

SPECIAL PROVISIONS

MODIFYING

SECTION 506: MECHANICALLY STABILIZED EARTH RETAINING STRUCTURES

The 2014 Edition of the New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction shall apply in addition to the following:

Delete **Section 506: MECHANICALLY STABILIZED EARTH RETAINING STRUCTURES** in its entirety and replace with the following:

506.1 DESCRIPTION

This Work consists of designing, furnishing all materials, and constructing mechanically stabilized earth (MSE) retaining structures in accordance with these specifications and in compliance with the lines and grades, dimensions and details shown in the Contract.

506.2 MATERIALS

506.2.1 Precast Concrete Elements

Provide precast concrete panel elements conforming to Section 517, "Precast Concrete Structures." Provide Class AA concrete. The concrete mix design shall be prepared in accordance with Section 509 "Portland Cement Concrete Mix Design" and approved by the State Materials Bureau.

506.2.1.1 Casting

For precast concrete face panels, place the panel forms on a horizontal surface with the front face of the panel at the bottom of the form. Set connection hardware in the rear face. Place the concrete in each precast concrete panel form without interruption and consolidate it with an approved vibrator and hand tamping to force the concrete into the corner of the forms and eliminate the formation of stone pockets or cleavage planes. Use clear form oil throughout the casting operation.

506.2.1.2 Finish

506.2.1.2.1 Non-exposed Surfaces

Screed the rear faces of precast concrete panels to create a uniform surface texture that is free of open pockets of aggregates and surface distortions greater than 3/16 inch. Apply a Class I finish, per Section 511 "Concrete Structures," to other non-exposed surfaces.

506.2.1.2.2 Exposed Surfaces

Provide the type of finish on the exposed surface per the Contract. If the Contract requires an exposed aggregate finish, produce as follows:

1. Before placing concrete, apply a set retarder to the casting forms in accordance with the manufacturer's instructions;
2. After removing the forms and after the concrete has set sufficiently to prevent dislodging, expose the aggregate with a combination of brushing and washing (using clean water) to a depth of between 3/8 inch and 1/2 inch; and
3. Apply an acrylic resin sealer, consisting of 80% thinner and 20% acrylic solids by weight, to the exposed aggregate surface at a rate of one (1) gal per 250 ft².

506.2.1.3 Tolerances

Manufacture the precast concrete elements in accordance with the following tolerances:

1. Dimensions within precast concrete panels, ± 0.2 inch;
2. Surface defects:
 - 2.1. Smooth formed surfaces not greater than $\pm 3/16$ inch within five (5) feet;
 - 2.2. Textured-finish surfaces not greater than $\pm 5/16$ inch within five (5) feet.
3. Differences in diagonal lengths not greater than 1/2 inch.

506.2.1.4 Identification and Markings

Inscribe the manufacture date, the production lot number, and the piece mark on a non-exposed surface of each element.

506.2.1.5 Handling, Storage, and Shipping

Handle, store, and ship units in a manner that eliminates damage and discoloration.

506.2.1.6 Compressive Strength

Do not ship or place elements in the wall until the design strength is reached. Cast wall panels on a flat area and fully support them until the concrete reaches a minimum compressive strength of 1,500 psi as determined by the Maturity Method detailed in Section 510.3.5.2, "In-Place Concrete Strength Measurements." Unless otherwise specified by the wall manufacturer, do not handle the elements until they reach a compressive strength of 1,500 psi.

506.2.1.7 Rejection

The following defects are sufficient cause for rejection:

1. Connection defects and out-of-tolerance connection imbeds/inserts;
2. Defects indicating imperfect molding;
3. Defects indicating honeycombing or open texture concrete;

4. Cracked or severely chipped panels;
5. Color variation on front face of panel due to excess form oil or other reason; and
6. Presence of oil on panels.

506.2.6 Reinforcing Steel

Provide reinforcing steel in accordance with Section 540, "Steel Reinforcement."

506.2.7 Soil Reinforcement

Provide galvanized steel, geosynthetics soil reinforcement will not be allowed. Provide galvanized steel connection hardware in accordance with AASHTO M 111. Support the soil reinforcement while lifting and placing so that the galvanization remains intact and does not crack.

506.2.7.1 Steel Reinforcing Strips

Hot roll reinforcing strips from bars to the required shape and dimensions. Provide reinforcing strips with physical and mechanical properties in accordance with AASHTO M 223M, Grade 65, or equivalent. Provide shop-fabricated tie strips of hot rolled steel in accordance with ASTM A 1011, Grade 50, or equivalent. The minimum bending radius of the tie strips is one (1) inch. Apply galvanization after strip fabrication.

506.2.7.2 Steel Reinforcing Bar Mats

Provide reinforcing bar mats of cold-drawn steel wire in accordance with AASHTO M 32 and weld the mats into the finished mesh fabric in accordance with AASHTO M 55. Form mesh button heads so that variations between the longest and shortest wire in any mesh is less than one (1) inch. Apply galvanization after mesh fabrication. Provide a 1-inch coil embed of cold drawn steel wire in accordance with AISI C 1035.

506.2.8 Connector Pins

Provide connector pins and mat bars from A-36 steel and weld to the soil reinforcement mats. Provide connector bars of cold drawn steel wire in accordance with AASHTO M 32.

506.2.9 Precast Concrete Panel Fasteners

Provide fasteners in accordance with the Contract or the approved Working Drawings. Cast fasteners in the precast concrete panels so that the fasteners are in alignment and will result in fasteners transferring a full and even load to the steel grid or steel strap reinforcement. The tolerance between the fastener and the steel reinforcement grid or steel straps for field installation is 3/16 in. Provide galvanized steel fasteners in accordance with AASHTO M 164.

506.2.10 Precast Concrete Panel Joints

Where walls wrap around a corner, provide a corner block panel with flange extensions that will allow differential movement without exposing the panel joints. Provide joint filler, bearing pads, and filter fabric in accordance with the wall manufacturer's recommendations and the approved Working Drawings.

If required, provide flexible foam strips for filler in vertical joints between panels, and in horizontal joints where pads are used, in accordance with the Plans.

Provide the following for horizontal joints between panels:

1. Pre-formed Ethylene Propylene Diene Monomer (EPDM) rubber pads in accordance with ASTM D 2000 for 4AA, 812 rubbers;
2. Neoprene elastomeric pads having a Durometer Hardness (ASTM D 2240) of 55 ± 5 ; or
3. High-density polyethylene pads with a minimum density of 60 lb per cubic foot in accordance with ASTM D 1505.

Cover the joints between panels on the backside of the wall with a geotextile meeting the requirements for filtration applications in accordance with Section 604.2.4 Separator Geotextile, Class 3. Provide a minimum lap width of one (1) ft.

506.2.11 Reinforced Soil Backfill Material

Provide backfill that is free of shale, organic matter, and other soft particles of poor durability. Provide backfill with a soundness loss of 30 or less if tested in accordance with AASHTO T 104 using a magnesium sulfate solution with a test duration of four (4) cycles. Determine gradations in accordance with AASHTO T 27 and Table 506.2.11:1, "Backfill Gradation Requirements," unless otherwise specified.

**Table 506.2.11:1
Backfill Gradation Requirements**

Sieve size	% passing
Four (4) inch	100
No. 40	0–60
No. 200	0–15

Provide backfill with a PI, no greater than 6 in accordance with AASHTO T 90.

The Department defines "rock backfill" as the Material that is composed primarily of rock fragments (Material having less than 15% passing a 1/2 inch sieve and no more than five percent (5%) passing a No. 4 sieve). If using "rock backfill," place a separator geotextile over the top of the backfill Material before placing the top two (2) ft of backfill. Also place a separator geotextile between the rock backfill and the random fill as the reinforced soil backfill is placed. Provide a separator geotextile in accordance with the minimum requirements for filtration applications in AASHTO M 288 and Section 604, "Soil and Drainage Geotextiles." Ensure the upper two (2) ft of backfill does not contain stones larger than three (3) inches at their greatest dimension and is free of rock backfill.

506.2.11.1 Internal Friction Angle Requirement

Provide backfill that exhibits a minimum angle of internal friction of at least 34° in accordance with AASHTO T 236 unless otherwise specified in the Contract. Run the test on the backfill Material passing the No. 10 sieve. Compact the sample in accordance with Section 506.3.5.1, "Compaction," at optimum moisture content, to 95% of maximum density. The Department will not require direct shear testing for backfills when the gradation is less than 20% passing a 3/4 inch sieve.

506.2.11.2 Electrochemical Requirements

Provide backfill in accordance with Table 506.2.11.2:1, "Electrochemical Requirements," when using steel soil reinforcement.

Table 506.2.11.2:1
Electrochemical Requirements for Steel Reinforcement

Characteristic	Requirement	Test method
pH	5–10	AASHTO T 289
Resistivity	>2,500 ohm/cm	AASHTO T 288
Chlorides	<100 ppm	AASHTO T 291
Sulfates	<200 ppm	AASHTO T 290
Organic content	<one percent (1%)	AASHTO T 267

The Department will not require electrochemical testing for backfills when the gradation is less than 20% passing a 3/4 inch sieve and less than five percent (5%) passing the No. 200 sieve. Recycled concrete aggregate is not allowed.

506.2.12 Cast-in-Place Concrete

Provide cast-in-place concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs," Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures." Unless otherwise approved, use Class A concrete for cast-in-place concrete.

506.2.13 Submittals

Ensure a New Mexico registered Engineer signs and seals Working Drawings and design calculations.

506.2.13.1 Working Drawings

Submit Working Drawings to the State Bridge Engineer for review and approval at least 40 Days before beginning Work on MSE retaining structures. Submit three (3) complete sets of half-size prints for preliminary review. The State Bridge Engineer will return one (1) set of prints to the Contractor with notations. Make necessary corrections and submit eight (8) sets of prints for final review, approval and distribution. Do not begin fabrication or erection before receiving written notification that the drawings are approved. Working Drawings shall include the following:

1. Layout of the wall including plan and elevation views;
2. Existing ground elevations field verified by the Contractor for each location that will involve wall construction wholly, or in part, on natural ground;
3. Complete details of elements and component parts required for the proper construction of the system;
4. A complete listing of Materials Specifications;
5. Earthwork requirements, including Specifications for Material and compaction; and
6. Other information required by the Contract or requested by the State Bridge Engineer.

Approval of the final Working Drawings covers the requirements for strength and detail, and the Department assumes no responsibility for errors or omissions in the Working Drawings. Provide three (3) sets of the manufacturer's written erection instructions with the final Working Drawings submittal.

506.2.13.2 Design Calculations

Along with the Working Drawing submittals, submit complete design calculations, including those required to establish service life, to the State Geotechnical Engineer for approval. Ensure the calculations confirm that the proposed design satisfies the design parameters in accordance with the Contract and:

1. FHWA NHI-10-024 Vol I and NHI-10-025 Vol II, "Design of MSE Walls and Reinforced Slopes," (Berg et al., 2009).
2. 2014,"AASHTO LRFD Bridge Design Specifications," 7th Edition (and latest interims)

Provide structures meeting the requirements of Table 506.2.13.2:1 "Design Parameters", unless otherwise specified in the contract.

**Table 506.2.13.2:1
Design Parameters**

Description	Value
Resistance factors	
Sliding	Strength (all)
^b Bearing	Strength (all)
^b Deep Seated Stability	Service I
^b Compound Stability	Service I
Pullout resistance	Section 11
Static	Strength (all)
Combined static/earthquake	Strength (all)
Tensile resistance of metallic reinforcements and connectors	
Static	
Strip and Grid reinforcement	Strength (all)
Combined static/earthquake	
Strip and Grid reinforcement	Strength (all)
Service life	75 years
Service life (supporting structure loads)	100 years
Soil unit weight (retained)	120 lb/ft ³
Soil unit weight (reinforced)	125 lb/ft ³
Friction angle (retained soil)	30°
Friction angle (reinforced soil)	34°
Coefficient of sliding friction	a
Factored bearing resistance	a
Minimum soil reinforcement embedment depth	a

^a In accordance with the Contract.

^b Global Stability Responsibility of NMDOT

506.2.13.3 Certificates of Compliance

Provide the Project Manager with a Certificate of Compliance for the Material (excluding backfill and concrete) that certifies that the Material is in accordance with the Contract and the approved Working

506.2.13.4 Exposed Surface Finish Panel Sample

If the Contract requires an exposed aggregate or other architectural finish, deliver a 36 inch × 36 inch panel, finished as specified, to the Project Manager for approval by the Landscape Architect.

506.3 CONSTRUCTION REQUIREMENTS

506.3.1 Excavation

Conduct wall construction excavation as unclassified excavation in accordance with Section 203, "Excavation, Borrow, and Embankment."

506.3.2 Foundation Preparation

Grade the foundation for the structural volume level for the entire area of the base of the Structure plus 12 inches on all sides, or as shown in the Contract. Before wall construction, break up the original ground surface to at least 6 inches by plowing or scarifying. Compact this area to 95% of maximum density in accordance with Section 203.3.8, "Moisture and Density Control."

Remove unacceptable foundation material, replace with suitable Material, and compact in accordance with Section 203.3.7, "Unstable Subgrade Stabilization", unless otherwise approved by the State Geotechnical Engineer.

506.3.3 Concrete Leveling Pad

Provide a leveling pad in accordance with the approved Working Drawings. Cure the pads at least 12 hours before placement of wall panels.

506.3.4 Wall Erection

Erect walls in accordance with the manufacturer's written instructions. Ensure that a field representative from the manufacturer is available during the erection of the first ten percent (10%) of the wall (and as directed by the Project Manager) to assist the Fabricator, Contractor, and Project Manager. Place panels so that their final position is vertical or battered in accordance with the Contract. Sequence the placement of panels in successive horizontal lifts during backfill placement in accordance with the Working Drawings.

506.3.4.1 Placement Tolerances for Precast Elements

When placing backfill Material, maintain precast elements in the specified vertical alignment with temporary wedges or bracing as recommended by the manufacturer. Ensure that vertical and horizontal alignment tolerances do not exceed 0.75 inch if measured with a ten (10) foot straightedge. Ensure that the overall horizontal tolerance (plumbness) of the vertical wall does not exceed 0.5 inch per ten (10) feet. Ensure that the offset at any panel joint does not exceed 0.4 inch.

506.3.4.3 Placement of Reinforcement Elements

Place the reinforcement elements normal to the face of the wall, unless otherwise shown on the Plans. Ensure that the reinforcement bears uniformly on the compacted reinforced soil from the connection to the wall to the end of the reinforcing elements. Do not cut the reinforcement elements to accommodate obstructions within the reinforced soil zone. Do not weld soil reinforcements (shop or field welds) to extend lengths of longitudinal reinforcements. The Department will allow approved shop welds at the connections and approved spot-welds at the transverse and longitudinal intersections of bar mats.

506.3.5 Backfill Placement

Perform backfill placement immediately after erecting each level of wall panels. Place backfill carefully to avoid damage or disturbance of the wall Materials, misalignment of wall panels, or damage to soil reinforcement. Replace wall Materials damaged during backfill placement at no additional cost to the Department. If backfill placement causes misalignment or distortion of wall panels, correct at no additional cost to the Department.

506.3.5.1 Compaction

Compact backfill in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), Note 7, to 95% of the maximum density, except as modified in accordance with Section 506.3.5.1.2, "Compaction Against Faces of Walls."

506.3.5.1.2 Compaction Against Faces of Walls

Compact the backfill to 90% density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), within 3 ft of the wall. Compact with a minimal number of passes using a lightweight mechanical tamper, roller, or vibratory system. Determine the number of passes with a test section before compaction against the wall, as approved by the Project Manager. Use approved compaction Equipment from the test section for production Work. If changing Equipment, create a new test section to determine the number of passes for the Project Manager's approval.

506.3.5.2 Moisture Control

Uniformly distribute the moisture content of the backfill Material throughout each layer before and during compaction. Ensure that backfill Materials have an in-place moisture content of three percent (3%) less than optimum to optimum. Remove backfill Material with in-place moisture content greater than optimum and rework, or replace with acceptable backfill Material.

506.3.5.3 Lift Thickness

Ensure that the maximum lift thickness after compaction does not exceed eight (8) inches. Decrease the lift thickness, if necessary, to obtain the specified density.

506.3.5.4 Protection of the Work

At the end of each Day's operation, slope the last level of backfill away from the wall to direct runoff away from the Structure. Do not allow surface runoff from adjacent areas to enter the wall construction site.

506.4 METHOD OF MEASUREMENT

The Department will measure the face of MSE Walls based on the dimensions shown in the Contract or approved modifications.

The Department will measure authorized *Excavation of Unsuitable Foundation Material* from the foundation surface to the depth of excavation in its original location. The Department will not measure material excavated outside the area bounded by vertical planes two (2) feet beyond the limits of the material designated for removal.

506.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>MSE Wall</i>	<i>Square Foot</i>
<i>Excavation of Unsuitable Foundation Material</i>	Cubic Yard

506.5.1 Work Included In Payment

The Department will consider the following Work as included in the payment for *MSE Walls* and will not pay for it separately:

1. Excavation for MSE retaining Structures other than authorized excavation of unsuitable foundation material, and including any required temporary shoring;
2. Placement and compaction of suitable Material for excavation of unsuitable foundation material;
3. Dewatering for excavation of MSE Retaining Wall or authorized unsuitable foundation Materials;
4. Leveling pads, facing elements, reinforcing bars, soil reinforcements, attachment devices, backfill, coping, drainage elements, foundation preparation, and geotextile fabric; and
5. Providing the manufacturer's field representative.