1. Design and Construct sheet pile RETAINING WALL (revised 2-3-2022)

Description. Furnish all materials, labor, equipment, and additional geotechnical investigation information necessary to design and construct steel sheet pile retaining wall(s) in accordance with these specifications and the lines, grades, and dimensions shown on the plans or otherwise established by the Engineer. Have a Montana licensed Professional Engineer oversee the retaining wall design and sign and seal the design calculations and drawings.

Preliminary dimensions given on the plans are for estimating purposes only. Produce a design for a sheet pile retaining wall system that will establish:

Top and Bottom (pile tip) elevation(s) of the retaining wall.

Type and dimensions of retaining wall materials.

Type and dimensions of any anchorage/tieback system and connection materials (if applicable).

A drainage system that will provide free drainage behind the retaining wall to prevent hydrostatic pressure buildup behind the wall.

Available Information. Available information developed by the Department or by the Department’s duly authorized representative includes the following items:

Layout Drawings prepared for the Contract. The Layout Drawings include the road plans and cross-sections for the proposed retaining wall location(s).

Boring Logs from subsurface investigation performed in the area of the retaining wall(s) are included in the Contract.

Project Geotechnical Report dated August 18, 2008.

As-built drawings depicting nearby existing structures are available upon request.

Retaining Wall Design Requirements.

Design the wall(s) in accordance with Section 11.8 (and Section 11.9 if applicable) of the most current AASHTO LRFD Specifications for Highway Bridges including current Interim Specifications.

The design life of the retaining wall is 75 years.

The design Peak Ground Acceleration (PGA) is 0.21 g.

The Layout Drawings show approximate top and base elevations. The wall base elevation(s) must be at least equal to the base elevation(s) shown in the plans. Design the walls with additional embedment below these elevations, as necessary, to meet stability requirements.

Design the wall so that the maximum deflection at the top of the wall is 2 inches or less.

Design a drainage system behind or integral to the wall to drain water from behind the wall and prevent hydrostatic pressure buildup.

Materials. Furnish steel sheet piles meeting the requirements of Subsection 106.09, ASTM A328 (at a minimum), and otherwise in accordance with the approved Contractor design.

Steel pile may be inspected at the rolling mill and will be inspected at the project. Furnish two copies of the mill test reports showing the chemical and physical test results for each steel pile heat number included in the shipment. Store and handle steel piles to prevent damage. Bent, deformed or kinked piles will be rejected.

Furnish pile quantities in accordance with the approved Contractor design. Adjust pile lengths in the Contractor design for the difference between the cut off length and the pile position in the driving equipment. Remove and dispose of excess pile length after the pile is driven.

Retaining Wall Design Submittals. Submit electronic copies (PDF format preferred) of the Design Calculations and Working Drawings to the Project Manager at least 30 calendar days prior to wall construction.

Include all details, di­men­sions, quantities, ground profiles, and cross-sections necessary to construct the wall(s).

Verify the limits of the wall(s) and ground survey data before preparing working drawings.

Design Calculations. Provide copies of the design calculations, prepared, signed and sealed by a Montana licensed Professional Engineer. Design calculations must include, but are not limited to, the following items:

Applicable code requirements and design references.

Retaining wall critical design cross-sections and geometry including:

Soil/rock strata and location.

Magnitude, and direction of design slope or external surcharge loads.

Piezometric levels.

The calculated capacity to demand ratios for construction, design flood stage, and long-term conditions.

Design parameters including soil/rock shear strengths (friction angle and cohesion), total and effective unit weights, and any other assumptions for each soil/rock strata.

Design parameters for wall material and anchorage/tieback system material properties.

Resistance Factors used for stability checks.

Design calcu­lation sheets with the following at the top of each page:

The MDT project number and UPN number.

The wall designers project/reference number.

Wall loca­tion and stationing.

Date of prepa­ration.

Initials of designer and check­er, and page num­ber

Provide an index page with the design calcula­tions.

Design notes including an explanation of any symbols and com­puter programs used in the design.

Accompany submitted computer output with supporting hand calculations detailing the calculation process.

Design calculations for wall structural properties, anchorage/tieback systems (if applicable), and connections between the anchorage/tieback systems and the wall.

Other supporting design calculations for the wall(s).

Working Draw­ings. Provide copies of the drawings designed, prepared, signed and sealed by a Montana licensed Professional Engineer. Working drawings must include, but are not limited to, the following items:

A plan view of the wall(s) identifying:

A reference baseline and elevation datum.

The offset from the con­struc­tion centerline or baseline to the face of the wall at its base and at all changes in horizontal alignment.

Beginning and end of wall stations.

The location of all known active and abandoned existing utilities, adjacent structures or other potential interferences within the limits of the wall installation.

The cen­terline of any drainage structure or drain­age pipe be­hind, passing through, adjacent to, or passing under the wall.

An elevation view of the wall(s) identifying:

The elevation at the top of the wall, at all horizontal and verti­cal break points, and at least every 15 feet along the wall.

Elevations at the wall base.

Beginning and end of wall stations.

The distance along the face of the wall to all steps in the wall base.

Wall elevation view showing the location of wall drainage elements along the wall length.

Existing and finish grade profiles both behind and in front of the wall.

Specifications for wall materials, anchorage/tieback system materials, and connection devices.

General notes for constructing the wall including construction sequencing, driving sequence and methods, and any other special construction requirements.

Horizontal and vertical curve data affecting the wall and wall control points. Include match lines or other details to relate wall stationing to centerline stationing.

A listing of the summary of quantities on the elevation drawing of each wall showing estimated square feet of wall face areas.

Retaining wall typical sections including final top and bottom elevations and wall face batter.

Details, dimensions, and schedules for all connection devices and wall and anchorage/tieback materials.

Details and dimensions for wall appurtenances such as barriers, coping, drainage gutters, fences, etc.

Details for constructing walls around drainage facilities (if applicable).

Details for connection or installation of sign posts into or on the wall.

Details for terminating walls and adjacent slope construction.

Have a Montana licensed Professional Engineer sign and seal the drawings and calculations. If the retaining wall Contractor uses a Consultant Designer, Subcontractor, or Manufacturer’s representative to prepare the design, the retaining wall Contractor still has overall contractual responsibility for both the design and the construction.

The Department will review the Contractor's submittals within 21 calendar days after receipt of a complete submission. If revisions are neces­sary, make the necessary corrections and resubmit the revised sets. After the drawings have been reviewed and found acceptable, furnish copies of the final drawings.

Do not begin wall construction or incorporate materials into the work until the submittal requirements are satisfied and found acceptable to the Department. Changes or deviations from the accepted submittals must be re-submitted and reviewed. No adjustments in contract time will be allowed due to incomplete submittals.

Revise the drawings when plan dimensions are revised due to field condi­tions or for other reasons.Within 30 days after completion of the work, submit as-built drawings to the Project Manager. Provide revised design calculations signed by a Montana licensed Professional Engineer for all design changes made during the construction of the wall.

Construction Requirements. Construct the wall according to the approved set of working drawings, the special provisions, and the appropriate sections of the Specifications.

Provide a single acting diesel impact hammer and/or vibratory driver capable of driving the sheet pile to the bottom of wall elevation shown on plans and in accordance with the approved design. Provide hammer manufacturer’s recommended pile driving aides and accessories.

Drive pile so the pile head at cutoff elevation is within 2 inches of the plan location. If a sheet pile encounters practical refusal above design tip elevation with either the vibratory or the impact hammer, drive the pile deeper with the other type of hammer.

If practical driving refusal occurs before the sheet pile achieves design tip elevation with the alternate method, the Project Manager will contact the Geotechnical Section.

The allowable alignment tolerance from a plumb line is 2 inches per 5 feet of pile length.

If a section of sheet pile comes out of interlock during driving, remove and inspect the sheet pile. If the pile is not damaged, re-drive the pile to bottom of wall elevation.

Do not reuse damaged piles.

The Project Manager may suspend driving if the either the pile location or alignment is not maintained as the pile is driven.

Within 2 working days after driving is completed, submit an electronic copy of a written plan to the Project Manager for correcting pile that do not meet the alignment or location tolerances. Laterally pulling on misaligned pile or splicing a properly aligned section on misaligned pile is not allowed.

Wall Batter. The completed wall has an overall vertical tolerance of the wall (top to bottom) not exceeding 1/2 inch per 10 feet of wall height from the batter shown on the approved set of working drawings.

Corrective Action. If any defects are found in the wall, submit proposed corrective actions and procedures to the Project Manager for evaluation.

Within 7 calendar days of determining the need for wall repairs, submit four copies of calculations and working drawings, stamped by a Montana licensed Professional Engineer, to the Project Manager for modifications to the wall caused by the remedial action.

Furnish all material and labor necessary to correct the wall at no cost to the Department.

Method of Measurement. Measure Sheet Pile Retaining Walls by the actual area in square feet calculated from the tip elevation to the cutoff elevation or ordered in writing by the Engineer.

Basis of Payment. Accepted quantities of Sheet Pile Retaining Wall will be paid for at the contract unit price per square feet. Payment is full compensation for all labor, tools, equipment and other incidentals necessary to complete the work in accordance with the specifications and as directed by the Engineer.

Pay Item Measurement Unit

Design, Construct Sheet Pile Retaining Wall Square Feet