipated foundation loads. If the structure requires pile loads in excess of 70 tons, the required pile capacity should be shown; and

7. Cross Section sheets.

**14-2.04(09) Stage 3 Review Submission [Rev. Feb 2012, May 2013, Apr 2017, May 2017, Nov. 2017, May 2020, Feb. 2021]**

Plans should be approximately 95% complete at this stage.

For this submittal, finalize the plans and include all roadway, traffic, and bridge details, and check the computations.

For a project that requires only a Stage 3 Submission, all documentation required for Stages 1 and 2, if not previously submitted, must be included in the Stage 3 submittal. Documentation will include the abbreviated Engineer's Assessment, geotechnical report, and pavement-design approval.

Complete the following and review these elements for quality assurance.

1. Previous Reviews. Include the marked-up plans from the previous submittal with this submission.

2. Conformance. Review the plans for conformance with the Level One controlling design criteria listed in Section 40-8.02(01) and identify approval dates of design exceptions.

3. Pavement Design. Incorporate the final pavement design into the typical cross section and final quantities.

4. Computations and Quantities. Include the computations and quantities with this submission as follows:

    a. final approach drainage design;
    b. superstructure design;
    c. end bent or abutment design;
    d. interior substructure design;
    e. bridge-seat elevations;
    f. screeds at copings, profile grade, each beam line, and each construction joint;
    g. superstructure quantities;
    h. end-bent or abutment quantities;
    i. interior substructure quantities;
    j. pavement, curb, sidewalks, and related quantities;
    k. drainage-structure quantities;
    l. riprap, sodding, and seeding quantities;

m. earthwork quantities;
n. traffic-related items and designs as discussed and revised from Field Check Plans;
o. traffic-maintenance quantities;
p. miscellaneous roadway quantities;
q. updated construction cost estimate;
r. completed special provisions; and
s. erosion- and sediment-control features design.

5. Reports. Ensure that the recommendations from the hearing comments, Geotechnical Report, or other reports regarding peat, hazardous waste, special wastes, etc., have been incorporated into the plans, specifications, and cost estimate.

6. Plans. The plans should be nearly complete at this stage and should include the following.

a. Title and Index Sheets. Complete the Design Data block and update the index as necessary.

b. Typical Cross Sections. Add the final pavement design information.

c. Plan and Profile Sheets. Ensure that structure notations are completed; sodding, riprap, and paved side ditch locations are indicated; earthwork balances are shown; and removal items identified. Right-of-way station offsets from the final right-of-way plans should be incorporated.

d. Details Sheets. Ensure that all details are completed and included with this submission. This includes details for the following:

(1) reinforced-concrete bridge approach bill of materials and details;
(2) temporary erosion control;
(3) traffic-maintenance details; and
(4) traffic-design elements (e.g., intersections, signals, signing, or lighting).

e. Bridge Sheets. Finalize the design for these sheets as follows.

(1) Soil Borings sheet.
(2) Layout sheet. Ensure that the riprap and slopewall quantities are shown and the earthwork summary is completed.
(3) General Plan sheet.
(4) End Bent or Abutment Details.
(5) Interior Substructure Details.
(6) Superstructure Details.

f. Tables. Complete all data tables including the following:

(1) Bridge Summary Table;
(2) Structure Data Table;
(3) Approach Table;
(4) Underdrain Table;
(5) Paved Side Ditch and Sodding Table;
(6) Guardrail Table;
(7) Sign Summary Table; and
(8) Curb Ramps and Sidewalks Table if not detailed elsewhere.

g. Cross Sections. Design information should be essentially complete. This includes final structure notations, earthwork areas and volumes, and benching areas and volumes.

7. Level One Checklists and Design Computations. If there are no changes to the plans which affect Level One criteria since the prior submission, it is acceptable to copy the previous Level One Checklist and add a statement that no changes have been made to the plans that affect Level One criteria. The statement should be initialed and dated for the current submission.

The designer should submit a Level One Checklist, including computations for the mainline, each S-line, and each traffic-maintenance phase. The designer should include computations for the required intersection sight distance at each public road, including each local-service road or frontage road within the project limits. The designer should also submit documentation of the intersection sight distance provided at each public road. This requirement also applies to the traffic-maintenance phases.

8. Environmental Consultation Form.

9. Rule 5 Submission. If required and not previously submitted, submit in accordance with Section 9-1.02.

10. Bridge Load Rating. Bridge load rating requests should be submitted through the Load Rating Request Application (LRRA), available through ITAP. Instructions for use are available for download from the Bridge Design and Load Rating webpage, under Bridge Load Rating.

a. Department-Owned Bridge. For both tradition design-bid-build and alternate procurement methods such as design-build, the Bridges Division Load Rating Engineer completes the load rating for a Department-owned bridge.

Traditional Project Development. Bridge load rating requests should be submitted through LRRA. A separate set of bridge plans (excluding cross sections) should also be uploaded through the LRRA.

If the analysis shows an unacceptable rating, a notification will be sent from the LRRA denying the request. When a request is denied, design and plan revisions are required. A new request should be submitted with revised plans.

Alternate Procurement Project Development. Bridge Load Rating should be included as a hold point in the technical provisions. The bridge load rating should be requested through the LRRA upon completion of the design plans. The load rating must be completed prior to the approval of structural member working drawings. Where working drawings are not required, the load rating must be complete prior to work being performed on bridge elements.

b. Local Public Agency (LPA) Bridge. A load rating request is not required for an LPA-owned bridge. The LPA is responsible for the load rating of an LPA-owned bridge in accordance with the INDOT *Bridge Inspection Manual*. An INDOT-certified Load Rating Engineer (LRE) must complete the load rating.

c. Bridge-Length Structure Under Fill. A load rating request is not required for a precast bridge-length three-sided structure or box structure. Load rating for these structures is performed in accordance with the *Standard Specifications* as part of the working drawing submission process. A copy of the load rating submitted with the working drawings should be forwarded to the Department's Load Rating Engineer.

11. INDOT All Project Commitments Report. This should include all known resolutions.

12. Foundation Review Form. This form is available for download from the Department's Editable Documents webpage, under Bridges.

13. MSE Wall Design Review Checklist. If the project includes MSE walls, the relevant plan sheets and the completed MSE Wall Design Review checklist are required to be submitted to the Geotechnical Services Division for review at MSEWallShopDrawings@indot.IN.gov. The checklist is available for download from the Department's Editable Documents webpage, under Geotechnical, and needs to be signed by the EOR and Geotechnical EOR prior to submission.

**14-2.05(03) Preliminary Plans Submission [Rev.Mar. 2016, Apr. 2020, Feb. 2021]**

A preliminary plans submission is required for all Rehabilitation projects. For a Preventative Maintenance project, the need for a preliminary plans submission is at the discretion of the Bridge Rehabilitation reviewer.

Plans for multiple bridge rehabilitations which are complementary to plans for road work may be combined into one set of bridge plans. Multiple bridge preventative maintenance projects may be combined into one set of bridge plans. The structure numbers and Des numbers for all bridge structures should be shown on the title sheet.

The following should be reviewed in accordance with quality assurance procedures and included in this submission.

1. Transmittal Letter. Identify any unique circumstances for the submittal, e.g. omitted items, the Responsible Person to receive the evaluation scores, as well as any subconsultants and their work responsibilities.

2. Plan Set, Rehabilitation project. Rehabilitation projects should be developed on full size sheets. See item 3 for a Preventative Maintenance project.

    a. Title Sheet.

    b. Index Sheet. Include the information as follows:

        1) an index of plan sheets (at this stage); and

        2) a revision table.

3) a list of utility owners, addresses, contact names, and phone numbers or e-mail addresses.

c. Maintenance of Traffic (MOT) Details. The proposed MOT scheme and phasing should be outlined with preliminary details.

d. Detail Sheets. These preliminary details should include, but not be limited to, typical cross sections, asphalt wedge details, guardrail details, and approach work details as appropriate.

e. Layout Sheet. A Layout Sheet should be included when the rehabilitation work is significant enough to warrant a full survey or is part of a larger 4R project.

f. General Plan Sheet. This sheet should include the following:

1) plan view;

2) elevation view;

3) typical bridge cross section;

4) design data relative to original design structural elements. The following note should be included:

Originally designed for ____ loading, in accordance with the AASHTO _____ Specifications, ____ Edition, and subsequent interims through _____[year].

Design data for new elements, such as a new bridge deck, should be indicated separately;

5) design loadings;

6) suggested substructure type;

7) minimum vertical and horizontal clearances;

8) minimum low structure, Q100, flowline, low water and ordinary high water mark elevations, as available;

9) related general notes;

10) general rehabilitation recommendations including, but not limited to, legend, material notes, and required stormwater- pollution-prevention retrofits; and

11) all recommendations outlined in the Bridge Scoping Report.

3. Plan Set, Preventative Maintenance project. Preventative Maintenance projects may be developed on letter-sized plan sheets. If a Preventative Maintenance project utilizes full size plans, the plan sheet development should be in accordance with item 2 above.

a. Title Sheet.

1) Project Description. The project description should include the work type, e.g., Polymeric Overlay and Joint Repair.

2) Project Location Maps. Include a State map, hatching the various counties included in the project and note the INDOT district. A separate project location map or enlarged detail should identify general locations of the various structures within the counties.

3) Bridge Index Table. The table should summarize the list of structures, including des. number, bridge file number, and county.

4) Contract number. The contract number should appear in the upper right hand corner of the sheet. This allows the number to be visible when the contract book is printed and bound.

5) *Standard Specifications* Reference. Indicate which version of the Department's *Standard Specifications* apply to the project. The *Standard Specifications* are published every two years.

6) Signature Block and Professional Engineer's Seal. The engineer's seal, signature of the engineer, and date signed is required on each sheet for consultant-developed plans and on the title sheet and detail sheets for in-house-developed plans. The seal may vary within the plan set depending on which engineer prepared the sheet. For the title sheet, "Indiana Department of Transportation", should be shown under the Approved for Letting signature line.

b. Project Location Sheet. This sheet is a tablelized summary of structures, including des number, structure number, route and facility crossed, and location (referenced from the nearest State route, US route, or interstate), latitude and longitude, reference post and county.

c. Work and Quantities Sheet. This sheet identifies the work to be completed for each structure, references to applicable details within the plans, reference to applicable maintenance of traffic *Standard Drawing*s, and an estimate of quantities.

d. Detail Sheets. Include preventative maintenance treatment details and maintenance of traffic details not covered by the *Standard Drawings*

4. All Project Commitments Report. The All Project Commitments Report is generated from the Commitments Database. Information on accessing the Commitments Database and other project commitments documents are available at http://www.in.gov/indot/2731.htm.

5. Level One Controlling Criteria Checklist and Design Computations. For a Preventative Maintenance project, a Level One controlling criteria checklist is required only for MOT. ADA and Bridge Railing Test Level should be addressed in accordance with Section 412-3.01. For a Rehabilitation project, the checklist is required for both the permanent condition and MOT.

   If there are no changes to the plans which affect Level One controlling criteria since the prior submission, it is acceptable to submit the previous checklist and initial and date next to the statement that no changes have been made to the plans that affect Level One controlling criteria. See Section 40-8.02. A checklist should be prepared for each phase of the proposed MOT.

6. Traffic Control Plan Checklist. The checklist will be incomplete at this stage, but should reflect MOT decisions from the initial field check. See Section 14-1.02(03) for Traffic Control Plan Checklist information.

7. Scour Analysis Memo. Include the approval letter from the Office of Hydraulics, where applicable.

8. Unique Special Provisions. Begin coordination for unique provisions and unique pay items. Unique provisions should be reviewed by the Specifications Engineer prior to the Final Plans submission.

9. Proprietary Materials. Submit justification for the use of proprietary materials. See Chapter 17.

10. Cost Estimate.

11. Permits Determination Request. For both Rehabilitation and Preventative Maintenance projects, the designer should coordinate with the Waterway Permitting Office to establish the need for a permits determination and items to be submitted.

12. Initiate Stormwater Quality Manager Determination. If possible, the designer should Provide initial Stormwater Quality Manager level recommendation. Otherwise submit with Final Plans. See section 14-2.04(06).

**Additional Preliminary Plans Information**

The designer should coordinate with the project manager to have preliminary plans reviewed by the Division of Utilities and Railroads.

Upon approval of the preliminary plans a geotechnical investigation request should be submitted. If a geotechnical investigation is not required a Geotechnical Waiver should be obtained. If the project includes MSE walls, the Preliminary Plans are required to be submitted to the Geotechnical Services Division for the initial feasibility review of MSE walls at MSEWallShopDrawings@indot.IN.gov.

**14-2.05(04) Final Plans Submission [Rev. Mar. 2016, Apr. 2017, Nov. 2017, May 2020, Feb. 2021]**

The following should be reviewed in accordance with quality assurance procedures and included in this submission. Information required for the Preliminary Plans Submission should be included in this submission, if not previously submitted.

1. Transmittal Letter. Identify any unique circumstances for the submittal, e.g. omitted items or items that are not applicable, the Responsible Person to receive the evaluation scores as well as any subconsulants and their work responsibilities.

2. Response to Comments. Include the Preliminary Plans comment letter and marked up plans with responses to all comments. These items should be combined into a single document.

3. Plan Sheets. Ensure plan sheets required in previous submittals are included as applicable. The Final Plans should include specific measures proposed by the Railroads, Utilities, Environmental, Geotechnical, or Hydraulics offices. The following additional sheets should be included as applicable.

   a. Soil Borings Sheets.

   b. Maintenance of Traffic (MOT) Details. Finalize MOT details.

   c. Detail Sheets. All necessary plans details required to adequately define the required repairs. Details could include, but not be limited to, floor details, superstructure details, substructure details, railing details, reinforced-concrete bridge approach details, and temporary erosion- and sediment-control measure details.

   d. Tables. Include a bridge summary, guardrail summary and other tables as applicable.

4. Quantity Calculations. Finalize all quantities. Designer and checker initials and date should be shown on each sheet.

5. Design Computations. Finalize design computations. Designer and checker initials and date should be shown on each sheet. Include the Hydraulics Approval and Scour memos from the Office of Hydraulics, where applicable.

6. Cost Estimate. Conduct a detailed review to ensure that all necessary pay items have been included.

7. Special Provisions. Complete the special provisions menus and include unique special provisions for non-standard pay items. Unique special provisions should be reviewed by the Specifications Engineer.

8. Geotechnical Report. Include the report or indicate its location within ERMS in the transmittal letter.

9. MSE Wall Design Review Checklist. If the project includes MSE walls, the relevant plan sheets and the completed MSE Wall Design Review checklist are required to be submitted to the Geotechnical Services Division for review at MSEWallShopDrawings@indot.IN.gov. The checklist is available for download from the Department's Editable Documents webpage, under Geotechnical, and needs to be signed by the EOR and Geotechnical EOR prior to submission.

**Summary of Revisions for Chapter 410**

**410-2.03(01) Responsibility [Rev. Feb. 2021]**

The designer will be responsible for all design and detailing where a cast-in-place rigid, semi-gravity wall or a non-gravity cantilever wall is specified.

The designer will be responsible for the conceptual application, external stability, and review of the proprietary design for another type of earth-retaining system.

At the Field Check Plans submission, the designer will provide the Geotechnical Services Division with a set of plans including cross sections and the information as follows:

**410-2.03(03) Wall-Selection Criteria [Rev. Feb. 2021]**

Other considerations in determining the acceptability of a particular earth-retaining system shall include the following:

1. geotechnical constraints;
2. future uses of the site;
3. differential deflection or settlement of wall sections;
4. project-specific special features;
5. long- and short-term wall stability;
6. comparable degree of safety;
7. accessibility to construction site;
8. staged-construction limitations;
9. right-of-way limits;
10. site-imposed physical limitations;
11. seismic activity;
12. wall inundation;
13. aesthetics;
14. economics;
15. environment; and

16. construction-time constraints.

The decision to select an earth-retaining system shall consider technical feasibility and its economy compared with a cast-in-place retaining wall. With respect to economy, the factors to be considered are as follows:

1. earthwork situation, cut or fill;
2. wall area;
3. average wall height;
4. foundation conditions;
5. availability and cost of select backfill material;
6. availability and cost of required right of way;
7. complex horizontal and vertical alignment changes;
8. need for a temporary excavation support system;
9. traffic maintenance during construction; and
10. aesthetics.

Each earth-retaining system has different performance histories, and this can create difficulty in adequate technical evaluation. Some systems are more suitable as a permanent wall, others are more suitable as a low-height wall; some are more applicable for a rural area, while others are more suited for a suburban area. The selection of the most appropriate system will thus depend on the specific project requirements. See Figure 410-2D, Wall Types and Classification of Earth-Retaining Systems; Figure 410-2A, Fill-Section Wall-System Selection Chart; and Figure 410-2B, Cut-Section Wall System Selection Chart, for system-selection guidelines.

The Geotechnical Services Division shall be informed of each potential system to be considered for a project, so that it can provide site-specific recommendations.

**410-5.01(05) Selection Criteria [Rev. Feb. 2021]**

Each topic described below shall be considered at the preliminary design stage. The appropriate elements and performance criteria shall be determined. The process consists of the successive steps as follows.

1. Consider all possible alternatives, and choose an earth-retaining system. Cantilever, gravity, semigravity, or counterforted concrete wall, or reinforced-soil slopes are the usual alternatives to an MSE wall and abutments.

2. In a cut situation, an in-situ wall such as a tieback anchored wall, soil-nailed wall, or nongravity cantilevered wall is often more economical. Where limited right of way is available, a combination of a temporary in-situ wall at the back end of the reinforcement and a permanent MSE wall is often competitive.

3. Consider facing options. The development of project-specific aesthetic criteria is principally focused on the type, size, and texture of the facing, which is the only visible feature of an MSE structure.

4. For a permanent application, an MSE wall with precast-concrete panels shall be considered. It is constructed with a vertical face. The precast-concrete panels can be manufactured with a variety of surface textures, colors, and geometrics.

5. At a more remote location, a gabion, timber faced, or vegetated MSE wall may be considered.

6. For a temporary wall, significant economy can be achieved with wire facings, geosynthetic wrapped facings, or wood-board facing. It can be made permanent by applying shotcrete or cast-in-place concrete in a post-construction application, provided that the wall design satisfies the criteria for a permanent wall.

7. Develop performance criteria for loads, design height, embedment, settlement tolerances, foundation capacity, effect on adjoining structures, etc. Performance criteria for an MSE structure with respect to design requirements are governed by design practice or the *LRFD Bridge Design Specifications* and the INDOT *Standard Specifications*.

8. Consider site effects on corrosion or degradation of reinforcement.

9. The top of the leveling pad should be at least 1 ft above the ordinary high-water and groundwater elevations. Coarse aggregate No. 8 is required to be placed behind the wall instead of structure backfill up to the $Q_{100}$ high-water elevation.

10. The minimum embedment at the front face of the wall is required to be in accordance with the AASHTO LRFD Bridge Design Specifications, section 11.10.2.2. However, the minimum embedment depth to the top of the leveling pad should never be less than 3 ft unless founded on rock. A 4 ft horizontal bench in front of the wall should be provided for slopes steeper than 4.0H:1.0V. The embedment and bench material, at the front face of the wall, should match the structure backfill material used for the wall.

10. Guardrail should not be used within the limits of the MSE wall reinforced zone.

**410-5.01(06) Design Criteria [Rev. May 2012, May 2013, Mar. 2017, Feb. 2021]**

The recommend minimum resistance strengths with respect to failure modes are as follows.

1. External Stability. Sliding eccentricity, *e*, at base, plus bearing capacity, deep-seated stability, and seismic stability shall be checked based on *LRFD* 11.10.5.

   The design height of the wall, *Z*, shall be measured from the theoretical top of the leveling pad to a point above the top of the wall as calculated from the formula as follows:

   $$Z = H + L \tan \beta$$

Where:

$H$ = height of the wall from the theoretical top of the leveling pad to the top of the coping,
$L$ = width of the reinforced zone, and
$\beta$ = surcharge slope angle as measured from the top of the coping.

See Figure 410-5(0)A.

2. Internal Stability. Pullout resistance shall be checked based on *LRFD* 11.10.6.

   a. Design Limits and Wall Height. The length and height required to satisfy the project's geometric requirements shall be established to determine the type of structure and external loading configurations.

   b. Length of Ground Reinforcement. The minimum reinforcement length for an MSE wall is the greater of 0.7*H* or 8 ft. A greater length may be required for a structure subject to surcharge loads, or if the factored MSE-wall loads are more than the factored bearing resistance.

   c. External Loads. The external loads can be surcharges required by the geometry, adjoining footing loads, line loads from traffic, traffic impact loads, or sound-barrier loads. Traffic live loads and impact loads are applicable where the traffic lane is located horizontally from the face of the wall within a distance of less than one half the wall height.

Item d. Wall embedment deleted.

3. Seismic Activity. Due to an MSE wall's flexibility, it is resistant to dynamic forces developed during a seismic event. See the *LRFD Bridge Design Specifications* for seismic-design considerations.

**410-5.01(07) Information to be Shown on Plans [Rev. Dec. 2012, Mar. 2017, Feb. 2021]**

In addition to the requirements shown in 410-2.03(04), the following information should be shown on the plans.

Wall Envelope. The wall envelope should be determined from the plans' elevation view with three control lines. Control Line 1 defines the elevation of the top of coping, or wall, if no coping is used. Control Line 1 should be shown on the elevation view with stations and elevations in conjunction with cross-section locations. It should be located on the back face of the MSE wall or coping. Control Line 2 defines the elevation of the final ground line in front of the wall. Control Line 3 defines the elevation of the top of the leveling pad. It is obtained by offsetting a minimum distance of 3 ft below the proposed ground line in front of the wall to the top of the leveling pad. All control lines should be shown and identified as such on the plans. Control Lines 1 and 3 should also be labeled as neat lines.

The minimum area required for the wall to be constructed should be defined by means of an envelope. The limits of the envelope are the beginning- and end-of-wall stations and the locations of Control Lines 1 and 3. From this information, a wall-elevation view along the front face of the wall showing leveling-pad and step locations, elevations, and dimensions should be prepared and shown on the plans as conceptual information for the contractor. The minimum area within the envelope described above should be the pay quantity for the wall. Figure 410-5(0)B shows the difference between the minimum area required and an estimated amount of additional surface area required to construct the wall based on the wall-panel sizes and leveling-pad step increments described below. The area below Control Line 3 is conceptual information for the contractor and should not be included in the panels' pay quantity because it can vary depending on the wall system the contractor chooses. Pay quantities for each wall should be shown on the plans.

The plans should show the minimum height from the top of the leveling pad to the existing or proposed ground line, as required. The plans should also show all stations and offsets relative to the survey centerline on the back face of the wall for the beginning and ending points, and all such offsets for turn-point locations where the wall forms an angle. Leveling-pad steps should be in 2.5-ft increments. The bottom of the pad should be level. The minimum extent and depth of undercut areas should be clearly shown.

Drainage. Details for drainage of the surface-water infiltration and reinforced-soil backfill should be included for all MSE walls. Figure 410-5(0)C shows the standard drainage details. It is the

designer's responsibility to determine the elevation of the drainage pipe such that it will drain and outlet adequately.

Wall Panels. Panels of 10-ft length by 5-ft height should be assumed for walls with a radius of 100 ft and greater. The assumed panel length should be 5 ft if the radius of the wall is between 50 ft and 100 ft. The top of the wall or coping may be sloped. The standard panel thickness should be taken as 6 in. The decorative panel thickness should be taken as 9 in. Panel sizes and wall thickness should not be shown on the plans, as the wall-system manufacturer will show these values on the working drawings.

Elevation View. An elevation view should show and label all obstructions (utilities, pipes, culverts, and other structures) placed below the leveling pad or passing through an MSE wall by station and elevation. The beginning and ending locations should be checked to determine where the final grading elevations are equal both in front of and behind the wall, whereby the wall is no longer required. The elevation view should also show the factored bearing resistance and the undercut area/soil improvement, if any, from the geotechnical report.

Plan View. A plan view on the MSE Wall Details sheet should show and label obstructions and their offset from the back of the wall panel. Obstructions include but are not limited to, piles, pile sleeves, catch basins, signal or sign foundation, and culverts. Where obstructions cannot be avoided, the wall-system designer must modify the wall design using one of the methods in *LRFD* 11.10.10.4. Details to avoid obstructions must be shown in the MSE wall working drawings. A plan view should also show the station and offset relative to survey centerline to the back of the wall panel and all such information for turn point locations; surface water flow arrows showing how water coming from above the MSE wall is directed away from the reinforced backfill area of the wall; the extent of soil improvement, if any; construction limits; temporary and permanent right-of-way limits; and internal drainage details with outlets to a ditch or sewer.

Section View. A section view should show the estimated dimensions of reinforced and retained backfill, subsurface drainage details, slope of ground above the top and in front of the wall and the distance between the back of the wall and pile or pile sleeves.

Special Wall Details. Special wall details should be shown separately and identified in the plan or elevation views as appropriate. Special wall details include, but are not limited to, architectural treatments, special facing elements where connecting to existing wall systems, tiered wall details, aesthetics within benches, and instrumentations.

MSE Wall at an End Bent. When an end bent is placed behind an MSE wall, expanded polystyrene should be shown for gap between the front face of the end bend and the back of the MSE wall. Do

not show Styrofoam or extruded polystyrene. See Figure 409-2G, End Bent Placed behind MSE Wall for additional details.

**410-5.02(01) Design Procedure [Rev. Feb. 2021]**

1. Earth-Pressure Considerations. The backslope is either horizontal such that $B = 0$ deg, or with sloping backfill such that $B > 0$ deg. The modular-block wall can be vertical such that A = 0 deg, or with setback such that $A > 0$ deg.

   The angles A and B are shown in Figure 410-5C or 410-5D.

   For a wall with a setback of 0 deg, the active earth pressure coefficient for external stability, $K_a$, can be determined from Equation 410-5.1, Rankine's formula.

$$Ka = (\cos B)\frac{\cos(B - X)}{\cos(B + X)} \qquad \text{(Equation 410.5-1)}$$

   where $X = \sqrt{\cos^2 B - \cos^2 \phi_r}$

   For a wall with a setback of 1 deg, $K_a$ can be determined from Equation 410-5.2, Coulomb's formula, with $\delta = 0$.

$$K_a = \frac{\cos^2(\phi_r + A)}{\cos^2 A[\cos(A - \delta)]\left(1 + \sqrt{Z/Y}\right)^2} \qquad \text{(Equation 410-5.2)}$$

   where $\varphi_r$ = angle of internal friction of the retained soil (from geotechnical report)
   $A$ = wall setback angle from vertical
   $\delta$ = interface friction angle between reinforced soil zone and retained soil, which shall be taken as 0 deg
   $B$ = backslope angle (see Figure 410-5C or 410-5D)
   $Z = \sin(\phi_r + \delta)\sin(\varphi_r - B)$
   $Y = \cos(A - \delta)\cos(A + B)$

2. External Stability.

   a. Analysis of Overturning. Eccentricity, e, at the base shall be checked based on *LRFD* 11.10.5.

b. Analysis of Sliding. Sliding at the base shall be checked based on *LRFD* 11.10.5. Sliding shall also be checked at the level of the first geogrid from the bottom using the geogrid coefficient of direct sliding, but including the shear strength between modular-block units. If the geogrid coefficient of direct sliding is unknown, use 0.65 tan *S*.

c. Analysis of Soil Bearing Pressure. The bearing pressure at the bottom of the reinforced-soil mass and blocks, BP, is determined by using the Meyerhof stress distribution.

$$BP = \frac{R}{L_2 - 2e} \qquad \text{(Equation 410-5.3)}$$

where $e$ is determined by taking moments about the center of the base length L2.

$$e = 0.5hH_1 \cos C + 0.33hH_2 \cos C - 0.5H_1 \sin C\left(L_2 + h \tan A\right) - H_2 \sin C -$$
$$0.5V_1\left(h + H\right)\tan A - 0.5V_1W_W - V_2\left(H \tan A + 0.67L + W_W - 0.5L_2\right) - \frac{2R}{V_3 H \tan A}$$

BP ≤ Factored bearing resistance

The factored bearing resistance is provided by the Geotechnical Services Division.

If a break in the slope behind the wall is located horizontally within a distance of 2*H*, broken-back backfill may be used. If the break is located at 2*H* or greater from the wall, a horizontal backslope shall be used.

## 410-5.03 Modular-Block Gravity Wall without Ground Reinforcement [Rev. Feb. 2021]

The proprietary modular blocks used in combination with ground reinforcement can also be used as a pure gravity wall (see Section 410-4.02). The height to which it can be constructed is a function of the width of the blocks, the setback of the blocks, the backslope angle, and the angles of internal friction of the retained earth behind the wall. The base of the block wall shall be placed at least 3 ft below the finish-grade elevation. A wall of this type is limited to a height of 5 ft or less, and is limited to a maximum differential settlement of 1 in 200. However, a wall of this type shall not be used to support a highway or other structure.

Dry-cast modular-block wall units are relatively small, squat concrete units that have been designed and manufactured for retaining-wall application. The weight of a unit ranges from 30 to 100 lb, with units of 60 to 100 lb used for highway work. Unit height ranges from 4 to 8 in. Exposed-face length varies from 8 to 18 in. Nominal width, or dimension perpendicular to the wall face, of a unit ranges between 9 and 24 in. Units are manufactured solid or with cores. Full-height cores are filled with aggregate during erection. Units are dry-stacked without mortar in a running-bond configuration. Vertical adjacent units are interconnected to prevent sliding.

The material specifications for the blocks used for a gravity wall are identical to those for the blocks used for a modular-block wall with ground reinforcement.

The design of a modular-block gravity wall shall be in accordance with the project requirements and the procedures described herein.

The modular-block manufacturer shall check the wall for overturning and internal stability and make certain that the factored bearing-resistance requirements are satisfied. The Geotechnical Services Division will check the wall for sliding, global stability, and settlement, and will provide the factored bearing resistance and the equivalent fluid pressure acting on the back of the wall.

The pay quantities shall be determined as described in Section 410-5.02(01) item 4.

**410-6.05(01) General [Rev. Feb. 2021]**

A prefabricated concrete modular gravity wall consists of interlocking reinforced precast concrete cells or modules, a cast-in-place concrete floor or dense-graded aggregate base, an optional reinforced-concrete parapet placed on top of the wall or concrete cap, and structural infill inside the modules. The parapet can be placed and held rigidly to a cast-in-place concrete slab.

The height and width shall be as determined based on the site-specific conditions, site constraints, and as required by the design. The proposed length and width of the modules shall be submitted to the Geotechnical Services Division for review and approval during the design stage.

**410-6.07(01) Background [Rev. Feb. 2021]**

A gravity retaining wall can be constructed from rock-filled wire baskets commonly called gabions or gabion baskets. The gabions are manufactured from a heavy wire mesh formed into rectangular baskets. Common basket sizes include a standard depth of 3 ft; heights of 1, 1.5, or 3 ft; and lengths of 3 to 12 ft. Individual baskets are placed on the prepared earth surface, reinforced with internal tie wires, and filled with riprap stone. After the baskets are filled, the lids are closed and wired shut to form a relatively rigid block. Succeeding rows of gabions are laced to the filled underlying gabions and are filled in the same manner until the wall reaches the design height. A proprietary gabion-basket manufacturer will supply details for the wires, lacing, and lid closure. However, the manufacturer does not provide internal or external wall design. External stability considerations are determined by the Geotechnical Services Division.

Foundation preparation shall include removing unsuitable material and vegetation, stabilizing weak or compressible material and replacing it with B borrow, then proofrolling the foundation area. The wall base shall be constructed of dense-graded crushed aggregate.

A gabion wall can be used for a variety of applications. A wall on a grade can be accommodated by either putting steps in the wall or by sloping the base of the wall. A gabion wall on a grade of 5% or more has a more pleasing appearance if steps are utilized. A gabion wall can be constructed adjacent to a stream or lake so that at least a portion of the wall is below the water line. For this application, it is necessary to dewater the wall site during construction. For an in-water installation, the wall shall be protected against erosion or scour by the use of riprap or other suitable protection. A gabion wall can also be constructed along a curved alignment. However, a sharp curve with a radius of less than 25 ft can be difficult to construct and shall be avoided. A layer of geotextile fabric shall be placed on the back side of the wall prior to backfilling to prevent soil migration and loss. The minimum embedment for a gabion wall is 1'-6".

The durability of a gabion wall is dependent upon maintaining the integrity of the gabion baskets. Galvanized steel wire is required for all each gabion installation. In an area of high corrosion potential due to soil, water, salt spray, or abrasion conditions, a polyvinyl chloride coating is required in addition to galvanizing. Conditions at each individual site shall be assessed to determine corrosion potential. Although gabions are manufactured from a heavy gage wire, there is a potential for damage due to vandalism. The potential for such vandalism shall be considered at each specific site.

In gabion-wall design, the mass of a wall will increase disproportionately with increases in height;. therefore, doubling the height of a wall will more than double the mass of the wall. The ratio of the base width to height will vary, but this value shall not be below 0.5. In practice, this value will range from 0.5 to 0.75 depending on backslope, surcharge, and angle of internal friction of retained

soil. A gabion wall has shown to be economical for a low to moderate height, but is less economical as height increases. A height of about 18 ft shall be considered as a practical limit for a gabion wall.

A gabion wall is tilted back into the slope for design stability. A declination of 6 deg is used, but another angle is acceptable. A geotechnical investigation and analysis is conducted by the Geotechnical Services Division to determine soil-design parameters for retained and foundation soils. Consolidation potential due to wall loads is considered in determining foundation design parameters.

**410-6.07(03) Summary of Design Requirements [Rev. Feb. 2021]**

1. Foundation-Design Parameters. Use values provided by the Geotechnical Services Division.

2. Traffic Surcharge. Traffic live load surcharge = 2 ft = 240 lb/ft$^3$

3. Retained Soil.

   a. Unit weight = 120 lb/ft$^3$
   b. Angle of internal friction as determined from tests made by the Geotechnical Services Division.

**410-7.01(01) Design Procedure [Rev. Feb. 2021]**

A description of the design of a sheet-piling wall along with some simplified earth-pressure distributions is shown in the *LRFD Bridge Design Specifications*. This type of wall is also referred to as a flexible cantilevered wall. A steel-sheet-pile wall can be designed as a cantilevered wall up to approximately 15 ft height. A steel-sheet-pile wall of greater height can require tiebacks with either prestressed soil anchors or deadman-type anchors. Anchored-wall design and details are discussed in Section 410-7.02. The preferred method of designing cantilever sheet piling is shown in the United States Steel *Sheet Piling Design Manual*, Conventional Method. The Geotechnical Services Division will provide the soil-design parameters including cohesion values, angle of internal friction, angle of wall friction, soil densities, and water-table elevations.

**410-7.01(02) Summary of Design Requirements [Rev. Feb. 2021]**

1. Foundation-Design Parameters. Use values provided by the Geotechnical Services Division.

2. Traffic Surcharge. Traffic live-load surcharge = 2 ft = 240 lb/ft$^3$

3. Retained Soil.

   a. Unit weight = 120 lb/ft$^3$
   b. Angle of international friction as determined from tests from the Geotechnical Services Division.

**410-7.02(03) Design of Timber Lagging [Rev. Feb. 2021]**

The lagging thickness is determined from past construction experience as related to depth of excavation, soil condition, and soldier-pile spacing. Otherwise, soil-pressure distribution recommended by the Geotechnical Services Division shall be used to determine the lagging thickness.

**410-7.04(01) Principles of Anchored-Wall Design [Rev. Feb. 2021]**

Anchored-wall design includes the following:

1. evaluation of the feasibility of anchors;
2. selection of an anchor system;
3. estimation of anchor capacity;
4. determination of unbonded length, bonded length; and
5. selection of corrosion protection.

The economical use of anchors shall be determined for a particular site based on installation ability and development of anchor capacity. The presence of utilities or other underground facilities can affect whether anchors can be installed.

Anchors can consist of bars, wires, or strands. The choice of appropriate type is usually left to the contractor but may be specified by the designer if site conditions exist which preclude the use of certain anchor types. Strands and wires have advantages with respect to tensile strength, limited work areas, ease of transportation, and storage. Bars are more easily protected against corrosion, and are easier to stress and transfer load.

A reliable estimate of the safe anchor capacity shall be provided by a geotechnical engineer to determine the feasibility of anchoring. The capacity of each anchor shall be verified through testing. Requirements for test methods and frequency are provided in the AASHTO *LRFD Bridge Construction Specifications*. Typical system design values are as follows.

1. Design loads shall range from 60 to 240 kip.

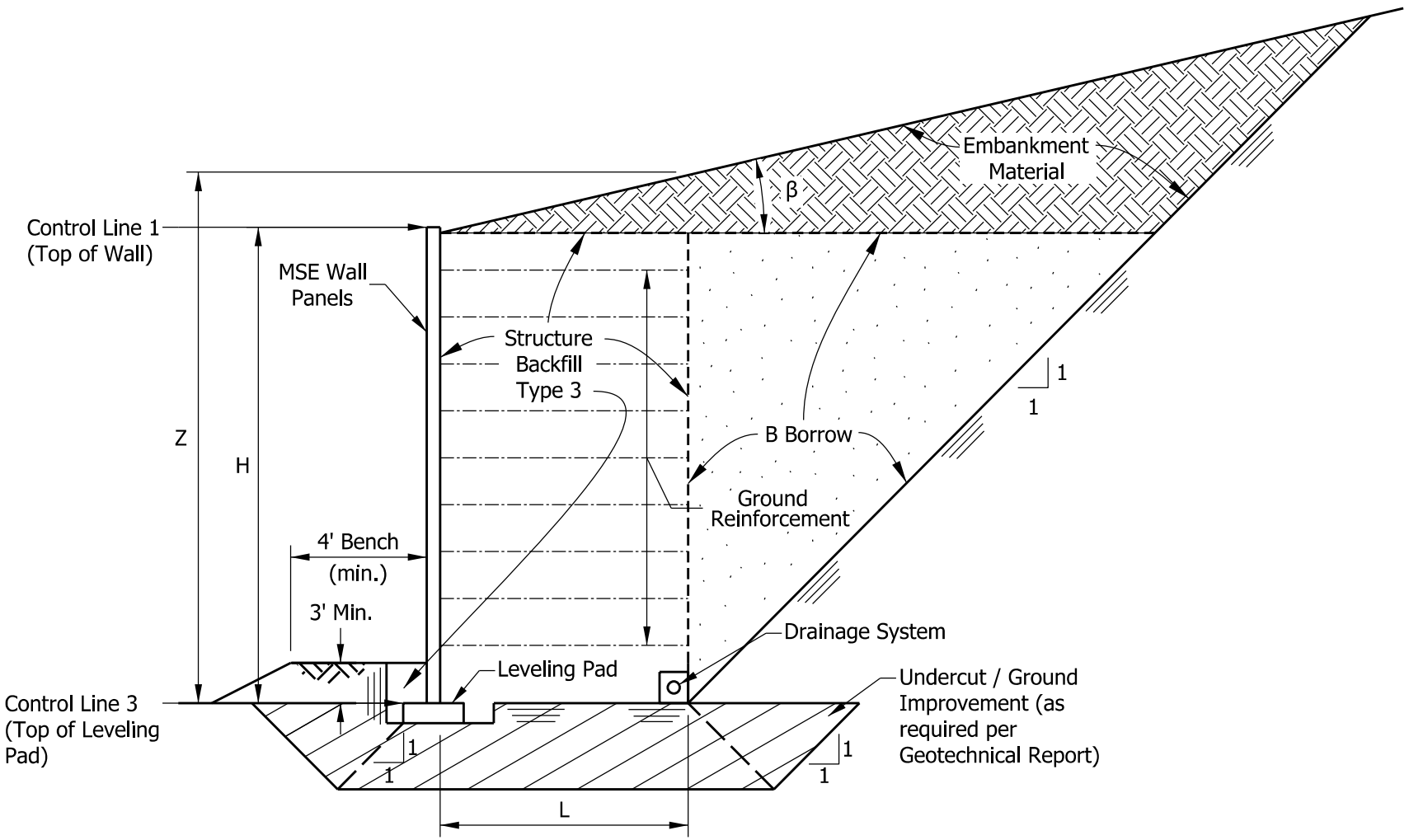
2. The anchor-wall system shall be analyzed to ensure long-term stability. The minimum unbonded length of 15 ft for soil or rock anchors shall be shown on the plans. A longer free length may be required in plastic soil. The designer shall contact the Geotechnical Services Division.

**410-7.05(01) Soil-Nailed Wall [Rev. Feb. 2021]**

A soil-nailed wall is an earth-retaining system consisting of reinforced in-situ material which can be either original ground or an existing embankment. Construction is accomplished by means of excavating from the top of wall elevation down in stages of typical height of 4 to 6 ft. After each stage of excavation, soil-reinforcing elements, or soil nails, generally consisting of reinforcing bars, are placed and grouted into drilled holes which have been drilled at a slight downward inclination from level into the in-situ material. The face of each stage of excavation is protected by a layer of reinforced shotcrete. After the full height of the wall has been excavated and reinforced, a finish layer of concrete facing is placed for the full head of the wall.

Soil nailing is most applicable for retaining excavations and for increasing the stability of slopes.

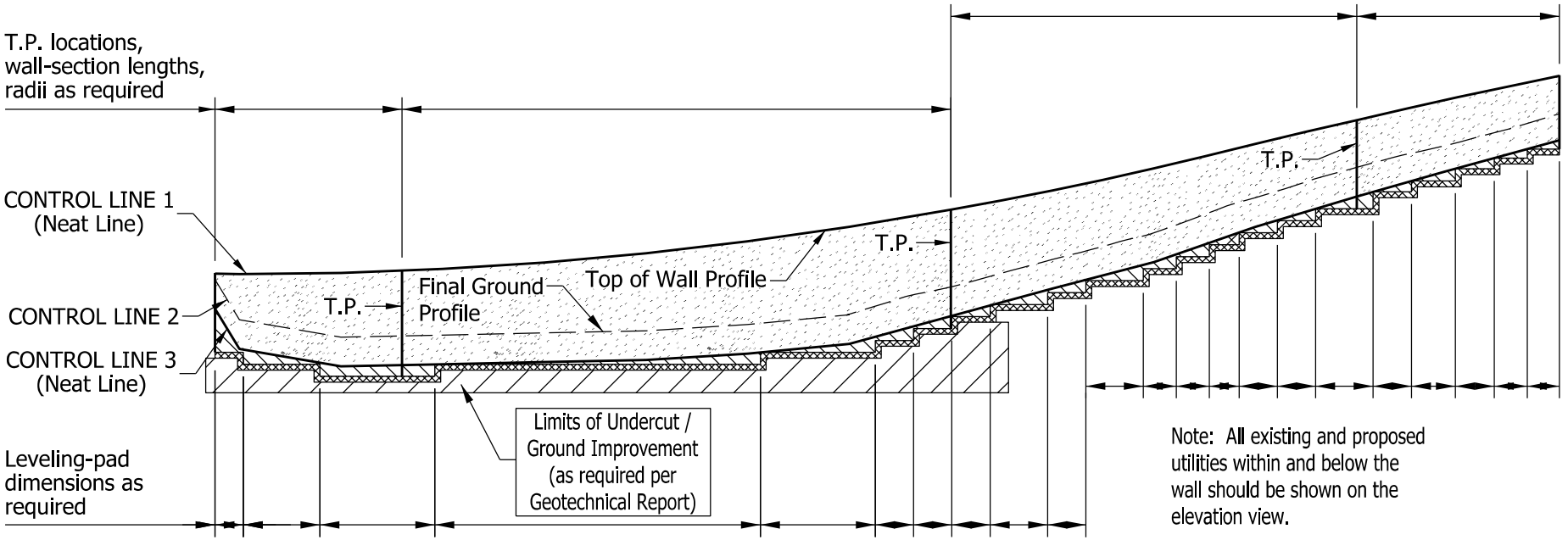
The designer is responsible for the structural design and preparation of the contract documents. The Geotechnical Services Division is responsible for the geotechnical design. The geotechnical aspect of the design establishes the soil-nail size, length, spacing, and minimum drilled-hole diameter.




# MSE RETAINING WALL SECTION SHOWING EXTERNAL-STABILITY VALUES AND BACKFILL TYPES AND LIMITS

## Figure 410-5(0)A

[Rev. Feb. 2021]



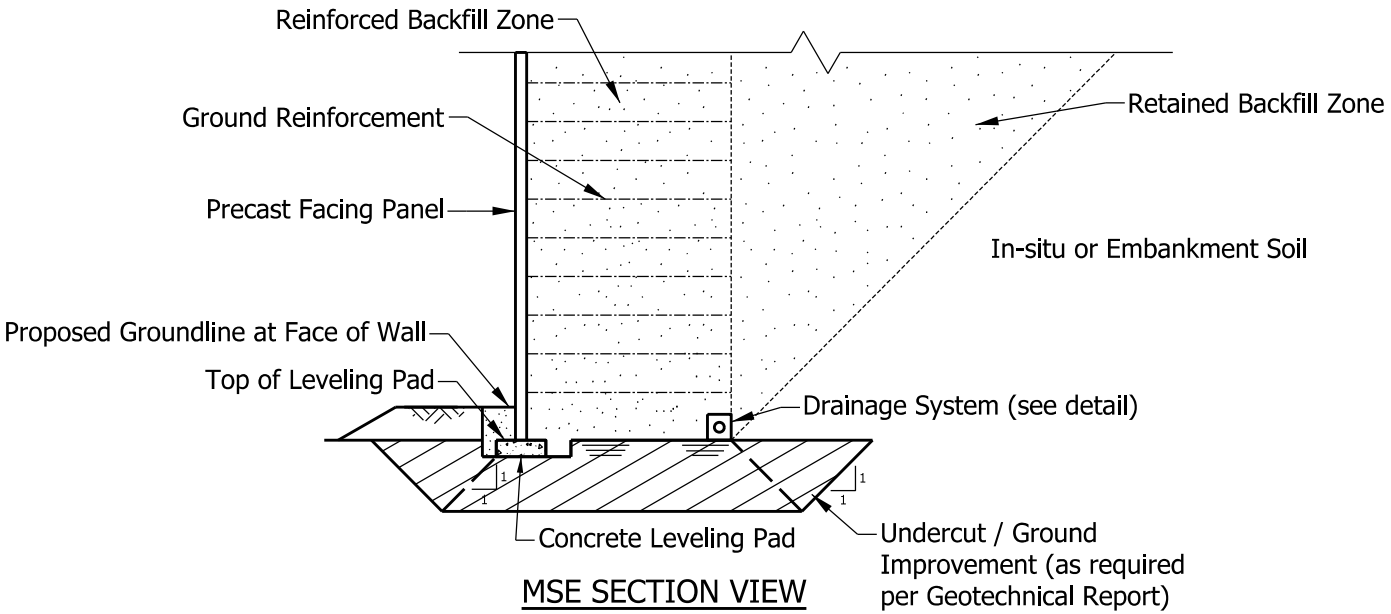

Legend:

- Theoretical area = Pay area, sf
- Additional wall area provided by the contractor
- Leveling pod
- T.P. Turning-point loaction (station, offset, elevation)

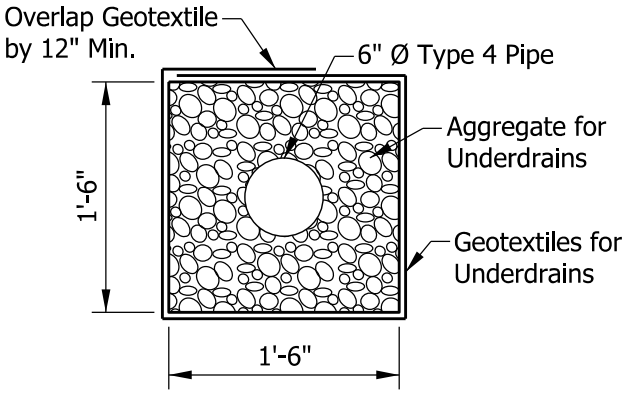
# TYPICAL MSE WALL ELEVATION VIEW WITH WALL ENVELOPE

## Figure 410-5(0)B

[Rev. Feb. 2021]




MSE SECTION VIEW




MSE WALL DRAINAGE DETAIL

# TYPICAL MSE WALL CROSS SECTION

## Figure 410-5(0)C

[Rev. Feb. 2021]

# MSE WALL DESIGN REVIEW CHECKLIST

## INSTRUCTIONS

This checklist should be completed by the Engineer of Record (EOR) and submitted to the Geotechnical Services Division for review at MSEWallShopDrawings@indot.IN.gov, in accordance with IDM Chapter 14.

A link to frequently used abbreviations and acronyms is provided here.

The following tables should be filled out by the party listed in parenthesis.

## PROJECT INFORMATION (EOR)

| | |
|---|---|
| Contract No. | |
| Des. No. (associated with MSE wall details) | |
| Route(s) | |
| Feature Crossed (if applicable) | |

## DESIGNER (EOR) and GEOTECHNICAL EOR INFORMATION

| | |
|---|---|
| Name of EOR | |
| EOR Consulting Firm or INDOT Location | |
| Name of Geotechnical EOR | |
| Geotechnical EOR Consulting Firm or INDOT Location | |

## INDOT GEOTECHNICAL REVIEWER INFORMATION (Geotechnical Services Division)

| | |
|---|---|
| Name | |
| Date Received | |
| Date Returned to EOR | |
| Is a resubmittal required? | |

## NOTES FOR CHECKLIST

1. The following information/material should be referenced while completing the checklist:
   a. Project documents (final plan set, *Standard Specifications*, Standard Drawings, special provisions, project geotechnical report)
   b. FHWA/NHI manual ("Mechanically Stabilized Earth Walls and Reinforced Soil Slopes," Publications. FHWA NHI-10-024 Vol I and NHI-10-025 Vol II, December 2009; Authors: Ryan R. Berg, Barry R. Christopher and Naresh C. Samtani)
   c. Applicable version of AASHTO *LRFD Bridge Design Specifications*, including interims referenced on the plans.
2. Each question must have a "Yes", "No" or "N/A" box checked. Add any pertinent project specific questions to the checklist under "Place comments here. If NO or N/A is checked comments are required," as necessary. Additional sheets may be used if more space is required.
3. The documents listed under the "Reference" column in the checklist are not intended to be a complete list of documents. Rather, the most common documents are listed where guidance/information related to the question in the checklist may be found. More stringent criteria may exist in other project documents (e.g., special provisions, etc.) that may be relevant to a given question. In such an event, the governing document should be noted in the "Comments/Action Required" column of the checklist.

## CHECKLIST

| I. INITIAL FEASIBILITY REVIEW FOR PROJECT SITE | | | | |
|---|---|---|---|---|
| QUESTION | REFERENCE | YES | NO | N/A |
| 1. Has the MSE Wall been submitted to INDOT Geotechnical Services Division for evaluation of suitability? [place date of submittal in comments below] | IDM Ch. 14 | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

| II. DESIGN CRITERIA | | | | |
|---|---|---|---|---|
| QUESTION | REFERENCE | YES | NO | N/A |
| 1. Are all acute angles greater than 70 degrees? | IDM 410-5.01(06) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 2. Are the radii of curves in the horizontal alignment of the wall greater than 100 ft for standard 10 ft wide panels, and greater than 50 ft for 5 ft wide panels? | IDM 410-5.01(06) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

## II. DESIGN CRITERIA (Continued)

| QUESTION | REFERENCE | YES | NO | N/A |
|---|---|---|---|---|
| 3. Are utilities located within the reinforced zone? Where utility placement in the reinforced zone is unavoidable, future access must be provided to the utility without disrupting the reinforcement. | IDM 410-5.01(06) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 4. Is the wall embedment per LRFD, but not less than 3 ft from final grade to top of leveling pad, unless founded on rock.? | LRFD 11.10.2.2, Spec 731.03 IDM 410-5.01(05) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 5. Is the top of leveling pad at least 1 ft above ordinary high water and groundwater elevation? | IDM 410-5.01(05) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 6. Is coarse aggregate No. 8 used behind the wall instead of structure backfill up to the Q100 high-water elevation? | IDM 410-5.01(05) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 7. Has a horizontal bench with a min. width of 4 ft been provided in front of walls where the back slope is steeper than 4H:1V? | IDM 410-55.01(05), Spec 731.03 | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 8. Is the embedment and bench day-lighted and riprapped?? | Spec 731.03 | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 9. MSE wall drainage system shows needed required drain outlets? | Spec 731.03 | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

## II. DESIGN CRITERIA (Continued)

| QUESTION | REFERENCE | YES | NO | N/A |
|---|---|---|---|---|
| 10. Does the MSE wall drainage system show the required drain outlets? | IDM 410-5.01(07) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 11. Has moment slab been placed adjacent to the MSE wall coping, and not on top of the coping? | Standard Drawings Series E 706-MSRW | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 12. Has guardrail be located so that the posts will be located outside the limits of the MSE wall reinforced zone? | IDM 410-5.01(05) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 13. Have the piles or pile sleeves been located a minimum of 3 ft between the back of the wall panels and the edge of the piles or pile sleeves? | IDM 402-6.02(02) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 14. Have the piles or pile sleeves been located a minimum of 3 ft between the back of the wall panels and the edge of the piles or pile sleeves? | IDM 402-6.02(02) | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 15. Has a minimum of 6 in. been provided between the MSE coping and face of end bent.? | IDM Fig. 409-2G | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 16. Have integral end bents and semi-integral end bent diaphragms been isolated from the MSE wall system for calculated thermal movements? | IDM Fig. 409-2G | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

## III. PLAN DETAILS

| QUESTION | REFERENCE | YES | NO | N/A |
|---|---|---|---|---|
| 1. Have the following been shown in the Elevation View? | | | | |
| a. Wall envelope including control lines 1, 2, and 3 | IDM 410-5.01(07), PGR | ☐ | ☐ | ☐ |
| b. Minimum embedment from top of leveling pad to the final ground line | | ☐ | ☐ | ☐ |
| c. Undercut and soil improvement requirements | | ☐ | ☐ | ☐ |
| d. Leveling pad steps level and in 2.5 ft increments | | ☐ | ☐ | ☐ |
| e. Obstructions that protrude through the wall face | | ☐ | ☐ | ☐ |
| f. Obstruction, such as utilities, pipes, or culverts, placed below the leveling pad | | ☐ | ☐ | ☐ |
| g. Factored bearing resistance from Geotechnical Report | | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 2. Have the following been shown in the Plan View? | | | | |
| a. Obstructions within reinforced or retained backfill zones, including station and offset to the back of wall panel. [due diligence is expected to avoid placing obstructions within the reinforced backfill zone] | IDM 410-5.01(07), PGR | ☐ | ☐ | ☐ |
| b. Station and offset relative to survey centerline to the back of the wall panel and all such information for turn point locations | | ☐ | ☐ | ☐ |
| c. Flow direction arrows for surface water coming from the bridge, ramp and/or road above the MSE wall and being directed away from the reinforced backfill area of the wall | | ☐ | ☐ | ☐ |
| d. Wall construction limits relative to temporary and permanent ROW | | ☐ | ☐ | ☐ |
| e. Internal wall drainage details with outlet locations | | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

| III. PLAN DETAILS (Continued) | | | | |
|---|---|---|---|---|
| QUESTION | REFERENCE | YES | NO | N/A |
| | | | | |
| 3. Have the following been shown in the Section Views? | | | | |
| a. Estimated dimensions of reinforced and retained backfill | IDM 410-5.01(07), PGR | ☐ | ☐ | ☐ |
| b. Slope of ground above the top and in front of wall | | ☐ | ☐ | ☐ |
| c. Distance between the back of the wall face and piles or pile sleeves | | ☐ | ☐ | ☐ |
| d. Undercut and soil improvement details | | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |
| 4. Have the following Special Wall Details been shown? | | | | |
| a. Architectural treatments | IDM 410-5.01(07), PGR | ☐ | ☐ | ☐ |
| b. Special facing elements where connecting to existing wall systems | | ☐ | ☐ | ☐ |
| c. Tiered walls detail in accordance with project criteria, including bench widths, aesthetics within benches, etc. | | ☐ | ☐ | ☐ |
| d. Instrumentation details | | ☐ | ☐ | ☐ |
| Place comments here. If NO or N/A is checked comments are required. | | | | |

# ABBREVIATIONS / ACRONYMS

| | |
|---|---|
| Construction Plans | Final plan set for the project as advertised, with all associated revisions. |
| EOR | Engineer of Record. Professional Engineer who stamped the construction plans |
| FHWA | Federal Highway Administration |
| Geotechnical EOR | Geotechnical engineer (in charge of the geotechnical investigation) |
| IDM | *Indiana Design Manual*<br>https://www.in.gov/indot/design_manual/design_manual_2013.htm<br>including INDOT Design Memorandum No. 17-03 available at https://www.in.gov/indot/files/17-03MSEwalls.pdf |
| LRFD | AASHTO *LRFD Bridge Design Specifications, including interims referenced on the plans.* |
| PGR | Project Geotechnical Report |
| Spec | INDOT *Standard Specifications* and any applicable special provisions (refer to contract documents for applicable spec year) |
| USP | Project specific unique special provision |