

734-R-566 PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

(Adopted 08-20-09)

The Standard Specifications are revised as follows:

SECTION 734, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 734 - PERMANENT EARTH RETENTION SYSTEM FOR CUT-WALL APPLICATION

734.01 Description

This work shall consist of designing and constructing a permanent earth retention system utilizing a cut-wall application in accordance with 105.03. Cut-wall applications refer to a class of earth retention systems in which construction of the system is performed from the top of the wall to the base utilizing either externally- or internally-stabilized elements or a combination of both. Geotechnical Engineering Circular No. 2 – Earth Retaining Systems, Report No. FHWA-SA-96-038 provides further discussion of cut-wall applications.

MATERIALS

734.02 Materials

Materials shall be in accordance with the following:

<i>Geotextile Under Riprap</i>	<i>918.02</i>
<i>Pneumatically Placed Mortar</i>	<i>708</i>
<i>Prestressing Strand.....</i>	<i>910.01(b)7</i>
<i>Reinforcing Bars.....</i>	<i>703</i>
<i>Steel H Piles.....</i>	<i>915.02</i>
<i>Steel Pipe Piles</i>	<i>915.01</i>
<i>Steel Sheet Piling.....</i>	<i>910.21</i>
<i>Steel Welded Wire Reinforcement, Smooth and</i>	
<i>Deformed.....</i>	<i>910.01</i>
<i>Structural Concrete</i>	<i>702</i>
<i>Structural Steel</i>	<i>910.02</i>

Structure backfill material used in the work described herein shall be in accordance with 211.

Drainage pipe shall be underdrain pipe in accordance with 715.02(d).

CONSTRUCTION REQUIREMENTS

734.03 General Requirements

Excavation and embankment shall be in accordance with 203.

Welding shall be in accordance with 711.32.

734.04 Contractor Design Requirements

The permanent earth retention system utilizing a cut-wall application shall be designed by a professional engineer having experience in the design of at least 3 completed permanent earth retention systems involving cut-wall applications. The permanent earth retention system shall be designed using the procedure described in the AASHTO LRFD Bridge Design Specifications, or in the FHWA report 0-IF-03-017, Soil Nail Walls. The required partial safety factors or allowable strength factors for Service Load Design, SLD, and load and resistance factors for Load and Resistance Factor Design, LRFD, shall be in accordance with the above-referenced publications. The minimum factor of safety for SLD global stability or minimum required LRFD global stability shall be in accordance with the above-referenced publications, unless specified otherwise. Structural design of an individual wall element not addressed in the FHWA report shall be designed in accordance with the AASHTO specifications. Geometric data and design criteria including shear strength parameters and unit weights for soil and rock, corrosion protection, internal and external drainage requirements, horizontal and vertical alignment of the wall, and all known site and construction constraints, wall facing, and facing architectural requirements shall be as shown on the plans.

(a) Design Calculations

Design calculations shall include, but not be limited to:

- 1. A written summary report which describes the overall design.*
- 2. Applicable code requirements and design references.*
- 3. Design cross-section geometry including soil and rock strata and location, magnitude and direction of design slope, external surcharge loads, and piezometric levels with the most-critical slip surface shown along with the minimum calculated SLD factor of safety for global stability or minimum required LRFD global stability soil resistance to load ratio.*
- 4. Design criteria including the undrained and drained shear strength parameters and unit weights for soil and rock.*
- 5. Unit bond resistances for externally and internally stabilized elements.*
- 6. Partial safety factors and strength factors for SLD or load and resistance factors for LRFD used in the design on the pullout resistance, surcharges, unit weights of soil and rock, and all materials proposed for the system including, but not limited to shotcrete, steel and concrete.*
- 7. Seismic design acceleration coefficient.*
- 8. Design calculation sheets with the contract number, designation number, wall location and designation, date of preparation, initials of designer and checker, page number shown on each page, and an index page.*
- 9. Design notes including an explanation of all symbols and computer programs used in the design.*
- 10. Structural design calculations for all temporary and permanent facing and facing connections, including consideration of flexural and shear strength of the facing and all externally stabilized elements, tensile strength of all headed studs, upper cantilever,*

minimum reinforcement ratio, mechanical splices, welds, built-up sections, and cover and splice requirements.

(b) Working Drawings

The limits of the wall and ground survey data shall be verified before preparing the drawings. Working drawings shall include all details, dimensions, quantities, ground profiles, cross-sections necessary to construct the wall, and the following:

1. *A plan view of the wall identifying the following:*
 - a. *A reference centerline and elevation datum.*
 - b. *The offset from the construction centerline to the finished face of the wall at its base and at all changes in horizontal alignment.*
 - c. *Beginning and ending stations of the wall.*
 - d. *Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures, or other potential interferences.*
 - e. *The centerline of each drainage structure or drainage pipe behind, passing through, or passing under the wall.*
 - f. *Limit of externally and internally stabilized elements.*
 - g. *Subsurface exploratory locations with appropriate reference base lines to fix the locations of the explorations relative to the wall.*
2. *An elevation view of the wall identifying the following:*
 - a. *The elevations at the top of the wall, at all horizontal and vertical break points, and at least every 30 ft (10 m) along the wall.*
 - b. *Elevations at the base and top of the wall for casting the facing.*
 - c. *Beginning and ending stations of the wall.*
 - d. *The distance along the face of the wall to all steps in the base of the wall.*
 - e. *All externally and internally stabilized elements as well as vertical and horizontal spacing.*
 - f. *The location of drainage elements and permanent facing expansion and contraction joints along the wall length.*
 - g. *Existing and finished grade profiles, both behind and in front of the wall.*
3. *Design parameters and applicable codes.*
4. *General notes for constructing the wall including sequencing and all special construction requirements, such as dewatering, if required.*
5. *Horizontal and vertical curve data affecting the wall and control points.*
6. *Match lines or other details to relate the wall stationing to centerline stationing.*

7. *A listing of the summary of quantities on the elevation drawing of each wall showing estimated square yards (square meters) of exposed wall face areas and other pay items.*
8. *Typical sections including staged excavation elevations, wall elements, and corrosion protection details.*
9. *Typical details of production and test anchors or nails defining the orientation and dimensional relationships of the unbonded and bonded lengths.*
10. *Details, dimensions, and schedules for all externally and internally stabilized elements, reinforcing bars, steel welded wire reinforcement, bearing plates, headed studs, and attachment devices for pneumatically placed mortar, cast-in-place, or prefabricated facings.*
11. *Details and dimensions for appurtenances such as barriers, coping, drainage gutters, and fences.*
12. *Details for constructing the wall around drainage facilities.*
13. *Details for terminating the wall and adjacent slope construction.*
14. *Facing finishes, color and architectural treatment requirements for permanent facing elements.*

(c) Submittals

The Contractor shall submit design calculations and working drawings as described herein and in accordance with 105.02. The calculations and drawings shall be signed and sealed by a professional engineer.

At least 30 calendar days before the start of the wall construction, the Contractor shall submit a quality control plan, QCP, for approval. The QCP shall include, but not be limited to, personnel qualifications, wall construction procedures and sequencing, a verification testing program, and a performance monitoring program. No work shall begin until written notice has been received from the Engineer that the QCP has been accepted.

1. Personnel Qualifications

The field superintendent or field foreman shall have supervised the construction of a minimum of 3 completed walls of the same type as that submitted by the Contractor.

2. Verification Testing Program

The program shall include a verification testing program of all production and test anchors and nails. The program shall identify the test locations, the type of test, i.e., proof, performance, or pullout, testing procedures, acceptance criteria, and load and measuring devices to be used.

3. Performance Monitoring Program

The program shall identify points of monitoring interest, in accordance with Geotechnical Engineering Circular No. 2 – Earth Retaining Systems, Report No. FHWA-SA-96-038, and the frequency of monitoring during and following construction of the wall. The program shall also include a baseline survey for points of monitoring interest.

During construction, the Contractor shall immediately notify the Engineer if signs of ground movement in the vicinity of the wall, increased size of old cracks or separation of joints in structures, foundations, streets, or paved and unpaved surfaces are observed. The Contractor shall monitor the performance of the wall and movements of buildings, roads, or other facilities within a distance of three times the excavation depth for the wall. If the Engineer determines that the movements exceed those anticipated for construction, the Contractor shall take corrective actions necessary to arrest the movement or perform repairs.

Within 30 days after completion of the work, as-built drawings shall be submitted to the Engineer. Revised design calculations signed by the professional engineer shall be provided for all design changes made during the construction of the permanent earth retention system.

734.05 Performance Requirements

Performance monitoring by the Contractor shall be done during construction and for a period of one year following acceptance of the contract. The Contractor shall post a warranty bond for the performance monitoring that takes place after the contract is accepted. The Contractor shall make evaluations of the test and monitoring data and performance of the wall at the frequency defined in the approved performance monitoring program. The Contractor, if necessary during the monitoring period or as directed, shall immediately take steps to correct deficiencies in the capacities of individual elements or other corrective measures which may be required to prevent damage or excessive movement of the wall and adjacent facilities. The Contractor shall submit all test and monitoring data to the Engineer on a weekly basis or as otherwise directed.

734.06 Method of Measurement

Cut wall will be measured by the square yard (square meter) of exposed face area of wall above finished grade.

734.07 Basis of Payment

The accepted quantities of cut wall will be paid for at the contract unit price per square yard (square meter) for cut wall.

Payment will be made under:

Cut-Wall, No. ____SYS (m2)

The costs of all professional services, labor, excavation, structure backfill, equipment, materials, tests, QCP, and incidentals necessary to design, construct, and monitor the wall including all drainage required by the wall design and all temporary construction facing or permanent facing, if applicable, and correction required by the wall design of deficiencies which may be required to prevent damage or excessive movement of the wall shall be included in the cost of this work. No additional payment will be made for the costs of providing and performing corrective actions.