STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0016

Paul R. LePage
GOVERNOR

David Bernhardt
COMMISSIONER

April 11, 2011
Subject: **Jefferson**
Federal Project No: BR-1708(200)X
State PIN: 017082.00
Amendment No. 1

Dear Sir/Ms:

Make the following changes to the Bid Documents:

In the Bid Book after page 76, **ADD** the attached "SPECIAL PROVISION, SECTION 504, ROCK ANCHORS", 7 pages dated April 8, 2011 is added to the Bid Book.

In the Bid Book (pages 131 to 136), **REMOVE** the "SPECIAL PROVION, SECTION 53,1 BRIDGE STRUCTURE DETAIL BUILD, (Lump Sum)", 6 pages dated March 21, 2011 and **REPLACE** with the attached new "SPECIAL PROVION, SECTION 531, BRIDGE STRUCTURE DETAIL BUILD, (Lump Sum)", 7 pages dated April 8, 2011.

In the Bid Book (pages 137 to 140), **REMOVE** the "SPECIAL PROVION, SECTION 534, PRECAST STRUCTURAL CONCRETE, (Precast Structural Concrete Arches, Box Culverts, Frames)", 4 pages dated February 10, 2011 and **REPLACE** with the attached new "SPECIAL PROVION, SECTION 534, PRECAST STRUCTURAL CONCRETE, (Precast Structural Concrete Arches, Box Culverts, Frames)", 4 pages dated April 8, 2011.

In the Bid Book, after page 141 **ADD** the attached "SPECIAL PROVISION, SECTION 635, PREFABRICATED BIN TYPE RETAINING WALL, (Prefabricated Concrete Modular Gravity Wall)", 6 pages dated January 8, 2010 is added to the Bid Book.

In the Bid Book, after page 149 **ADD** the attached "SPECIAL PROVISION, SECTION 636, MECHANICALLY STABILIZED EARTH RETAINING WALL", 13 pages dated August 20, 2010.

The following questions have been received:

Question: Can the spread footing be pinned to bedrock to support lateral load and/or moment? If so, is there a recommended special provision for grouted rock anchors?

Response: Yes, the spread footings may be pinned to bedrock with rock anchors to support lateral load and/or moment. The rock anchors shall be constructed in accordance with the attached Special Provision 504, Rock Anchors.

Question: The bridge width as shown in the drawings is 30 ft. Can the width be reduced, provided the dimensions satisfy the requirements for lane width and rails?

Response: The clear span cannot be reduced. The clear span shall be a minimum of 30 feet per Special Provision 531.

Question: Are MSE wall an acceptable option for headwalls on a buried structure?

Response: Yes, an MSE wall can be used for a headwall. The MSE wall shall meet the requirements of the attached Special Provision SECTION 636, MECHANICALLY STABILIZED EARTH RETAINING WALL.

Question: The geotechnical report states that the full extent of the rock excavation is unknown but should be "planned and accounted for". Would the Department consider paying for this rock excavation and the fill/seal concrete required on a unit price basis? Relieving the Contractor of this responsibility will result in a lower total cost.

Response: No

Consider these changes and information prior to submitting your bid on April 20, 2011.

Sincerely,

George MacDougall

For Scott Bickford

Jefferson
BR-1708(200)X
April 8, 2011

SPECIAL PROVISION
SECTION 504
ROCK ANCHORS

504.01 Description. This work shall consist of designing, furnishing, installing, testing and tensioning grouted rock anchors

The Contractor shall select the drilling or coring method and equipment, and the grouting procedures to meet the specified design loads. The bonded length of anchors in bedrock shall be designed by the Contractor and verified by testing, but shall not be less than (10 ft). One anchor shall be installed and successfully performance-tested as specified herein to a load of 133% of the design load to confirm adequacy of the Contractor proposed bond length. The bond length of the successfully performance-tested anchor shall be used for all anchors.

Each anchor shall be locked-off at no less than ten (10) kips minimum anchor load by torqueing the anchor nut to a torque value determined from the specified lift-off test procedure. All anchor head assembly components shown on the drawings shall be epoxy coated in accordance with this Special Provision.

All rock anchors shall be designed and tested in conformance with AASHTO LRFD Bridge Design Specifications and the Post Tension Institute (PTI) Specifications, latest editions.

504.02 Submittals. The following shall be submitted to the Resident not less than 30 days prior to the start of the work.

(a) Shop drawings and material certifications of the complete rock anchor assembly. The drawings shall provide details and dimensions of the thread bar, corrosion protection system, anchor head, bond breaker, grout sleeve, couplings, length of unbonded zone, total anchor length, design, test and lock-off loads, grout type, grout admixture, and grouting procedures. Shop drawings detailing the monitoring system for measuring movements during performance and proof load tests; detailed procedures for testing and load transfer to anchors including method for verifying lock-off loads; detail procedures for installation of anchors, including method of drilling, thread bar installation, and grouting of anchors; and certified copies of chemical analyses and tensile strength.

(b) List and description of proposed equipment to be used for rock anchor installation, including drilling and coring rock anchor holes, cleaning holes, checking cleanliness of drill/core holes, centralizing anchors, installing anchors, grouting, tensioning, testing and load transfer. Details of methods for the above mentioned rock anchor installation activities.

(d) Plan for controlling and mitigating overbreakage of bedrock, precluding damage to adjacent utilities, if utilities are located on the site.

(e) Calibration for jacks and pressure gages or other equipment to be used in stressing and testing.

(f) Within one week of completing installation of the rock anchors, provide as-built information of data for each anchor, to include: identification, location, dates and depths of initial drilling, grouting, tensioning, testing, and final lock- off loads; observed loads and tendons elongation; grouting pressures; bonded and unbonded anchor lengths and any unusual events.

(g) Drawing showing layout and location of remote reference beam for monitoring of anchor deformation during load tests.

(h) Certificate of Compliance of Conformance for anchor thread bar and plastic sheathing.

504.03 Inspection

(a) Field inspection shall be provided as follows:

(1) The Contractor shall provide personnel, qualified by training and experience, to perform the required rock anchor installation and tests and to monitor, record and plot the data. The Resident shall be allowed unrestricted access.

(2) The Contractor's qualified rock anchor installation personnel shall keep a daily construction record during rock anchor installation. The daily record shall be submitted to the Resident.

(2) The Contractor shall be responsible for making prompt evaluations of the test data and, whenever necessary, taking immediate steps to correct any deficiencies in the capacities of individual members or to provide other corrective measures at no additional cost to the Department.

(b) During installation of rock anchors, conduct performance tests and proof tests as specified.

(c) All pressure gages and jacks employed in the tensioning of anchors shall be calibrated by a certified and approved testing laboratory which shall submit a certificate of calibration which was performed within one month of the start of testing. Tensioning will not be permitted until the calibration certificates are submitted. All jacks and gauges shall be recalibrated monthly.

504.04 Quality Assurance. The contractor shall submit and provide evidence of at least three previous successful installations comparable to the work shown in the Contract Documents and specified herein, employing labor and supervisory personnel who are experienced in this type of work. The drilling operator and foremen shall have a minimum of 1 year experience with installing permanent rock anchors of highway quality within the last three years including the owners, names and phone numbers.

MATERIALS

504.05 Materials. Rock anchors shall consist of continuously threaded bar with double corrosion protection provided by a grout-filled corrugated sheathing (minimum thickness 0.05 inch) over the bar for its entire length plus an additional smooth sheathing over the unbonded length. A smooth sheathing fitting snugly over the free stressing length shall guarantee unobstructed elongation during stressing.

(a) Rock Anchors. The Rock Anchors shall be XX inch(es) diameter threaded bars, Grade 150 ksi conforming to ASTM A722M, Type II, cold stretched and stress relieved after the threading process, as manufactured by Dywidag Systems International, or approved equal.

(b) Corrosion Protection. Thread bar anchors and all exposed steel components including anchor head assembly (nuts, bar, bearing plates, wedge plates, sealing cap, exposed bar etc.) shall have factory-applied epoxy coated in accordance with AASHTO M284 (ASTM A-775), to a minimum thickness of 12 mils. Rock anchors shall have double corrosion protection consisting of a grout-filled corrugated sheathing (minimum thickness 0.05 inch) over the bar for its entire length plus an additional smooth sheathing over the unbonded length. The rock anchor assembly shall be assembled by the rock anchor manufacturer.

(c) Nuts. Anchor nuts shall be hexagonal head, heavy duty type, conforming to ASTM A325 or to bar manufacturer's special specifications.

(d) Anchor plate, plastic sealing cap and sealing nut shall conform to thread bar manufacturer's recommendation, Anchor heads shall be installed with mastic corrosion inhibitor in accordance with manufacturer's recommendation.

(e) Bond Breaker. Smooth plastic sheathing shall be polyvinylchloride with a minimum compressive strength of 7,000 psi and a minimum tensile strength of 7,000 psi. Material shall be free of water soluble chlorides and other ingredients which might enhance corrosion, hydrogen embrittlement or stress corrosion on the thread bar. The plastic shall be non-reactive with the grout and its ingredients. The plastic sheathing shall be gas and watertight, and resistant against chemical attacks and aging.

(f) Couplings shall be capable of developing 100% of the thread bar capacity and shall be fully protected within the corrosion protection system.

(g) PVC sleeve shall be Schedule 40 Polyvinyl Chloride plastic pipe conforming to ASTM D1785.

(h) Cement grout for grouting the rock anchors and filling the PVC sleeve shall be neat cement with a non-shrink additive, with a water-cement ratio not more than 0.45 by weight. Expansion agent shall not be used. Minimum unconfined compressive strength of grout shall be 4,000 psi at time of anchor stressing, or 28 days. Admixtures shall be submitted to the Resident for approval. Materials for cement grout shall be in accordance with Section 502.

Rock anchors shall be factory grouted within the PVC sheath, meeting the grout requirements in the paragraph above.

(j) Bearing Plates. Steel bearing plates shall conform to ASTM A36. Plates shall be epoxy coated per AASHTO M284 to a 15 mil thickness. Bearing plates shall be drilled with a center hole as indicated on the plans.

(k) Other materials shall be those recommended by the thread bar manufacturer for the intended use.

CONSTRUCTION REQUIREMENTS

504.06 Rock Anchors.

(a) Method of Drilling and Coring. The rock anchor drilling or coring equipment shall have adequate capacity. Core drilling, rotary drilling or percussion drilling may be employed as the conditions warrant. The Contractor shall provide drilling equipment including but not limited to rock core barrels, rock tools, air tools, grout pumps and other equipment necessary to install rock anchors to the size and depth required. The Contractor shall determine and modify as necessary his drilling and coring methods necessary to achieve the drill holes and anchor design capacity.

(b) The Contractor shall provide sufficient length of grouted anchor such that the anchor will develop the test load capacity indicated on the plans, but in no case shall the length of anchor be less than the minimum bonded length indicated on the plans. Each rock anchor shall be verified by performance or proof tests. Anchors shall consist of a pressure or tremie grouted anchor zone (bonded length) in the drill hole in bedrock, and a bond-free zone (unbonded length where the thread bar is prevented from bonding to bedrock) and an anchor head assembly.

(c) Drilled/Cored Holes. Drill or cored holes for installation of rock anchors shall be not be less than the dimension shown on the drawings. Anchors shall be drilled and fully grouted in drill holes that extend not less than 12 inches below the bottom of the anchor thread bar.

Drill holes shall be drilled to an angle tolerance of 3% of planned orientation. Drill holes shall be true to permit installation of rock anchor without bending the anchor in any direction.

(d) Cleaning drill hole and testing. Drilled and cored holes shall be cleaned of all drill cuttings, sludge and debris before the rock anchor is inserted into the hole. The drill hole shall be tested for water tightness prior to rock anchor installation, by filling it with water and subjecting it to a pressure of 5 psi. If water loss over a period of 10 minutes is excessive, the drill hole shall be consolidation grouted, redrilled and retested.

(e) Anchor placement and grouting. The anchor assembly shall be completely ready for immediate installation prior to beginning the grout operation. Rock anchors shall be centered in the drill holes with centralizers.

The grout for the anchor shall be pressurized or tremie placed by injection at the lowest point of the anchor. The Contractor shall determine the grouting method necessary to achieve the anchor design capacity. For tremie methods, the discharge end shall be completely submerged in grout at all times. Grout volume shall be sufficient to return neat grout to the top of the casing pile once the anchor is installed.

(f) Grouting tubes shall be connected to and lowered with the rock anchor. All equipment used for placing shall be such that it will not damage the polyvinylchloride sheathing. Grout shall be placed to the calculated depth plus fifty percent extra prior to the installation of the anchor.

(g) For tremie methods, rock anchor bond lengths shall be grouted by injecting grout approximately 6 inches above the lowest point of the anchor. Grouting shall continue

within the drill casing until the grout level inside the casing is 12 inches above the top of bedrock and at least 120 percent of the calculated annular volume of the bore hole is installed. Retract the temporary drill casing to approximately 12 inches above the top of bedrock, or in the case foundations on bedrock, retract the temporary drill casing to the top of the unbonded anchor length. Pump an additional volume of grout sufficient to create a 6 inch average thickness grout plug on top of the bedrock.

(h) For pressurized grouting methods, grouting shall be performed with sufficient pressure and volume flow to produce a grouted anchor zone of the rock anchor capable of developing the load capacity indicated on the plans. Approved materials and continuous mixing and pumping equipment shall be able to produce a homogeneous in-place cement grout of the desired consistency. All oil and other rust inhibitors shall be removed from the mixing drums and pumps. Once started, grouting shall be continuous until the rock anchor and PVC sleeves are completely grouted, unless approved by the Resident. Grout not placed within one hour of mixing shall be wasted in an approved manner.

(i) Grout Testing. Two inch test cubes shall be made of each grout mix design used. Six cubes shall be made of each mix design for every 10 anchors installed or per day of grout placement which results in more cubes. Three cubes shall be tested at 7 days and three cubes shall be tested at 28 days. Testing shall be done in accordance with ASTM C 109.

(j) The anchor head assembly shall be installed with mastic corrosion inhibitor in accordance with the manufacturer's recommendations. All exposed surfaces of the anchor and head assembly shall be protected with corrosion inhibitor at all times after installation.

(k) Each anchor head assembly shall be fully encased by the foundation concrete in accordance with the plans.

(l) If rock anchor thread bars must be cut, no torch cutting is permitted. Anchor bars shall be sawcut, if necessary, with an abrasive wheel saw, in accordance with manufacturer's recommendations. Torch cutting of anchors before or after installation shall be grounds for rejection of the anchor and replacement by the Contractor at no additional cost to the Owner.

504.07 Rock Anchor Testing Procedures and Acceptance Criteria.

(a) Each anchor installed shall be tested , as called for on the plans, to verify and establish its capacity. Performance testing shall be performed no less than two rock anchors, one in each abutment foundation. All other anchors shall be proof tested. The Contractor shall be responsible for maintaining the structures during testing, and shall provide adequate shoring and bracing as required.

(b) Performance and Proof Tests shall be conducted in accordance with the project plans and the Post Tensioning Manual of the Post Tensioning Institute except as modified herein:

(1) Deformation measurements shall be made to the nearest 0.001 inches using a dial indicator mounted independent of the stressing system and referenced to a remotely supported reference beam.
(2) An Ames dial shall be used to record the movement of the anchor. The dial shall be capable of reading movement to 0.001 inch accuracy.

(3) In order for proper execution of the test the hydraulic system should be equipped with needle valve control. The jack load shall be monitored with a pressure gauge or load cell.
(4) The Contractor shall submit a tabulation of loads, elongations and rebound reading, indicating times involved, to the Resident.
(5) For each test anchor which is rejected, an additional anchor shall be tested to the test load.

(c) The proof and performance tests shall be started only after concrete grout in the anchor assembly has attained a minimum compressive strength of 4,000 psi, as shown by cube samples taken during filling operations.

(d) If at any time during testing a failure of any element (jack, rock anchor, bearing pile, etc.) occurs which results in a non-symmetrical loading condition, the load in the jacks shall be reduced to zero as soon as practicable. The cause of the failure shall be rectified by the Contractor prior to restarting the load test.

(e) No performance or proof test shall be conducted unless the Resident is present. The Resident shall be given a minimum of one day's notice of anchor testing.

(f) The performance test shall be made by incrementally loading and unloading the anchor in accordance with the following schedule, where P equals the design load: alignment load (AL), 0.25P, AL, 0.25P, 0.50P, AL, 0.25P, 0.50P, 0.75P, AL, 0.25P, 0.50P, 0.75P, 1.00P, AL, 0.25P, 0.50P, 1.00P, 1.2P, AL, 0.25P, 0.50P, 1.00P, 1.2P, 1.33P, (Hold for creep test, if warranted), adjust to Transfer Load. The test load shall be held for 10 minutes. Movement shall be recorded at 1, 2, 3, 4, 5, 6, and 10 minutes.

(g) The proof tests shall be performed by incrementally loading and unloading the anchor in accordance with the following schedule: 0, 0.25P, 0.50P, 0.75P, 1.00P, 1.2P, adjust to Transfer Load. The test load shall be held for 10 minutes. Movement shall be recorded at 1, 2, 3, 4, 5, 6, and 10 minutes.

(h) <u>Acceptance Criteria:</u>

An anchor is acceptable if:

i. The measured total movement from the performance test is greater than 80 percent of the theoretical elastic elongation of the actual free (stressing) length and is less than the theoretical elastic elongation of 100 percent of the actual free length plus 50 percent of the bond length.
ii. Creep movement does not exceed 0.080 inches during the final time increment of the performance test regardless of anchor bar length.

The proof test results should be compared to the performance test results. Any significant variation from the performance test results warrant making a performance test on the next anchor.

Any anchor which does not meet the acceptance criteria shall be replaced, a new location adjacent to the failed anchor will be located by the Resident, and the Contractor shall select a new bond length and repeat the process. If regroutable anchors are used, they will be accepted at full capacity after regrouting and acceptable proof-testing.

Once the bond length is proven by the test described, its length shall be used for all remaining anchors in that abutment. Production anchors at a given abutment shall not be installed until the test anchor is successfully tested to 133% of the design load. Any substandard length anchors installed shall not be counted, either fully or partially, toward the required number. Only full length, test verified bond length anchors, as required on the Drawings or as modified by the field testing, will be acceptable.

SPECIAL PROVISION
SECTION 531
BRIDGE STRUCTURE DETAIL BUILD
(Lump Sum)

DESCRIPTION

This work shall consist of the design, detailing, fabrication, delivery, and construction of a single span Bridge Structure in accordance with these Specifications, and in close conformity with the lines, grades, and dimensions shown on the Plans. This work shall include the following:

- Design, load rating, and detailing of the new bridge superstructure
- Design and detailing of the new bridge substructures and retaining walls
- Removal of the existing bridge in its entirety to bedrock
- Structural earth and rock excavation for major and minor structures
- Granular and gravel borrow
- Cast-in-place structural concrete including quality control program
- Concrete fill
- Reinforcing steel
- Structural steel
- Rock Anchors
- Shear connectors
- Bridge rail
- Membrane waterproofing
- Composite Arch Bridge System
- Hybrid-Composite Beams
- French drains
- Curing box for concrete cylinders
- Protective coating for concrete surfaces
- Bearings
- Permanent concrete transition barriers
- Buried precast structural concrete
- Precast, prestressed concrete superstructure elements
- Bridge mounted guardrail
- Bridge guardrail transitions
- Riprap
- Non-woven geotextile
- Prefabricated Bin Type Retaining Wall

*Some of the items listed above may not be applicable, depending on the structure option chosen.

DETAIL BUILD OPTIONS

All options shall have a foundation consisting of cast-in-place footings on sound bedrock. This requirement includes foundations for wingwalls.

1. Precast structural concrete arch or three-sided frame with wingwalls
2. Composite Arch Bridge System with headwalls and wingwalls
3. Precast, prestressed concrete superstructure on concrete abutments with wingwalls
4. Galvanized or weathering steel girders with concrete deck on concrete abutments with wingwalls
5. Prefabricated galvanized steel truss with concrete deck on concrete abutments with wingwalls
6. Prefabricated galvanized steel truss or galvanized steel girders with corrugated metal deck & bituminous fill superstructure on concrete abutments with wingwalls
7. Hybrid-Composite Beams with concrete deck on concrete abutments with wingwalls

DESIGN REQUIREMENTS

The bridge structure, including superstructure and substructure elements, shall be designed by a Professional Engineer (Engineer of Record) licensed in the State of Maine. The design shall be in accordance with the latest editions of the AASHTO LRFD Bridge Design Specifications, the MaineDOT Bridge Design Guide, MaineDOT Standard Details, MaineDOT Standard Specifications and Project specific Special Provisions.

The geotechnical design shall follow the recommendations of the *Geotechnical Design Report for the Replacement of Davis #2 Bridge Over Davis Stream, Jefferson, Maine* (Soils Report No. 2011-02) as appropriate for the Bridge Structure option chosen above, and be in accordance with the AASHTO LRFD Bridge Design Specifications and the MaineDOT Bridge Design Guide.

The bridge design, in its entirety, shall be independently checked by a Professional Engineer (different than the Engineer of Record) licensed in the State of Maine.

All design options shall be load rated in accordance with the AASHTO manual for bridge Evaluation, latest edition by the LRFR method. Gusset plates for steel trusses shall be load rated per the latest FHWA guidance. Each design option shall be rated based on the HL-93 Live load and the HL-93 modified live load. The live load rating computations shall include a completed

MaineDOT Summary of Rating Form based on the rating factors for the HL-93 live load only. The MaineDOT Summary of Rating Form maybe accessed at the following MaineDOT web address: http://www.maine.gov.mdot/comprehensive-list-projects/projects-information.php

The bridge shall be designed for a modified HL-93 live load. The modification to the HL-93 loading shall be an increase in the truck live load by 25% for the Strength I load combination only; all other load combinations shall use the standard HL-93 live load.

The clear span of the bridge structure shall be centered over the stream and be a minimum of 30 feet with a maximum skew of 20˚. The bridge travel way width shall consist of one 14 foot lane clear. There shall be a normal crown on the bridge with two percent cross slopes. The vertical alignment and finished grades shown in the Plans shall not be modified. The elevation of the bottom of the structure over the water (bottom of girders, truss, precast, or composite elements) at the center of the bridge shall be equal to or higher than 150.4 feet (NAVD88). The total open area under the bridge from streambed shall be greater than or equal to 280 square feet.

If a bridge structure with a span longer than the specified minimum is proposed, in all cases, construction of the bridge shall stay within the temporary construction limits and the finished bridge structure shall be within the proposed right-of-way limits. These limits are shown on the right-of-way plan.

The top of footings shall be at or above the Q1.1 elevation. The Contractor may use concrete fill directly on bedrock in order to create a level surface under the required footings. If this option is used, the concrete fill surface shall be intentionally roughened.

If wingwalls are used in the bridge design proposed by the Contractor, they shall be founded on cast-in-place concrete footings on sound bedrock as described in the project documents. The wingwalls shall be constructed of cast-in-place concrete, or shall consist of any concrete proprietary wall system on MaineDOT's pre-approved list.

Requirements specific to bridge structure options 1 and 2:

The typical approach section shown in the Plans shall carry over the bridge structure with the exception that the sideslopes shall have a 12 inch layer of Stone Ditch Protection in place of Loam, Mulch, and Seed. The berm offset from face of rail shall be two feet, thereby matching the typical approach section.

Each option shall have a headwall on each end of the buried structure (upstream and downstream) to retain the road embankment.

Requirements specific to bridge structure options 3 - 7:

The bridge rail and its attachment to the deck overhang shall satisfy crash testing requirements to confirm that they meet the structural and geometric requirements of TL-2 (AASHTO LRFD or

NCHRP Report 350). In addition, if the bridge rail selected consists of steel parts, those parts shall be galvanized in accordance with Supplemental Specification Section 506. Bridge transitions shall be either MaineDOT bridge transitions or any other transitions satisfying the requirements of TL-2.

Precast concrete superstructures shall have a 3 inch bituminous wearing surface with a high performance waterproofing membrane from the approved products list.

Cast-in-place concrete bridge decks may use a 1 inch integral concrete wearing surface in lieu of a bituminous wearing surface and waterproofing membrane. The extra inch of concrete on the deck shall be included in the design as dead load, but shall not be included as part of the slab cross-sectional properties. If used, the concrete wearing surface shall be treated with protective coating for concrete surfaces and have a tined or grooved finish.

If used, superstructure steel end diaphragm plates supporting and/or in contact with soil shall be a minimum of ½" in thickness and galvanized in accordance with Supplemental Specification Section 506.

The concrete abutment on the cast in place concrete footing shall be either full height cast in place concrete or Prefabricated Concrete Modular Gravity Wall with a cast in place concrete stub abutment located behind the Prefabricated Concrete Modular Gravity Wall.

MATERIALS

Material requirements are covered in the MaineDOT Standard Specifications, Project specific Special Provisions, and Bridge Design Guide and apply to all work included within this Special Provision with additional Project specific requirements listed below:

Buy America **IS** applicable to this project.

Structural Steel

- Steel corrugated decking shall have a minimum thickness of 5 gauge and shall be galvanized in accordance with ASTM A653
- Anchor rods and nuts shall conform to the requirements of ASTM F1554 and shall be hot-dip galvanized
- Fasteners shall be galvanized in accordance with ASTM A153

Structural Concrete

- Precast concrete shall be class P
  Note: The maximum permeability for precast shall be 3000 coulombs
- Wearing surface concrete shall be Class A

- Curb and transition barrier concrete shall be Class LP
- All other concrete shall be Class A unless otherwise noted
- All steel hardware shall be galvanized per ASTM A153

Backfill material shall meet the requirements of Standard Specification 703.19, Granular Borrow, Material for Underwater Backfill, unless otherwise noted.

SUBMITTALS

The Contractor shall submit to the Department a formal design package submittal at the 50% design development stage containing plans that show the type of bridge structure to be constructed and an overall layout of the bridge including a plan, profile, and typical section drawing. The Department shall have up to five business days to return comments on the 50% submittal. All comments by the Department shall be addressed by the Contractor with written verification of resolution from the Department prior to the final submittal.

The final submittal shall be submitted by the Contractor to the Department electronically and shall include the final Design Drawings, Design Computations, Load Rating Computations, including MaineDOT Load Rating form, and Design Check Computations for the bridge. The Department shall have up to five business days to return comments on the final submittal. **All comments by the Department on the final submittal shall be addressed by the Contractor and verified by written approval from the Department prior to fabrication.** The Design Computations and Load Rating Computations shall be signed and sealed by the Engineer of Record and the Engineer reponsible for the design check. The Design Drawings shall be signed and sealed by the Engineer of Record.

Upon completion of construction, the Contractor shall submit an electronic submission of as-built drawings signed and sealed by the Engineer of Record with any field changes or alterations noted. If any field changes or alterations do occur and will affect the bridge structure load capacity, the load rating shall be updated.

CONSTRUCTION REQUIREMENTS

All included work shall meet the applicable sections of the Standard Specifications, Project specific Special Provisions, and Standard Details as well as the following:

Protective Coating for Concrete Surfaces shall be applied to the following areas (where applicable dependent on the structure type chosen):

- All exposed surfaces of concrete curbs
- Fascias down to the drip notch
- All exposed surfaces of Concrete Transition Barriers
- Concrete wearing surfaces
- Concrete barrier railing
- Top of abutment backwalls and to one foot below the top of backwalls on the back side
- All exposed surfaces of concrete headwalls
- All exposed surfaces of buried precast end sections

METHOD OF MEASUREMENT

The accepted Bridge Structure will be measured by lump sum for the complete removal of the existing bridge and the design, detailing, fabrication, delivery, and construction of the new Bridge Structure.

If bridge structure option 1 or 2 is chosen, the following items needed as part of the roadway section, only over the top of the bridge structure, shall be included:

- Aggregate Subbase Course - Gravel
- Hot Mix Asphalt
- Guardrail
- Stone Ditch Protection

BASIS OF PAYMENT

The accepted Bridge Structure will be paid for at the contract lump sum price for the pay item listed below. Such payment shall be full compensation for the removal of the existing bridge, design, detailing, fabrication, delivery, and construction of one of the options listed under **Detail Build Options**, and all of the applicable items listed under **Description** required for that option. The individual items shall be governed by their respective Specifications and Special Provisions. See also **Method of Measurement** for items included in bridge structure options 1 and 2.

The Lump Sum will be payable in installments as follows:

Upon removal of the existing bridge	10%	
Upon acceptance of the design plans, computations, and load rating		10%
Completion of footings and abutments	20%	
Erection of superstructure or buried structure		40%
Completion of deck or roadway section over buried structure	10%	
Upon acceptance of Bridge Structure	5%	
Upon acceptance of As-Built plans	5%	

Payment will be made under:

Pay Item		Pay Unit
531.51	Bridge Structure – Detail Build	Lump Sum

SPECIAL PROVISION
SECTION 534
PRECAST STRUCTURAL CONCRETE
(Precast Structural Concrete Arches, Box Culverts, Frames)

534.10 Description The Contractor shall design, manufacture, furnish, and install elements, precast structural concrete structures, arches, box culverts or three sided frames and associated wings, headwalls, toewalls/cut off walls and appurtenances, in accordance with the Contract Documents.

534.20 Materials Structural precast elements for the arch or box culvert and associated precast elements shall meet the requirements of the following Subsection:

Structural Precast Concrete Units	712.061

Grout, concrete patching material, and geotextiles shall be one of the products listed on the Department's list of prequalified materials, unless otherwise approved by the Department.

Box culvert bedding and backfill material shall consist of Standard Specification 703.19, Granular Borrow, Material for Underwater Backfill, with the additional requirement that the maximum particle size be limited to 4 inches, or as shown on the Plans.

534.30 Design Requirements

The live load deflection check per AASHTO LRFD Bridge Design Specifications section 2.5.6.2 for the top slab of the box culverts with clear spans 15 feet or greater and cover depths of 4 feet or less is mandatory. The live load deflection check shall be documented in the design computations.

Design calculations that consist of computer program generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. The hand calculation shall document as a minimum the Strength 1 load case flexural check of the top slab positive moment reinforcing steel. Design calculations shall provide thorough documentation of the sources of equations used and material properties.

The Contractor shall submit the following items for review by the Resident at least ten working days prior to production:

A) The name and location of the manufacturer.
B) Method of manufacture and material certificates.
C) Description of method of handling, storing, transporting, and erecting the members.
D) Shop Drawings with the following minimum details:

1) Fully dimensioned views showing the geometry of the members, including all projections, recesses, notches, openings, block outs, and keyways.

2) Details and bending schedules of reinforcing steel including the size, spacing, and location. Reinforcing provided under lifting devices shall be shown in detail.
3) Details and locations of all items to be embedded.
4) Total mass (weight) of each member.

534.40 Construction Requirements The applicable provisions of Subsection 535.10 - Forms and Casting Beds and Subsection 535.20 – Finishing Concrete and Repairing Defects shall be met.

Manufacture of Precast Units The internal dimensions shall not vary by more than 1 percent from the design dimensions or 38 mm [1 ½ in], whichever is less. The haunch dimensions shall not vary by more than 19 mm [¾ in] from the design dimension. The dimension of the legs shall not vary by more than 6 mm [¼ in] from the dimension shown on the approved shop drawings.

The slab and wall thickness shall not be less than the design thickness by more than 6 mm [¼ in]. Where the thickness is greater than the design thickness, this shall not be cause for rejection.

Variations in laying lengths of two opposite surfaces shall not be more than 15 mm [⅝ in] in any section, except where beveled ends for laying of curves are specified.

The under-run in length of any section shall not be more than 12 mm [½ in].

The cover of concrete over the outside circumferential reinforcement shall be 50 mm [2 in] minimum. The concrete cover over the inside reinforcement shall be 38 mm [1 ½ in] minimum. The clear distance of the end of circumferential wires shall not be less than 25 mm [1 in] or more than 50 mm [2 in] from the end of the sections. Reinforcement shall be single or multiple layers of welded wire fabric or a single layer of deformed billet steel bars.

Welded wire fabric shall meet the space requirements and contain sufficient longitudinal wires extending through the section to maintain the shape and position of the reinforcement. Longitudinal distribution reinforcement may be welded wire fabric or deformed billet steel bars which meet the spacing requirements. The ends of the longitudinal distribution reinforcement shall be not more than 75 mm [3 in] from the ends of the sections.

The inside circumferential reinforcing steel for the haunch radii or fillet shall be bent to match the radii or fillets of the forms.

Tension splices in the reinforcement will not be permitted. For splices other than tension splices, the overlap shall be a minimum of 300 mm [12 in] for welded wire fabric or billet steel bars. The spacing center to center of the circumferential wires in a wire fabric sheet shall be not less than 50 mm [2 in] or more than 100 mm [4 in]. For the wire fabric, the spacing center to center of the longitudinal wires shall not be more than 200 mm [8 in]. The spacing center to center of the longitudinal distribution steel for either line of reinforcing in the top slab shall be not more than 375 mm [15 in].

The members shall be free of fractures. The ends of the members shall be normal to the walls and centerline of the section, within the limits of variation provided, except where beveled ends are specified. The surfaces of the members shall be a smooth steel form or troweled surface finish, unless a form liner is specified. The ends and interior of the assembled structure shall make a continuous line of members with a smooth interior surface.

Defects which may cause rejection of precast units include the following:

1) Any discontinuity (crack or rock pocket etc.) of the concrete which could allow moisture to reach the reinforcing steel.
2) Rock pockets or honeycomb over 4000 mm² [6 in²] in area or over 25 mm [1 in] deep.
3) Edge or corner breakage exceeding 300 mm [12 in] in length or 25 mm [1 in] in depth.
4) Extensive fine hair cracks or checks.
5) Any other defect that clearly and substantially impacts the quality, durability, or maintainability of the structure as measured by accepted industry standards.

The manufacturer of the members shall sequentially number and shop fit each adjacent member to ensure that they fit together in the field. This fit up shall be witnessed by the QA inspector. Any non-fitting members shall be corrected or replaced at no cost to the Department.

The Contractor shall store and transport members in a manner to prevent cracking or damage. The Contractor shall not place precast members in an upright position until a compressive strength of at least 30 MPa [4350 psi] is attained.

Installation of Precast Units The Contractor shall not ship precast members until sufficient strength has been attained to withstand shipping, handling and erection stresses without cracking, deformation, or spalling (but in no case less than 30 MPa [4350 psi]).

The Contractor shall set precast members on 12 mm [½ in] neoprene pads during shipment to prevent damage to the section legs. The Contractor shall repair any damage to precast members resulting from shipping or handling by saw cutting a minimum of 12 mm [½ in] deep around the perimeter of the damaged area and placing a polymer-modified cementitious patching material.

When footings are required, the Contractor shall install the precast members on concrete footings that have reached a compressive strength of at least 20 MPa [2900 psi]. The Contractor shall construct the completed footing surface to the lines and grades shown on the plans. When checked with a 3 m [10 ft] straightedge, the surface shall not vary more than 6 mm [¼ in] in 3 meters [10 ft]. The footing keyway shall be filled with a non-shrink flowable cementitious grout with a design compressive strength of at least 35 MPa [5075 psi].

The Contractor shall fill holes that were cast in the units for handling, with either Portland cement mortar, or with precast plugs secured with Portland cement mortar or other approved adhesive. The Contractor shall completely fill the exterior face of joints between precast members with an approved material and cover with a minimum 300 mm [12 in] wide joint wrap. The surface shall be free of dirt and deleterious materials before applying the filler material and

joint wrap. The Contractor shall install the external wrap in one continuous piece over each member joint, taking care to keep the joint wrap in place during backfilling. The Contractor shall seal the joints between the end unit and attached elements with a non-woven geotextile. The Contractor shall install and tighten the bolts fastening the connection plate(s) between the elements that are designed to be fastened together as designated by the manufacturer. Final assembly shall be approved by the manufacturer's representative prior to backfilling.

The Contractor shall place and compact the bedding material as shown on the Plans prior to lifting and setting the box culvert sections. The Contractor shall backfill the structure in accordance with the manufacturer's instructions and the Contract Documents. The Contractor shall uniformly distribute backfill material in layers of not more than 200 mm [8 in] depth, loose measure, and thoroughly compact each layer using approved compactors before successive layers are placed. The Contractor shall compact the Granular Borrow bedding and backfill in accordance with Section 203.12 - Construction of Earth Embankment with Moisture and Density Control, except that the minimum required compaction shall be 92 percent of maximum density as determined by AASHTO T180, Method C or D. The Contractor shall place and compact backfill without disturbance or displacement of the wall units, keeping the fill at approximately the same elevation on both sides of the structure. Whenever a compaction test fails, the Contractor shall not place additional backfill over the area until the lift is re-compacted and a passing test achieved.

The Contractor shall use hand-operated compactors within 1.5 m [5 ft] of the precast structure as well as over the top until it is covered with at least 300 mm [12 in] of backfill. The Contractor shall take adequate precautions to protect the top of the culvert from damage during backfilling and/or paving operations. Any damage to the top of the culvert shall be repaired or members replaced at no cost to the Department.

534.60 Basis of Payment Payment for the Precast Structural Concrete Arch or Box Culvert shall be considered incidental to Special Provision Section 531 - Bridge Structure Detail Build. Payment will be for all labor, equipment, materials, professional services, and incidentals for furnishing and installing the precast concrete elements and accessories. Falsework, reinforcing steel, jointing tape, grout, cast-in-place concrete fill or grout fill for anchorage of precast wings and/or other appurtenances shall be considered incidental.

SPECIAL PROVISION
SECTION 635
PREFABRICATED BIN TYPE RETAINING WALL
(Prefabricated Concrete Modular Gravity Wall)

The following replaces Section 635 in the Standard Specifications in its entirety:

635.01 Description. This work shall consist of the construction of a prefabricated modular reinforced concrete gravity wall in accordance with these specifications and in reasonably close conformance with the lines and grades shown on the plans, or established by the Resident.

Included in the scope of the Prefabricated Concrete Modular Gravity Wall construction are**:** all grading necessary for wall construction, excavation, compaction of the wall foundation, backfill, construction of leveling pads, placement of geotextile, segmental unit erection, and all incidentals necessity to complete the work.

The Prefabricated Concrete Modular Gravity Wall design shall follow the general dimensions of the wall envelope shown in the contract plans. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be at or below the elevation shown on the plans. The top of the face panels shall be at or above the top of the panel elevation shown on the plans.

The Contractor shall require the design-supplier to supply an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Resident. The work done by this representative is incidental.

635.02 Materials. Materials shall meet the requirements of the following subsections of Division 700 - Materials:

Gravel Borrow	703.20
Preformed Expansion Joint Material	705.01
Reinforcing Steel	709.01
Structural Precast Concrete Units	712.061
Drainage Geotextile	722.02

The Contractor is cautioned that all of the materials listed are not required for every Prefabricated Concrete Modular Gravity Wall. The Contractor shall furnish the Resident a Certificate of Compliance certifying that the applicable materials comply with this section of the specifications. Materials shall meet the following additional requirements:

Concrete Units:

Tolerances. In addition to meeting the requirements of 712.061, all prefabricated units shall be manufactured with the following tolerances. All units not meeting the listed tolerances will be rejected.

1. All dimensions shall be within (edge to edge of concrete) ±3/16 in.

2. Squareness. The length differences between the two diagonals shall not exceed 5/16 in.
3. Surface Tolerances. For steel formed surfaces, and other formed surface, any surface defects in excess of 0.08 in. in 4 ft will be rejected. For textured surfaces, any surface defects in excess of 5/16 in. in 5 ft shall be rejected.

Joint Filler. (where applicable) Joints shall be filled with material approved by the Resident and supplied by the approved Prefabricated Concrete Modular Gravity Wall supplier. 4 in. wide, by 0.5 in. preformed expansion joint filler shall be placed in all horizontal joints between facing units. In all vertical joints, a space of 0.25 in. shall be provided. All Preformed Expansion Joint Material shall meet the requirements of subsection 502.03.

Woven Drainage Geotextile. Woven drainage geotextile 12 in. wide shall be bonded with an approved adhesive compound to the back face, covering all joints between units, including joints abutting concrete structures. Geotextile seam laps shall be 6 in., minimum. The fabric shall be secured to the concrete with an adhesive satisfactory to the Resident. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident.

Concrete Shear Keys. (where applicable) Shear keys shall have a thickness at least equal to the pre-cast concrete stem.

Concrete Leveling Pad. Cast-in-place concrete shall be Class A concrete conforming to the requirements of Section 502 Structural Concrete. The horizontal tolerance on the surface of the pad shall be 0.25 in. in 10 ft. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident.

Backfill and Bedding Material. Bedding and backfill material placed behind and within the reinforced concrete modules shall be gravel borrow conforming to the requirements of Subsection 703.20. The backfill materials shall conform to the following additional requirements: backfill and bedding material shall only contain particles that will pass the 3-inch square mesh sieve and the plasticity index (PI) as determined by AASHTO T90 shall not exceed 6. Compliance with the gradation and plasticity requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

The backfilling of the interior of the wall units and behind the wall shall progress simultaneously. The material shall be placed in layers not over 8 in. in depth, loose measure, and thoroughly compacted by mechanical or vibratory compactors. Puddling for compaction will not be allowed.

Materials Certificate Letter. The Contractor, or the supplier as his agent, shall furnish the Resident a Materials Certificate Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications. A copy of all test results performed by the Contractor or his supplier necessary to assure contract compliance shall also be furnished to the Resident. Acceptance will be based upon the materials Certificate Letter, accompanying test reports, and visual inspection by the Resident.

635.03 Design Requirements. The Prefabricated Concrete Modular Gravity Wall shall be designed and sealed by a Professional Engineer registered in accordance with the laws of the State of Maine. The design to be performed by the wall system supplier shall be in accordance with AASHTO LRFD Bridge Design Specifications, current edition, except as required herein. Design shall consider Strength, Service and Extreme Limit States. Thirty days prior to beginning construction of the wall, the design computations shall be submitted to the Resident for review by the Department. Design calculations that consist of computer generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties. The design by the wall system supplier shall consider the stability of the wall as outlined below:

A. Stability Analysis:
   1. Overturning: For foundations on soil, the location of the resultant of the reaction forces shall be within the middle one-half of the base width.
   2. Sliding: $R_R \geq \gamma_{p(max)} \cdot (EH+ES)$
      Where: R_R = Factored Sliding Resistance
      $\gamma_{p(max)}$ = Maximum Load Factor
      EH = Horizontal Earth Pressure
      ES = Earth Surcharge (as applicable)
   3. Bearing Pressure: $q_R \geq$ Factored Bearing Pressure
      Where: q_R = Factored Bearing Resistance, as shown on the plans
      Factored Bearing Pressure = Determined considering the applicable loads and load factors which result in the maximum calculated bearing pressure.
   4. Pullout Resistance: Pullout resistance shall be determined using nominal resistances and forces. The ratio of the sum of the nominal resistances to the sum of the nominal forces shall be greater than, or equal to, 1.5.

   Live load surcharge on PCMG walls shall be estimated as a uniform horizontal earth pressure due to an equivalent height of soil (h_{eq}) taken from LRFD Table 3.11.6.4-2 with consideration for the distance from the wall pressure surface to the edge of traffic. Traffic impact loads transmitted to the wall through guardrail posts shall be calculated and applied in compliance with LRFD Article 11, where 11.10.10.2 is modified such that the upper 3.5 ft of concrete modular units shall be designed for an additional horizontal load of $\gamma P_{H1,}$ where γP_{H1}=300 lbs per linear ft of wall.

B. Backfill and Wall Unit Soil Parameters. For overturning and sliding stability calculations, earth pressure shall be assumed acting on a vertical plane rising from the back of the lowest wall stem. For eccentricity (overturning), the unit weight of the backfill within the wall units shall be limited to 96 pcf. For sliding analyses, the unit weight of the backfill within the wall units can be assumed to be 120 pcf. Both analyses may assume a friction angle of 34 degrees for backfill within the wall units.

   These unit weights and friction angles are based on a wall unit backfill meeting the requirements for select backfill in this specification. Backfill behind the wall units shall be assumed to have a unit weight of 120 pcf and a friction angle of 30 degrees.

The friction angle of the foundation soils shall be assumed to be 30 degrees unless otherwise noted on the plans.

C. Internal Stability. Internal stability of the wall shall be demonstrated using accepted methods, such as Elias' Method, 1991. Shear keys shall not contribute to pullout resistance. Soil-to-soil frictional component along stem shall not contribute to pullout resistance. The failure plane used to determine pullout resistance shall be found by the Rankine theory only for vertical walls with level backfills. When walls are battered or with backslopes > 0 degrees are considered, the angle of the failure plane shall be per Jumikus Method. For computation of pullout force, the width of the backface of each unit shall be no greater than 4.5 ft. A unit weight of the soil inside the units shall be assumed no greater than 120 pcf when computing pullout. Coulomb theory may be used.

D. Safety against Structural Failure. Prefabricated units shall be designed for all strength and reinforcement requirements in accordance with LRFD Section 5 and LRFD Article 11.11.5.

E. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic and seismic loads shall be accounted for in the design.

F. The maximum calculated factored bearing pressure under the Prefabricated Concrete Modular Gravity Wall shall be clearly indicated on the design drawings.

G. Stability During Construction. Stability during construction shall be considered during design, and shall meet the requirements of the AASHTO LRFD Bridge Design Specifications, Extreme Limit State.

H. Hydrostatic forces. Unless specified otherwise, when a design high water surface is shown on the plans at the face of the wall, the design stresses calculated from that elevation to the bottom of wall must include a 3 ft minimum differential head of saturated backfill. In addition, the buoyant weight of saturated soil shall be used in the calculation of pullout resistance.

I. Design Life. Design life shall be in accordance with AASHTO requirements, or 75 years; the more stringent requirements apply.

J. Not more than two vertically consecutive units shall have the same stem length, or the same unit depth. Walls with units with extended height curbs shall be designed for the added earth pressure. A separate computation for pullout of each unit with extended height curbs, or extended height coping, shall be prepared and submitted in the design package described above.

635.04 Submittals. The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall. Thirty (30) days prior to beginning construction of the wall, the design computations and wall details shall be submitted to the Resident for review. The fully detailed plans shall be prepared in conformance with

Subsection 105.7 of the Standard Specifications and shall include, but not be limited to the following items:

A. A plan and elevation sheet or sheets for each wall, containing the following: elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the designation as to the type of prefabricated module, the distance along the face of the wall to where changes in length of the units occur, the location of the original and final ground line.

B. All details, including reinforcing bar bending details, shall be provided. Bar bending details shall be in accordance with Department standards.

C. All details for foundations and leveling pads, including details for steps in the leveling pads, as well as allowable and actual maximum bearing pressures shall be provided.

D. All prefabricated modules shall be detailed. The details shall show all dimensions necessary to construct the element, and all reinforcing steel in the element.

E. The wall plans shall be prepared and stamped by a Professional Engineer. Four sets of design drawings and detail design computations shall be submitted to the Resident.

F. Four weeks prior to the beginning of construction, the contractor shall supply the Resident with two copies of the design-supplier's Installation Manual. In addition, the Contractor shall have two copies of the Installation Manual on the project site.

635.05 Construction Requirements

Excavation. The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein.

Foundation. The area upon which the modular gravity wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the module. Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density, determined using AASHTO T180, Method C or D. Frozen soils and soils unsuitable or incapable of sustaining the required compaction, shall be removed and replaced.

A concrete leveling pad shall be constructed as indicated on the plans. The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Resident. Allowable elevation tolerances are +0.01 ft and -0.02 ft from the design elevations. Leveling pads which do not meet this requirements shall be repaired or replaced as directed by the Resident at no additional cost to the Department. Placement of wall units may begin after 24 hours curing time of the concrete leveling pad.

Method and Equipment. Prior to erection of the Prefabricated Concrete Modular Gravity Wall, the Contractor shall furnish the Resident with detailed information concerning the proposed construction method and equipment to be used. The erection procedure shall be in

accordance with the manufacturer's instructions. Any pre-cast units that are damaged due to handling will be replaced at the Contractor's expense.

Installation of Wall Units. A field representative from the wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the Department. Vertical and horizontal joint fillers shall be installed as shown on the plans.

The maximum offset in any unit joint shall be 3/4 in. The overall vertical tolerance of the wall, plumb from top to bottom, shall not exceed 1/2 in per 10 ft of wall height. The prefabricated wall units shall be installed to a tolerance of plus or minus 3/4 inch in 10 ft in vertical alignment and horizontal alignment.

Select Backfill Placement. Backfill placement shall closely follow the erection of each row of prefabricated wall units. The Contractor shall decrease the lift thickness if necessary to obtain the specified density. The maximum lift thickness shall be 8 in. (loose). Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 92 percent of maximum density as determined by AASHTO T180 Method C or D. Backfill compaction shall be accomplished without disturbance or displacement of the wall units. Sheepsfoot rollers will not be allowed. Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved.

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T180, Method C or D. At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rain water away from the wall face.

SPECIAL PROVISION
SECTION 636
MECHANICALLY STABILIZED EARTH RETAINING WALL

The following replaces Standard Specification Section 636 in its entirety:

636.01 Description The work under this item shall consist of design, fabrication, furnishing, transportation, and erection of Mechanically Stabilized Earth (MSE) retaining wall system of the required type, including miscellaneous items necessary for a complete installation.

The MSE retaining walls shall consist of reinforcing strips or reinforcing mesh earth wall systems utilizing architectural precast concrete facing panels supported on cast-in-place concrete leveling pads. All reinforcing strips or mesh material shall consist of galvanized steel. The wall structures shall be dimensioned to achieve the design criteria shown on the plans and specified herein.

The MSE retaining walls shall be constructed in accordance with these specifications and in conformity with the lines, grades, design criteria, and dimensions shown on the plans or established by the Geotechnical Engineer.

636.02 Quality Assurance. The MSE retaining wall system shall be one of the approved wall systems noted in the Contract Documents.

All necessary materials, except backfill and cast in-place concrete shall be obtained from the approved system designer.

Mechanically Stabilized Earth (MSE) retaining walls shall be designed and constructed as specified herein. The design shall be subject to review and acceptance by the Geotechnical Engineer. The acceptability of a MSE retaining wall design shall be at the sole discretion of the Geotechnical Engineer. Any additional design, construction or other costs arising as a result of rejection of a retaining wall design by the Geotechnical Engineer shall be borne by the Contractor.

Precast facing panels shall be manufactured in a concrete products plant with approved facilities. Before proceeding with production, precast sample units shall be provided for the Resident's acceptance. These samples shall be kept at the plant to be used for comparison purposes during production.

All calculations and Shop Drawings shall be signed and sealed by a licensed Professional Engineer registered in accordance with the laws of the State of Maine and specializing in geotechnical construction.

The Contractor installing the MSE retaining walls shall have demonstrated experience constructing MSE walls and shall use personnel having demonstrated experience in the installation procedures recommended by the manufacturer and as specified herein.

All MSE walls shall be built in accordance with the plans and accepted shop drawings for the proposed wall systems.

A qualified representative from the wall design-supplier shall be present during construction of the MSE walls. The services of the qualified representative shall be at no additional cost to the project. The qualified experienced technical representative will advise the Contractor and the Resident concerning proper installation procedures.

The vendor's representative shall specify the required back-batter so that the final position of the wall is vertical. Furthermore, footing berms shall be placed in front of the first three (3) levels of panels erected, to maintain verticality.

636.03 Design Requirements The MSE retaining walls shall be designed to provide the grade separation shown on the plans with a service life of not less than 100 years.

The MSE wall system shall be designed in accordance with:

1. The manufacturer's requirements
2. The Contract Plans
3. The requirements specified herein
4. AASHTO LRFD Bridge Design Specifications, current edition
5. AASHTO LRFD Bridge Construction Specifications, current edition
6. FHWA-NHI-10-024, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume I, November 2009,
7. FHWA-NHI-10-025, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume II, November 2009,
8. FHWA-NHI-09-087, Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, November 2009.

Where conflicting requirements occur, the more stringent requirements shall govern.

The MSE wall design shall follow the general dimensions of the wall envelope shown on the plans. Base of footing elevation shall be as shown on the plans, or may be lower. All wall elements shall be within the right-of-way limits shown on the plans. The panels shall be placed so as not to interfere with drainage or other utilities, or other potential obstructions.

All appurtenances behind in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, fences, concrete parapet wall or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

Facing panels shall have tongue and groove, ship lap or similar approved connections along all joints, both vertical and horizontal. Where foundation conditions indicate large differential settlements, vertical full-height slip joints shall be provided. The shape of the panels shall be such that adjacent panels will have continuous, vertical joints, or as noted on the plans.

MSE facing panels shall be installed on cast-in-place concrete leveling pads. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be 4.0 ft as measured to the top of the leveling pad, or as shown on the plans, whichever is greater. The top of the face panels shall be at or above the top of the panel elevation

shown on the plans. Where coping or barrier is used, the wall face shall extend up into the coping or barrier a minimum of 2 in.

The MSE walls shall be dimensioned so that the factored bearing pressure resistance of the foundation soils, as noted on the plans, is not exceeded. Requirements for over excavation of native foundation soils and replacement with compacted structural fill are detailed on the plans.

The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

(a) Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined per LRFD Section 11 and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design.

(b) External Stability - Load and Resistance Factors Loads and load combinations selected for design shall be consistent with AASHTO LRFD. Application of load factors shall be taken as specified in AASHTO LRFD. Sliding resistance factors and bearing resistance factors shall be consistent with LRFD Section 10. Overturning provisions of LRFD Section 11 shall apply.

MSE walls shall be designed to resist failure by instability of temporary construction slope. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes. The factored applied bearing pressures under the MSE mass for each reinforced length shall be clearly indicated on the design drawing.

(c) Internal Stability - Load and Resistance Factors Evaluation of reinforcement pullout, reinforcement rupture and panel connection pullout or rupture shall be consistent with LRFD Section 11. Loads, load combinations and load factors shall be as specified in LRFD Article 11. Resistance factors for internal design shall be consistent with LRFD Article 11. Maximum reinforcement loads shall be calculated using the Simplified Method approach. Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life. The design life of steel soil reinforcements shall comply with LRFD Section 11.

(d) Backfill and Foundation Soils Parameters. The friction angle of the select backfill used in the reinforced fill zone for the internal stability design of the wall shall be assumed to be 34° unless noted otherwise. The friction angle of the foundation soils and random backfill shall be assumed to be 30° unless otherwise shown on the plans.

(e) Reinforcement Length. The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 8 ft, but shall not be less than 70 percent of the wall height, H, for walls with level surcharges, or 70 percent of H1 for walls with a sloped surcharge or walls

supporting an abutment. The mechanical wall height, H or H1, shall be the vertical difference between the top of the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

(f) Steel Reinforcement For steel reinforcements, all structural connections, tie strips and loop inserts, the following galvanization and carbon steel loss rates shall be assumed:

	Mil./year/side
Zinc galvanizing (first 2 years)	0.58
Zinc galvanizing (subsequent years to depletion):	0.16
Carbon Steel (after zinc depletion to 100 yrs):	0.47

Calculations for factored stresses and resistances in steel reinforcements and connections, including tie-strips and loop inserts, shall be based upon assumed conditions at the end of the design life. (or: The nominal long-term design strength in steel reinforcements and connections, including tie-strips and loop inserts shall be determined at the end of the service life.) The applied factored reinforcement loads shall be calculated in accordance with LRFD Section, and shall be checked against the nominal tensile strength multiplied by a resistance factor per LRFD Table 11.5.6-1. Transverse and longitudinal grid members shall be sized in accordance with ASTM A 185.

When the expected differential settlement normal to the wall exceeds 3 in, the lower level reinforcement facing connections shall be designed to accommodate the increased tensile forces due to settlement.

(g) Facing Panel Requirements

1. Facing panels shall be designed to resist compaction stresses that occur during wall erection.

2. The minimum thickness for concrete panels in the zone of embedded connections shall be 5.5 in and 3.5 in elsewhere. The minimum concrete cover shall be 1.5 in. Facing panels shall meet the design requirements of LRFD 11.10.2.3

3. The wall facing shall be designed to accommodate differential settlements of 1/100 ft.

4. The minimum spacing between adjacent panels shall be ¾ inches in order to accommodate differential settlements without impairing the appearance of the facing or compromising the structural integrity of the individual panels. Joints between panels shall be no more than 0.75 in. Joint between panels shall have a ship lap configuration or tongue and groove connection. There shall be no openings through the wall facing, except for utilities to pass through the wall. Slip joints to accommodate differential settlement shall be included where shown on the plans.

5. Where wall or wall sections intersect with an angle of 130º or less, a special vertical corner element panel shall be used. The corner element panel shall cover the joint of the panels that abut the corner and allow for independent movement of the abutting panels. Corner elements shall not be formed by connecting standard facing panels that abut the acute corner.

636.04 Materials The Contractor shall be responsible for the purchase or manufacture of the precast concrete facing panels, reinforcing mesh or strips, panel/reinforcement connections, bearing pads, joint filler, and all other necessary components. The Contractor shall furnish to the Resident the appropriate Certificates of Compliance certifying that the applicable wall materials meet the requirements of the project specifications. All materials used in the construction of the MSE retaining walls shall meet the requirements specified in the following subsections of the Maine Standard Specifications and as specified herein.

Materials not conforming to this section of the specifications, or from sources not listed in the contract documents, shall not be used without written consent from the Resident.

636.041 Reinforced Concrete Facing Panels Reinforced concrete facing panels shall meet the requirements specified in the following subsections:

Structural Precast Concrete Units	712.061
Drainage Geotextile	722.02

636.042 Precast Panel Tolerances and Surface Finish Concrete surface for the front face shall have a smooth steel formed finish, or as noted on the plans. The rear face shall have an unformed surface finish. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of ¼ in. All uncoated steel projecting from the panel unit shall be galvanized in accordance with ASTM A 123/A 123M (AASHTO M 111) with a minimum coating thickness of 2 oz/ft^2.

Precast panel tolerances shall comply with the following; units that do not meet the listed tolerances will be rejected.

1. Panel dimensions (edge to edge of concrete) within ±3/16 in.
2. Panel thickness: ± ¼ in.
3. Squareness. The length difference between the two diagonals shall not exceed ½ in.
4. Distance between the centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 1/8 in.
5. Face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 1/8 in.
6. Position of panel connection devices (Tie Strip) shall be ± 1 in.
7. Location of Coil and loop Imbeds shall be ± 1/8 in.
8. Warping of the exposed panel face shall not exceed 1/4 in. in 5 ft.
9. Surface defects on smooth-formed surfaces measured over a length of 5 ft shall not exceed 1/8 in. Surface defects on textured-finished surfaces measured over a length of 5 ft shall not exceed 5/16 in.

636.043 Reinforcing All reinforcing, tie strips, and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

A. Reinforcing Mesh shall be shop fabricated from cold drawn steel wire conforming to the requirements of AASHTO M 32 (ASTM A 82-97) yield strength minimum of 65 ksi and shall be welded into the finished mesh fabric in accordance with AASHTO M 55 (ASTM A 185). Galvanizing shall be in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum coating thickness shall be 2 oz/ft^2. Any damage done to the mesh galvanization prior to the installation shall be repaired in an acceptable manner and provide a minimum galvanized coating of 2 oz/ft^2.

B. Reinforcing Strips shall be fabricated from hot rolled bars to the required shape and dimensions. Their physical and mechanical properties shall conform to AASHTO M 223 (ASTM A 572/A572M) Grade 65, or approved equal. Reinforcing strips shall be hot dipped galvanized in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum galvanization coating thickness shall be 2 oz/ft^2. Any damage done to the mesh galvanization prior to the installation shall be repaired 2 oz/ft^2.

C. Tie strips shall be fabricated of hot rolled steel conforming to ~~ASTM A570~~ ASTM A 1011/A1011M, Grade 50 or equivalent. Tie strips shall be hot dipped galvanized in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum coating thickness shall be 2 oz/ft^2.

D. The tie strips and reinforcing strips shall be cut to lengths and tolerances shown on the submitted plans. Holes for bolts shall be punched in the locations shown.

636.044 Attachment Devices

A. Steel clevis loop embeds shall be fabricated of cold drawn steel wire conforming to ASTM A 510, UNS G 10350 or AASHTO M 32 (ASTM A 82). Loop embeds shall be welded in accordance with AASHTO M 55 (ASTM A 185). Both shall have electrodeposited coatings of zinc applied in accordance with ASTM B 633.

B. Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of AASHTO M 164 (ASTM A 325) or equivalent.

C. Connector pins and mat bars shall be fabricated from AASHTO M 183 (ASTM A 36/A36M) steel and welded to the soil reinforcement mats as shown on the plans. Galvanization shall conform to AASHTO M111 (ASTM A 123/A123M) with a minimum coating thickness of 2 oz/ft^2. Connector bars shall be fabricated of cold drawn steel wire conforming to the requirements of ASTM A 82 (AASHTO M 32) and galvanized in accordance with ASTM A 123/A123M.

D. Structural plate connectors and fasteners used for yokes to connect reinforcements to wall panels around pile or utility conflicts shall conform to the material requirements for reinforcing strips and fasteners in 677.042 (c).

636.045 Joint Materials Joint material shall be installed to the dimensions and thicknesses specified below, or in accordance with the plans or approved shop drawings.

A. Provide flexible foam strips for filler for vertical joints between panels, and in horizontal joints where pads are used.

B. Provide in horizontal joints between panels either preformed EPDM rubber pads conforming to ASTM D 2000 for 4AA, or 812 rubbers or neoprene elastomeric pads having a Durometer Hardness of 55±5, or high density polyethylene pads with a minimum density of 0.946 g/cm3 in accordance with ASTM D 1505

636.046 Nonwoven Drainage Geotextile Cover all joints between panels on the back side of the wall with a geotextile fabric meeting the minimum requirements of 722.02 Class 2. Slit film and multifilament woven and resin bonded woven geotextile fabrics are not allowed for this application. The minimum width of the fabric shall be 12 in. Lap fabric at least 12 in. where splices are required. Nonwoven Drainage Geotextile shall be bonded with an approved adhesive compound to the back face covering all joints between panels. Adhesives used to hold the geotextile filter fabric material to the rear of the facing panels prior to backfill placement shall be supplied by the wall supplier and approved by the Resident.

636.047 Concrete Leveling Pad The cast-in-place leveling pad shall be constructed of Class A concrete conforming to the requirements of Section 502 - Structural Concrete. Leveling pad shall have minimum dimensions of 6 in thickness and 12 in width and be placed at the design elevation shown on the shop drawings within a 1/8 in tolerance.

636.048 Backfill Materials All backfill materials used in the MSE Walls volume shall conform to Gravel Borrow conforming to the requirements of Section 703.20, with and the following additional requirements:

A. The maximum aggregate size is limited to 4 in (U.S Sieve Size - 102 mm)

B. Soundness The material shall be substantially free of shale or other soft, poor durability particles. The materials shall have a magnesium sulfate soundness loss, as determined by AASHTO T104 (ASTM C 88), of less than 30 percent after four cycles.

C. Electrochemical Requirements The backfill materials shall meet the following criteria:

Requirements		Test Methods
Resistivity	>3,000 ohm-centimeters	AASHTO T 288
pH between	Between 5 and 10, inclusive	AASHTO T 289
Chlorides	<100 parts per million	AASHTO T 291
Sulfates	<200 parts per million	AASHTO T 290
Organic Content	<1%	AASHTO T 267-86

D. The plasticity index (PI) as determined by AASHTO T90 shall not exceed 6.

E. The select backfill material shall exhibit an angle of internal friction of not less than 34 degrees, as determined by the standard Direct Shear Test, AASHTO T236 (ASTM D3080-72), on the portion finer than the 2 mm [#10 sieve], compacted to 95 percent of AASHTO T99, Methods C or D (with oversized correction as outlined in Note 7) at optimum moisture content. No testing is required for backfills where 80 percent of sizes are greater than 3/4 in. (19 mm) Before construction begins, the borrow material selected shall be subject to show conformance with this frictional requirement. Compliance with the test requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

636.049 Crushed Stone for Abutment Foundation Crushed stone for use in the foundation layer below the abutment shall be crushed stone conforming to the requirements of MaineDOT Standard Specification Section 703.31.

636.050 Impervious Membrane An impervious geomembrane shall be installed near the top of the reinforced backfill to reduce the chance of water infiltrating into the reinforced backfill. The geomembrane shall be bonded to the inside face of the wall panels and extend perpendicularly from the wall face into the fill, while being parallel to the top of the wall. The membrane should be sloped to drain away from the facing and outlet beyond the reinforcing zone. The impervious geomembrane shall extend into the fill a distance of 1 ft beyond the MSE reinforcement. The geomembrane shall have a minimum thickness of 0.76 mm, 30 mil (0.03 in, 1/32 in)

The geomembrane shall have both sides textured with a rough finish to improve resistance against sliding. The texture shall be approved by the Resident before installation. The geomembrane shall be shown on the design drawings of the MSE submittal of the Contractor.

636.051 Acceptance of Material The Contractor shall furnish to the Resident a Certificate of Compliance certifying that the above materials comply with the applicable contract specifications including the backfill material, in accordance with Section 700. A copy of all test results performed by the Contractor necessary to assure contract compliance shall also be furnished to the Resident. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Resident.

636.06 Submittals

A. Design computations demonstrating compliance with the criteria specified herein and shown on the plans, shall be prepared, signed and stamped by a licensed Professional Engineer licensed in the State of Maine and specializing in geotechnical engineering. Design calculations that consist of computer generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties.

The design calculations shall include:

1. Statement of all assumptions made and copies of all references used in the calculations.

2. Analyses demonstrating compliance with all applicable earth, water, surcharges, seismic, or other loads, as specified herein and required by AASHTO LRFD.

3. Analyses or studies demonstrating durability and corrosion resistance of retaining wall systems for the proposed location and environment. The designer shall provide all corrosion protection devices necessary for the retaining wall to have a minimum service life of 100 years in the proposed location and environment.

B. A detailed resume of the wall designer listing similar projects with references, and demonstrating necessary experience to perform the MSE retaining wall design, including a brief description of each project that is similar in scope.

C. A detailed listing of MSE walls that the Contractor has constructed including a brief description of each project and a listing of personnel who will construct the walls demonstrating their experience in construction of MSE retaining walls. A reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, address and current phone number.

D. Manufacturer's product data for the MSE wall system, including material, manufacture and erection specifications, all specified erection equipment necessary, details of buried MSE wall elements, special details required of reinforcing layout around drainage structures and sign foundations, structures design properties, type of backfill and details for connections between facing panels.

E. Details of precast yard and concrete mix design.

F. Shop drawing showing the configuration and all details, dimensions, quantities and cross sections necessary to construct the MSE wall, including but not limited to the following:

1. A plan view of the wall, which shall include Contract limits, stations and offsets, and the face of wall line shown on the plans.

2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 50 ft along the face of the wall, all steps in the leveling pads, the designation as to the type of retaining wall system(s), and an indication of the final ground line and calculated factored bearing pressures. The face of wall shown on the plans shall be indicated.

3. A typical cross section or cross sections showing the elevation relationship between existing ground conditions and proposed grades, and the proposed wall configuration, including details for the proposed methods for connecting to existing conditions. The sections shall also indicate the location of the face of wall shown on the plans.

4. General notes pertaining to design criteria and wall construction.

5. A listing of material quantities for each wall.

6. Details of sleeves and pipes and other embedded items to be installed through the walls.

7. Clearly indicated details for construction of walls or reinforcing elements around drainage, foundations, utilities or any other potential obstructions.

8. Details of the architectural treatment of facing panels.

9. Drainage design detail and design scheme.

10. Location of utilities.

11. Sequence and schedule of construction, including overall construction schedule.

12. Methods of excavation and backfill.

13. Method of maintaining stability of excavated trenches.

14. Method of monitoring plumbness and deviation of wall.

15. Excavation support system, if any.

16. Any acceptance testing and frequency.

17. Details and location of all necessary construction and expansion joints along the wall.

18. Connection details at the interface of the wall and any adjacent proposed cast in place retaining wall or abutment structure.

19. Details of impermeable membrane connection to abutment in roadway runoff collection system.

636.07 Delivery, Storage and Handling

A. Contractor shall check the material upon delivery to assure that the proper material has been received. A product certification should be provided with each shipment.

B. Material shall be stored above -20º F

C. Contractor shall prevent excessive mud, wet cement, epoxy and like substances which may affix themselves to the material from coming in contact with the material.

D. Material may be laid flat and stored outside for 30 days. For extended storage, material shall be stored in or beneath a trailer or covered with a colored tarpaulin to prevent long-term exposure.

636.08 Wall Excavation The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 - Excavation and Embankment, except as modified herein. Temporary excavation support as required shall be the responsibility of the contractor.

636.09 Foundation Preparation. The foundation for the structure shall be graded level for a width equal to the length of reinforcement elements plus 5 ft, or as shown on the plans. Prior to wall construction the foundation shall be compacted with at least 10 passes of a smooth wheel vibratory roller weighing at least 10,000 lbs. Any foundation soils found to be unsuitable or incapable of sustaining the required compaction shall be removed and replaced with Special Borrow Material. The foundation for the structure shall be approved by the Resident before erection is started.

A concrete leveling pad shall be constructed as indicated on the submitted plans. The leveling pad shall be cast to the design elevations as shown on the plans. Allowable elevation tolerances are +0.01 ft and -0.02 ft from the design elevations. Placement of wall panels may begin after 24 hours curing time of the concrete leveling pad.

636.10 Wall Erection A field representative from the proprietary wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

Precast concrete panels shall be placed so that their final position is vertical or battered as shown on the plans. The vendor representative shall specify the required back-batter so that the final position of the wall is vertical. Earth berms at the footing shall be placed to maintain the desired position of panels. For erection, panels are handled by means of lifting devices connected to the upper edge of the panel. Panels should be placed in successive horizontal lifts in the sequence shown on the approved shop drawings as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed ¾ inch when measured with a 10 ft straightedge (¼ in/yd). During construction, the maximum allowable offset in any panel joint shall be ¾ in. The overall vertical tolerance of the wall (from top to bottom) shall not exceed ½ inch per 10 ft of wall height.

636.11 Backfill Placement Backfill shall not be placed between November 1st and April 1st. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed and compacted in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the facing panels or reinforcing elements. Any wall materials which become damaged during backfill placement shall be removed and replaced at the Contractor's expense. Any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this specification shall be corrected by the Contractor at his expense. Prior to the placement of the soil reinforcement, the backfill elevation after compaction shall be at the

required elevation of the reinforcements. At each reinforcement level, the backfill shall be placed to the level of the connection. Backfill placement methods near the panels shall assure that no voids exist directly beneath the reinforcing element.

Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 92 percent of maximum density as determined by AASHTO T180, Method C or D (with oversize correction, as outlined in Note 7 of that test). If 30 percent or more of the backfill material is greater than 19 mm [3/4 in] in size, AASHTO T180 is not applicable, and the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D4253 and D4254, or a method of compaction consisting of at least 4 (four) passes by a heavy roller.

Where spread footings support bridge or other structural loads, the top 5 ft below the bottom of footing elevation shall be compacted to 98 percent of the maximum density as determined by AASHTO T180, Method C or D (with oversize correction, as outlined in Note 7 of that test).

The moisture content (determined in accordance with AASHTO T180, Method C or D) of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have be placed at a moisture content not more than 2 percentage points less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

At each reinforcing level, backfill shall be leveled before placing and bolting the reinforcing. The maximum lift thickness after compaction shall not exceed 12 in. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Heavy compaction equipment shall not be used to compact backfill within 3 ft of the wall face. Compaction within 3 ft of the back face of the wall shall be achieved by at least three (3) passes of lightweight mechanical tamper, lightweight roller, or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used. No vehicular equipment shall be operated within 3 ft of the panels.

The frequency of sampling of the backfill material necessary to assure gradation control throughout construction shall be as directed by the Resident.

At the end of each day's operation, the Contractor shall slope the last level of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

636.12 Reinforcement Placement Prior to placing the first layer of reinforcements (strips, mats or grids), backfill shall be placed and compacted in accordance with Subsection 677.11, Backfill Placement.

Bending of reinforcements in the horizontal plane resulting in a permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations is allowable.

Cutting of longitudinal or transverse reinforcement bars to avoid conflicts with utility obstructions or piles will not be allowed. A structural connection (yokes) from the wall panel to the reinforcement shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcement due to pile or utility conflicts.

Soil reinforcements shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Resident. If skewing of the soil reinforcements is required due to obstructions in the reinforced fill, rotatable bolted connections shall be used and the maximum skew angle shall not exceed 15º from the normal position except in the case of acute corner where redundant reinforcements are used. The tensile capacity of splayed reinforcement shall be reduced by the cosine of the splay angle.