

## SECTION 506: PROPRIETARY EARTH RETAINING STRUCTURES

### 506.1 DESCRIPTION

This Work consists of designing, furnishing all materials and constructing Proprietary Earth Retaining (PER) Wall Systems in accordance with these specifications and in compliance with the lines and grades, dimensions and details shown on the Plans. PER Wall Systems may be either:

- Precast Gravity, Semi-gravity, Bin and Crib Retaining Wall Systems
- Gravity Block Retaining Walls
- Mechanically Stabilized Earth (MSE) Panel Walls and MSE Modular Block (Block) Walls.

Only those PER Wall Systems placed on the current NMDOT Proprietary Earth Retaining List of Approved Systems (PER-LAS) may be submitted. Unless otherwise specified in the Contract, any of the PER Wall Systems on the NMDOT PER-LAS may be submitted. When a particular PER Wall is specified in the Contract, (such as Gravity Block Walls or MSE Block Walls), other PER Systems may not be submitted. Precast Gravity, Semi-gravity, Bin and Crib, Gravity Block and MSE Block Walls may not be submitted to support Bridge Foundation loads. Other PER Wall Systems on the NMDOT PER-LAS may have restrictions for submission and those restrictions apply to the Contract.

External stability requirements of Engineered Retaining Wall Systems are the responsibility of the Department.

### 506.2 MATERIALS

#### 506.2.1 Precast Concrete Elements

The Contractor shall provide precast concrete block or panel elements conforming to Section 517, "Precast Concrete Structures." Provide Class AA concrete. The concrete mix design shall be prepared and approved in accordance with Section 509 "Portland Cement Concrete Mix Design".

##### 506.2.1.1 Casting

For precast concrete face panels, the Contractor shall 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.

For concrete block and panels, the Contractor shall place the concrete in each precast concrete block or 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

The Contractor shall 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

The Contractor shall 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 ft<sup>2</sup>.

#### 506.2.1.3 Tolerances

The Contractor shall manufacture the precast concrete elements in accordance with the following tolerances:

1. Dimensions within precast concrete blocks or panels,  $\pm 0.2$  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

The Contractor shall 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

The Contractor shall handle, store, and ship units in a manner that eliminates damage and discoloration.

### 506.2.1.6 Compressive Strength

The Contractor shall 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 1,000 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 1,000 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.

### 506.2.2 Modular Dry Cast Concrete Block Elements

The Contractor shall provide dry-cast hollow and solid concrete masonry structural retaining wall units, machine made from Portland cement, water, and suitable mineral aggregates.

#### 506.2.2.1 Casting

Cementitious material in the modular block wall unit shall be Portland cement conforming to the requirements of ASTM C 150. Fly ash shall not exceed 20% by weight of the total cement content and shall conform to ASTM C 618. Aggregates used in concrete blocks shall conform to ASTM C 33 for normal weight concrete aggregate. Efflorescence control agent shall be used in concrete mix design to prevent efflorescence on the block.

The Contractor shall advise the Project Manager of the starting date for concrete modular block wall units casting at least 14 calendar days prior to beginning the operation.

#### 506.2.2.2 Finish

Units that indicate imperfect molding, honeycomb or open texture concrete and color variation on front face of block due to excess form oil or other reasons shall be rejected. All units shall be visually efflorescence free. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. Minor cracks (e.g. no greater than 0.02 inch in width and no longer than 25% of the unit height) incidental to the usual method of manufacture or minor chipping resulting from shipment and delivery, are not grounds for rejection.

The exposed faces shall be free of chips, cracks or other imperfections when viewed from a distance of 30 feet. Up to five (5) percent of a shipment may contain slight cracks or small chips not larger than 1.0 inch.

Color and finish shall be as shown on the plans and shall be erected with a running bond configuration.

#### 506.2.2.3 Tolerances

The Contractor shall manufacture the modular blocks in accordance with the following tolerances:

1. The length and width of each individual block shall be within  $\pm 1/8$  inch of the specified dimension. Hollow units shall have a minimum wall thickness of 1 1/4 inches.
2. The height of each individual block shall be within  $\pm 1/16$  inch of the specified dimension.
3. When a broken (split) face finish is required, the dimension of the front face shall be within  $\pm 1/10$  inch of the theoretical dimension of the unit

#### 506.2.2.4 Identification and Markings

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

#### 506.2.2.5 Handling, Storage, and Shipping

The Contractor shall handle, store, and ship units in a manner that eliminates damage and discoloration.

#### 506.2.2.6 Compressive Strength

Modular block wall units shall conform to the following physical requirements:

1. Minimum required compressive strength of 4000 psi (average 3 coupons)
2. Minimum required compressive strength of 3500 psi (individual coupons)
3. Minimum oven dry unit weight of 125 pcf
4. Maximum water absorption of 5% after 24 hours
5. Maximum number of blocks per lot of 2,000. Tests on blocks shall be submitted at the frequency of one set per lot.

#### 506.2.2.7 Durability

In areas where repeated freezing and thawing under saturated conditions occur as designated in the Plans, the Contractor shall test the units to demonstrate freeze-thaw durability in accordance with Test Method ASTM C 1262. Freeze-thaw durability shall be based on tests from five specimens made with the same materials, concrete mix design, manufacturing process, and curing method, conducted not more than 18 months prior to delivery. Specimens used for absorption testing shall not subsequently be used for freeze-thaw testing. Specimens shall comply with either or both of the following acceptance criteria depending on the severity of the project location as determined by the Department:

1. The weight loss of four out of five specimens at the conclusion of 150 cycles shall not exceed 1% of its initial weight when tested in water.
2. The weight loss of each of four out of the five test specimens at the conclusion of 50 cycles shall not exceed 1.5% of its initial mass when tested in a saline (3% sodium chloride by weight) solution.

#### 506.2.2.8 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 units;
5. Color variation on front face of units; and
6. Presence of oil on units.

#### 506.2.3 Modular Block Cap Units and Adhesive

The cap unit connection to the block unit immediately under it shall be of a positive interlocking type and not frictional. Cap units shall be cast to or attached to the top of modular block facing units in strict accordance with the requirements of the manufacturer of the blocks and adhesive. The surface of the block units under the cap units shall be clear of all debris and standing water before the approved adhesive is placed.

#### 506.2.4 Modular Block Unit Core Fill

Unit core fill is defined as free-draining, coarse grained material that is placed within the empty cores of the hollow modular block wall units. Unit core fill shall be a well graded crushed stone or granular fill meeting the gradation shown in Table 506.2.4:1 "Block Core Fill Requirements". The Contractor shall perform gradation tests for unit fill at the job site and for every change in the material source Per ASTM C 33.

**Table 506.2.4:1  
Block Core Fill Requirements**

Sieve size	% passing
1 ½ inch	100
1 inch	95–100
¾ inch	60–95
½ inch	25–60
No. 4	0–10
No. 8	0–5

### 506.2.5 Modular Block Gravel Fill

The Contractor shall provide a minimum width of 1-ft of gravel fill provided behind solid (non-hollow) modular block units. A minimum volume of 1-ft<sup>3</sup>/ft<sup>2</sup> of drainage fill shall be provided. Gravel fill shall meet the requirements of the unit core fill. A suitable geotextile fabric placed between the gravel fill and reinforced wall fill shall be used to meet the filtration requirements if the gravel fill does not meet the filtration criteria. The selection of a suitable geotextile for filtration purposes shall be supported by design computations taking into account the actual gradations of the gravel fill and the reinforced wall fill to be used on the project. Gradation for gravel fill shall be tested at the frequency of 1 test per 300 CY at the job site and for every change in the material source.

### 506.2.6 Reinforcing Steel

The Contractor shall provide reinforcing steel in accordance with Section 540, "Steel Reinforcement."

### 506.2.7 Soil Reinforcement

The Contractor shall provide galvanized steel or geosynthetic geogrids extruded from a continuous sheet for soil reinforcement. 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

The Contractor shall provide 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

The Contractor shall 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.

#### 506.2.7.3 Geosynthetic Soil Reinforcing Elements

Geosynthetic soil reinforcement shall be limited to approved geogrids of High Density Polyethylene (HDPE), Polyester (PET) or Polypropylene (PP). Provide PET geogrids with Polyvinyl Chloride (PVC) coating. Use only geogrids as placed on the current NMDOT Geogrid Soil Reinforcement List of Approved Systems (GSR-LAP). The long term available strength ( $T_{a1}$ ) of the geogrid shall be the ultimate tensile strength  $T_{ult}$  divided by a combined strength reduction factor (RF). RF is the product of the reduction factor for installation damage based on ASTM D5818 ( $RF_{ID}$ ), the creep reduction factor based on ASTM D6992 ( $RF_{CR}$ ), and the durability reduction factor. ( $RF_D$ ). Use strength reduction factors as shown in the NMDOT

GSR-LAP for the submitted geogrid reinforcement.

## 506.2.8 Connector Pins

### 506.2.8.1 Precast Concrete Panel Connector Pins

The Contractor shall 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.

### 506.2.8.2 Modular Block Connector Pins

The Contractor shall provide connector pins of a non-degrading polymer or hot-dipped galvanized steel made for the express use with the modular block units supplied. Connecting pins shall be capable of holding the geogrid in the proper design position during backfilling.

## 506.2.9 Precast Concrete Panel Fasteners

The Contractor shall 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 geogrid, 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. The tolerance for the location of the geogrid tab in the rear face of the precast facing panel is 1" vertical and/or horizontal from the location indicated on the approved panel shop drawings.

## 506.2.10 Precast Concrete Panel Joints

Where walls wrap around a corner, the Contractor shall 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  $55 \pm 5$ ; or
3. High-density polyethylene pads with a minimum density of 60 lb per cubic foot in accordance with ASTM D 1505.

The Contractor shall 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 or Gravity Wall Backfill Material

The Contractor shall 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**

<b>Sieve size</b>	<b>% passing</b>
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 very high survivability separator geotextile meeting the minimum requirements for filtration applications specified in AASHTO M 288 and Section 604 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 very high survivability 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 an 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 and Table 506.2.11.2:2 "Electrochemical Requirements" when using geosynthetic 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.

**Table 506.2.11.2:2**  
**Electrochemical Requirements for Geosynthetic Reinforcement**

Characteristic	Requirement	Test method
pH	3<pH<9	AASHTO T 289

### 506.2.12 Cast-in-Place Concrete

The Contractor shall 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

The Contractor shall 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 PER Walls. 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.

#### **506.2.13.1.1 Soil Reinforcement for MSE Block Wall Systems**

Use mechanical soil reinforcement connection (pins or slotted); no friction connections will be accepted.

The vertical spacing of the soil reinforcement for walls with modular block facing units shall be as follows:

1. The first (bottom) layer of soil reinforcement shall be no further than 16 inches above the top of the leveling pad.
2. The last (top) layer of soil reinforcement shall be no further than 20 inches on the average below the top of the uppermost block unit.
3. The maximum vertical spacing between layers of adjacent soil reinforcement shall not exceed 24 inches.
4. The top row of reinforcement should be one-half the vertical spacing.

#### **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. Utilize MSEW computer software; MSEW latest version and updates, manufactured by ADAMA Engineering, Inc. for design calculations. For geosynthetic soil reinforcement, use MSEW input parameters consistent with the NMDOT GSR-LAP design values. 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)
<sup>b</sup> Bearing	Strength (all)
<sup>b</sup> Deep Seated Stability	Service I
<sup>b</sup> Compound Stability	Service I
Pullout resistance	
Static	Strength (all)
Combined static/earthquake	Strength (all)
Tensile resistance of metallic reinforcements and connectors	2014, "AASHTO LRFD Bridge Design Specifications," 7th Edition (and latest interims) Section 11
Static	
Strip and Grid reinforcement	Strength (all)
Combined static/earthquake	
Strip and Grid reinforcement	Strength (all)
Tensile resistance of geosynthetic reinforcements and connectors	
Static	Strength (all)
Combined static/earthquake	Strength (all)
Service life	75 years
Service life (supporting structure loads)	100 years
Soil unit weight (retained )	120 lb/ft <sup>3</sup>
Soil unit weight (reinforced)	125 lb/ft <sup>3</sup>
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

<sup>a</sup> In accordance with the Contract.

<sup>b</sup> 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 Drawings; including the following certifications:

1. *Certification of  $T_{ULT}$  (MARV) or Ultimate Tensile Strength.* For geosynthetic reinforced systems only, the Contractor shall submit a certification letter from the manufacturer which provides the  $T_{ULT}$  (MARV) and certifies that the  $T_{ULT}$  (MARV) of the supplied materials have been determined in accordance with ASTM D6637 as appropriate. For metallic wall reinforcement, a mill test report containing the ultimate tensile strength for the soil reinforcement shall be included in the certification.
2. *Mill Report for Metallic Reinforcements and Connectors.* This includes mill certifications on ultimate tensile and yield strength.
3. *Report and Certification for Concrete Block 28-Day Compressive Strength and Water Absorption Rate.* Acceptance of the concrete block, with respect to compressive strength, water absorption and unit weight, will be determined on a lot basis. The lot shall be randomly sampled and tested in accordance with ASTM C140. At no additional expense to the Department, the manufacturer shall perform the tests at an approved laboratory and submit the results to the Project Manager for approval. Compressive strength test specimens shall be cored or shall conform to the saw-cut coupon provisions of ASTM C 140.
4. *Certification of Freeze Thaw Test.* An independent laboratory shall provide certifications in accordance with ASTM C1262 using tap water or 3 percent saline solution and ASTM C1372 as appropriate.

### 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 in 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 or blocks so that their final position is vertical or battered in accordance with the Contract. Sequence the placement of panels or blocks 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) ft straightedge. Ensure that the overall horizontal tolerance (plumbness) of the vertical wall does not exceed 0.5 inch per ten (10) ft. Ensure that the offset at any panel joint does not exceed 0.4 inch.

#### 506.3.4.2 Placement Tolerances for Block Units

Erection of walls with Block Units shall be as per the following requirements:

1. Vertical and horizontal alignment of the wall face shall not vary by more than 3/4-inch when measured along a 10-foot straightedge.
2. Overall vertical tolerance (plumbness) of the wall shall not exceed 1¼-inch per 10-ft of wall height from the final wall batter. Negative (outward leaning) batter is not acceptable.
3. The first row of units shall be level from unit-to-unit and from front-to-back. Use the tail of the units for alignment and measurement.
4. All units shall be laid snugly together and parallel to the straight or curved line of the wall face.
5. Unless otherwise noted, all blocks shall be dry-stacked and placed with each block evenly spanning the joint in the row below (running bond). Shimming or grinding shall control the elevations of any two adjacent blocks within 1/16 inch.
6. The top of blocks shall be checked with a minimum length of 3-foot long straight edge bubble level. Any high points identified by the straight edge shall be ground flat. Block front to back tilting shall be checked frequently, however correction by shimming shall be done no later than 3 completed courses.

Wall sections not conforming to these tolerances shall be reconstructed at no additional cost to the Department.

#### **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.

Tension geosynthetic reinforcing elements by approved methods to remove slack from the geosynthetic prior to placing backfill. Insure geosynthetic reinforcing is placed so that the strongest direction is perpendicular to the wall facing. A minimum backfill layer of 6 inches of soil shall be placed on the geosynthetic prior to operating any vehicle or compaction equipment over the geosynthetic.

#### **506.3.5 Backfill Placement**

Perform backfill placement immediately after erecting each level of wall panels or blocks. Place backfill carefully to avoid damage or disturbance of the wall Materials, misalignment of wall panels/blocks, 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/blocks, correct at no additional cost to the Department.

The backfill shall not be advanced more than the height of a modular block unit until the drainage fill, core fill and all fill in all openings within the blocks at that level have been placed. The filled units shall be swept clean of all debris before installing the next level of units and/or placing the geosynthetic materials.

##### **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 Proprietary *Earth Retaining 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) ft beyond the limits of the material designated for removal.

**506.5 BASIS OF PAYMENT**

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

**506.5.1 Work Included In Payment**

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

1. Excavation for Proprietary Earth Retaining Walls 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. Testing;
4. Dewatering for excavation of Proprietary Earth Retaining Wall or authorized unsuitable foundation Materials;
5. Leveling pads, facing elements, reinforcing bars, soil reinforcements, attachment devices, backfill, coping, drainage elements, foundation preparation, and geotextile fabric; and
6. Providing the manufacturer's field representative.