

SUPPLEMENTAL SPECIFICATION
SECTION 540 - PRECAST CONCRETE

540.01 DESCRIPTION. This work shall consist of manufacturing, transporting, and erecting precast concrete structure components. This specification also addresses the manufacture of precast concrete mechanically stabilized earth (MSE) wall panels. Hereafter, the phrase "precast concrete" will be used to include both precast concrete structure components and MSE wall panels.

540.02 MATERIALS. Materials shall meet the requirements of the following Subsections:

Portland Cement.....	701.02
High Early Strength Portland Cement.....	701.04
Blended Silica Fume Cement.....	701.06
Tar Emulsion.....	702.05
Fine Aggregate for Concrete.....	704.01
Coarse Aggregate for Concrete	704.02
Mortar, Type I.....	707.01
Mortar, Type IV.....	707.03
Asphalt-Treated Felt.....	707.08
PVC Waterstop.....	707.10
Bar Reinforcement.....	713.01
Mechanical or Welded Splices for Bar Reinforcement.....	713.02
Welded Steel Wire Fabric.....	713.05
Coated Bar Reinforcement.....	713.07
Structural Steel.....	714.01-714.05
Concrete Curing Materials.....	725.01
Air-Entraining Admixtures.....	725.02 (b)
Retarding Admixture.....	725.02 (c)
Water-Reducing Admixture.....	725.02 (f)
Water-Reducing and Retarding Admixture.....	725.02 (g)
Water-Reducing, High Range Admixture.....	725.02 (h)
Water-Reducing, High Range, and Retarding Admixture.....	725.02 (i)
Accelerating Admixture.....	725.02 (j)
Water-Reducing and Accelerating Admixture.....	725.02 (k)
Mineral Admixture.....	725.03
Silica Fume Admixture.....	725.03 (b)
Ground Granulated Blast-Furnace Slag (GGBFS).....	725.03 (c)
Bearing Pads for Structures	731
Polystyrene Insulation Board.....	735.01
Blanket Insulation Material.....	735.02
Pipe Insulation.....	740.08
Water.....	745.01
Overhead and Vertical Concrete Repair Material.....	780.02

540.03 GENERAL FABRICATION REQUIREMENTS.

- (a) Qualification. For all Contracts advertised for bids after December 31, 2006, precast concrete shall be manufactured in a plant that has been certified by either the Prestressed Concrete Institute (PCI) under its Plant Certification Program for precast concrete or by the National Precast Concrete Association (NPCA) Plant Certification Program.

Precast concrete shall be manufactured in a plant that maintains a quality control laboratory complete with equipment for measuring the properties of fresh and hardened concrete. As a minimum, the laboratory shall be equipped with a compression testing machine, curing room or chamber, apparatus for measuring slump and air entrainment, and a complete set of aggregate sieves. The compression testing machine shall be calibrated yearly by an independent laboratory using equipment that is certified by the National Institute of Standards and Technology. The testing machine shall be power operated and capable of applying the load continuously rather than intermittently, and without shock.

- (b) Quality Control. The manufacture of precast concrete shall be in accordance with the latest editions of *PCI MNL-116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products* and *PCI MNL 135 Tolerance Manual for Precast and Prestressed Concrete Construction*, except as modified in this Section, or with the *National Precast Concrete Association (NPCA) Quality Control Manual for Precast Plants*.

The fabricator shall demonstrate a level of quality control testing that satisfies the Agency as to its ability and commitment to produce precast concrete to the requirements of this Section. A satisfactory program of quality control shall include gradation and moisture determinations of the aggregates, as well as slump, air content, and strength determinations of the concrete. These tests shall be performed at regular and suitable intervals and actively used to maintain the quality of the concrete within the specified requirements.

540.04 SUBMITTALS. As soon as practical after award of the Contract, all required information shall be prepared and submitted.

A complete copy of the structural design calculations for the precast concrete shall be submitted as Construction Drawings in accordance with Section 105. The design calculations shall substantiate that the proposed precast concrete satisfies the design parameters of the Contract. The design calculations shall include a load rating for superstructures for the seven standard axle configurations shown in the load rating block in the Contract plans and any general or construction notes required for the fabrication and construction of the precast concrete. The applicable design code will be the latest edition of the *AASHTO LRFD Bridge Design Specifications* unless indicated otherwise in the Contract Documents.

Fabrication Drawings for the precast concrete shall be submitted in accordance with Section 105, with an additional copy to the Structural Concrete Engineer. In addition to the requirements for Fabrication Drawings in Section 105, the following shall be included:

- (a) Dimensions of the precast concrete to be fabricated.
- (b) The concrete mix design, including but not limited to the following:
 - (1) Batch weights specifying dry or saturated surface dry.
 - (2) Material names and sources.

- (3) Aggregate properties and date tested.
- (4) Chemical and physical properties of cementitious material.
- (5) Admixture names and sources.
- (6) Lab data that shall include, but not be limited to:
 - a. Slump.
 - b. Air Content.
 - c. Temperature.
 - d. Ratio of Water/Cementitious Material.
 - e. Cylinder breaks for 3, 7 and 28 days cured in the same manner as the piece to be fabricated.
 - f. 56 day Rapid Chloride Ion Permeability - AASHTO T 277 test data. The results shall be the average from testing 3 specimens, but the individual specimen results shall also be included. Testing shall be performed by a CCRL qualified laboratory.
 - g. Alkali-Silica Reactivity (ASR) - AASHTO T 303 data from testing of both the fine and coarse aggregates. Testing shall be performed by a CCRL qualified laboratory.
- (7) Alkali-Silica Reactivity (ASR) - If potentially reactive aggregates are to be used in a mix design, then proposed mitigation method(s) and test results must be provided. The AASHTO T 303 test must be run again with the proposed mitigation method(s) and using the proposed job cementitious material proportioning. The proposed mitigation method(s) shall reduce expansion to below 0.10%.

If a mix design, including the testing results, has been submitted and approved within a 12 month period for the manufacture of precast concrete, it may be used in lieu of submitting an additional mix design. However, if any change in the material sources or properties has occurred, then a new mix design with lab test data will be required regardless of previous approval.

The requirements for testing in Subsections 540.04(b)(6)f, 540.04(b)(6)g, and 540.04(b)(7) above shall be waived if the submitted mix design has a minimum proportion of the cementitious material content of 25% ground granulated blast-furnace slag (GGBFS) and 6% silica fume or 20% fly ash and 6% silica fume.

The mix design shall be approved by the Structural Concrete Engineer prior to fabrication.

- (c) The sources and properties of the materials proposed for use.
- (d) The placement of reinforcing steel, welded wire fabric, mechanical bar connectors, and inserts.

- (e) The type of surface finish and how the finish will be obtained. Include details of potential repair procedures.
- (f) The curing method, detailing sequence and duration.
- (g) The minimum required concrete strength for form removal.
- (h) The design of the lifting attachments.
- (i) Transportation, handling, and storage details.
- (j) The installation procedure including a detailed grouting procedure.
- (k) Description of Quality Control procedures.

540.05 CONCRETE.

- (a) Batch plant equipment, materials, and batching procedures shall conform to the following provisions of Section 501:

- 501.04 BATCHING, paragraphs 1 and 3 only.
- 501.04 (b) Testing Laboratory.
- 501.04 (c) Bins and Scales.
- 501.04 (d) Accuracy of Plant Batching.
- 501.04 (e) Storage and Proportioning of Materials.
- 501.05 MIXING AND DELIVERY, for plants not located in the State, the Agency has the option of waiving the requirements of Subsections 501.05(a)(4) and 501.05(c), paragraphs 1 and 3 only.

- (b) Concrete for precast concrete shall conform to the following:
 - (1) The cementitious material content in the mix design shall be between 363 and 475 kg/m³ (611 and 800 pounds per cubic yard) of concrete.
 - (2) The percent of air entrainment shall be 7 percent with a tolerance of +/- 2 percent, as tested in accordance with AASHTO T 152.
 - (3) The temperature of the concrete at the time of placement shall be between 10 and 29 °C (50 and 85 °F), as tested in accordance with AASHTO T 309.
 - (4) The maximum water-cementitious material ratio shall be 0.44. When a water-reducing, high range admixture (AASHTO M 194, Type F or Type G) has been included in the approved mix design, the concrete shall not demonstrate segregation at the proposed slump.
 - (5) The maximum allowed rapid chloride ion coulomb permeability result as tested per AASHTO T 277 is 2000, tested at 56 days from the date specimens were cast.
 - (6) The maximum allowable mortar bar expansion when tested per AASHTO T 303 (with proposed mitigation method(s), as described previously, if required) shall be 0.10%.

- (c) The proposed concrete mix design, including performance history and all requests for variance from the material requirements of these Specifications, shall be submitted for approval as part of Subsection 540.04. The Structural Concrete Engineer may require a minimum of 8 weeks for testing and approval of the mix design.
- (d) Any admixture containing calcium chloride shall not be used. Type II, Type III or Blended Silica Fume portland cement may be used. Only one type of cement and only one source of that type shall be used for the precast concrete units required for any one structure.
- (e) Compressive Strength.
 - (1) Compressive strength for precast concrete structure components at 28 days, as determined in accordance with AASHTO T 22, shall not be less than 35 MPa (5000 psi). When an acceptance test result, as defined in this Section, is below the specified strength, all concrete represented by that test shall be unacceptable for the requirements of this Section. The Engineer shall reject all precast concrete structure components that were manufactured from this concrete. Acceptance of precast concrete structure components, with respect to compressive strength, shall be determined on the basis of representative compression strength tests. The representative samples shall be taken per each piece cast, a single day's production or 75 CM (100 CY) placed, whichever is less or other sampling sequence accepted by the Structural Concrete Engineer.

Specimens shall be standard cylinders made by the fabricator in accordance with AASHTO T 23. Fabrication of test specimens shall be witnessed by an Agency representative.

Four specimens are required to determine compliance with the 28-day strength requirement. The specimens shall be cured under the same conditions as the piece from the time of casting until the piece is removed from the form. At that time, the specimens shall be moved to storage where curing shall continue under standard conditions in accordance with AASHTO T 23. These specimens shall be retained by the fabricator for testing.

The average of the compressive strengths of two specimens shall constitute a test result. Specimens shall be tested either at the Agency's Materials and Research Section laboratory, or at the fabricator's plant laboratory. An Agency representative shall witness all tests.

If the average strength of specimens representing precast concrete structure components does not reach the 28-day design strength within 28 days, the precast concrete structure components shall be rejected.

- (2) Acceptance of the MSE wall panels, with respect to compressive strength, shall be determined on the basis of production lots. A production lot is defined as a group of panels that shall be represented by a single set of compressive strength samples and shall consist of not more than 80 panels or a single day's production, whichever is less.

Compressive strength test specimens shall be prepared in accordance with AASHTO T23. During the production of the concrete panels, the manufacturer shall randomly sample the concrete in accordance with AASHTO T141.

A single set of compressive strength samples, consisting of a minimum of four (4) cylinders, shall be made for every production lot.

For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the panels and tested at seven (7) days or less. The average compressive strength of these cylinders, when tested in accordance with AASHTO T22, will determine the initial strength of the concrete.

In addition, a minimum of two cylinders shall be cured in accordance with AASHTO T23 and tested at 28 days. The average compressive strength of the cylinders, when tested in accordance with AASHTO T22, will determine the compressive strength of the production lot.

If the initial strength test results indicate a compressive strength greater than or equal to 27.6 MPa (4000 psi), then this test result will be utilized as the compressive strength test result for that production lot, and the requirement for testing at 28 days will be waived for that particular production lot.

A production lot will be accepted if the compressive strength test result is greater than or equal to 27.6 MPa (4000 psi) at 28 days.

If the compressive strength test result is less than 27.6 MPa (4000 psi) at 28 days, the acceptance of the production lot will be based on its meeting each of the following acceptance criteria:

- a. Ninety (90) percent of the compressive strength test results for the overall production shall exceed 28.6 MPa (4150 psi).
- b. The average of any six (6) consecutive compressive strength test results, including the one in question, shall exceed 29.3 MPa (4250 psi).
- c. No individual compressive strength test result shall be below 24.8 MPa (3600 psi).

In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at the manufacturer's expense, obtains and submits evidence to the Engineer that the strength and quality of the concrete placed within the panels of the production lot is acceptable. If such evidence consists of tests made on cores taken from the panels within the production lot, then the cores shall be obtained and tested in accordance with AASHTO T24.

540.06 INSPECTION. Materials furnished and the work performed under Section 540 shall be inspected by the Agency. The inspector shall have the authority to reject any material or work that does not meet the requirements of these Specifications. Advance notification of at least two weeks must be provided by the fabricator to the Agency's Engineer and the Structural Concrete Engineer concerning the proposed intention to commence work. A minimum of five working days notification must be provided to the Structural Concrete Engineer by the fabricator to confirm the fabrication start date.

Prior to shipment of any precast concrete, the Materials and Research Engineer shall have approved all applicable material certifications required in accordance with Subsection 700.02.

540.07 FABRICATION.

- (a) Forming Members. Any defects or damage due to form work, stripping, or handling may be cause for rejection. Holes or cutouts for anchoring devices, diaphragm connections, openings for connection rods, recesses for grout holes for railing bolts, and any other related details shown on the Plans shall be provided for in the members.
- (b) Post Tensioning Strands and Conduits. Each post tensioning strand to be post-tensioned shall be encased in an approved conduit. Unless otherwise shown on the Plans, the ratio of cross-sectional area of the post tensioning strand to be encased to the interior cross-sectional area of the conduit shall not exceed 0.4, except when a steel bar is used as a tendon, the inside diameter of the conduit shall be at least 10 mm (3/8 inch) greater than the diameter of the bar. Conduit that has been crushed or has opened seams shall not be used.

The conduit shall be rigidly constructed, completely sealed, accurately placed, and securely fastened to maintain the desired profile during concreting. No conduit shall be located more than 6 mm (1/4 inch) from the position shown on the Plans. Bundling of conduits will not be permitted.

- (c) Bar Reinforcement and Welded Wire Reinforcement. Bar reinforcement and welded wire reinforcement shall be furnished and installed in conformance with Subsections 507.03, 507.04, 507.05, 507.07, and 507.08. The chairs or spacers used to support or locate the reinforcement that bears on the faces of the forms shall be made of, or be coated with a non-corrosive material so that no discoloration will show on the faces of the precast concrete units.

- (d) Placing Concrete. Concrete shall not be deposited in the forms until the Agency representative has approved placement of the reinforcement, conduits, and anchorages. The concrete shall be vibrated internally, externally, or a combination thereof to the required consolidation. The vibrating shall be done with care and in such a manner to ensure that:
- (1) The concrete is uniformly consolidated.
 - (2) Displacement of reinforcement, inserts, conduits, and anchorages is avoided.
 - (3) Acceptable finish surfaces are produced.
- (e) Repairs/Patching. Precast concrete structure components that contain minor defects caused by manufacture or handling may be repaired at the manufacturing site. Minor defects are defined as holes, honeycombing or spalls, which are 150 mm (6 inches) or less in diameter, that do not penetrate deeper than 25 mm (1 inch) into the concrete. Surface voids or "bugholes" that are less than 16 mm (5/8 inch) in diameter and less than 6 mm (1/4 inch) deep need not be repaired. Repairs shall be made using a material from the Approved Products List for overhead and vertical concrete repair. The repair material shall be cured as specified by the manufacturer. Repairs shall be approved by the Engineer.
- (f) Cracking. Cracks less than 0.25 mm (0.01 inch) in width shall be sealed by a method approved by the Engineer. Cracks in excess of 0.25 mm (0.01 inch) may be cause for rejection. At the Engineer's discretion, cracked precast concrete structure components shall be repaired or replaced at the Contractor's expense.
- (g) Dimensional Tolerances for Precast Concrete Structure Components. All tolerances shall be in accordance with the latest editions of both PCI MNL 116 *Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products* and PCI MNL 135 *Tolerance Manual for Precast and Prestressed Concrete Construction*, or with the *National Precast Concrete Association (NPCA) Quality Control Manual for Precast Concrete*, unless otherwise noted in the Contract Documents or as approved by the Engineer.
- (h) Welding. All welding shall conform to the requirements of Subsection 506.10.
- (i) Cold Weather. When the concrete is cast in ambient air temperatures of 10°C (50°F) or less, the requirements of Subsection 501.07(b) shall apply.
- (j) Marking. The date of manufacture, the production lot number and the piece mark shall be clearly marked on each individual piece of precast concrete. The mark shall be in a location that will not be visible in the finished product.
- (k) Form Removal. Unless otherwise specified, form removal shall be permitted only after the strength required and approved in Subsection 540.04 (g) is attained on two successive test specimens.

- (1) MSE Wall Panel Tolerances and Acceptance/Rejection. MSE wall panels shall have a minimum structural thickness of 140 mm (5 inches) and a minimum cover for steel reinforcement of 40 mm (1 1/2 inches). The concrete surface for the front face shall have a form liner finish as required on the approved Fabrication Drawings. The concrete surface on the rear face shall be an unformed flat finish. The concrete panels shall be constructed using colored concrete. The color shall be as specified in the Plans. A full size test panel shall be produced and approved by the Agency prior to production of the MSE wall panels. The panel shall be available for review a minimum of five working days prior to the start of production. The approved test panel shall be used as a benchmark for the correct color and form liner finish.

All MSE wall panels shall be manufactured within the following tolerances with respect to the dimensions shown on the approved Fabrication Drawings:

- (1) Attachment Device Locations and Alignment. Lateral position of reinforcing element attachment devices shall be within 25 mm (1 inch). Embedment measured from the back face of the panel shall be 100 mm (4 inches) within + 6 mm (1/4 inch) or - 13 mm (1/2 inch).
- (2) Panel Dimensions. All panel dimensions shall be within 6 mm. All hardware embedded in the panel with the exception of attachment devices shall be within 6 mm (1/4 inch).
- (3) Panel Squareness. Squareness, as determined by the difference between the two diagonals, shall not exceed 13 mm (1/2 inch).
- (4) Panel Surface Finish. Surface defects on smooth-formed surfaces, measured on a length of 1.5 m (5 feet), shall not exceed 6 mm (1/4 inch). Surface defects on textured-finished surfaces, measured on a length of 1.5 m (5 feet), shall not exceed 8 mm (5/16 inch).

MSE wall panels shall be accepted for use in wall construction provided the concrete strength meets or exceeds the minimum compressive strength requirement, the soil reinforcement connection devices and the panel dimensions are within tolerances, and any chipping, cracks, honeycomb or other defects are repaired to the satisfaction of the Structural Concrete Engineer using methods submitted and approved under Subsection 540.04.

The MSE wall panels shall be subject to inspection by the Engineer at the time of unloading and once placed in their final position. MSE wall panels that do not meet the required specifications are subject to rejection. Individual panels may be rejected for any of the following:

- (1) Variations in the exposed face that deviate from the approved model as to color and texture in accordance with precast concrete industry standards.
- (2) Dimensions not conforming to 540.07 (1), Tolerances.

- (3) Honeycombed or open texture not properly repaired.
- (4) Defects which would affect the structural integrity of the unit.

540.08 CURING.

- (a) General. All curing methods for precast concrete shall be subject to the Structural Concrete Engineer's approval.

Where the fabricator elects to cure precast concrete structure components by method(s) other than low pressure steam or radiant heat as described below, the fabricator shall submit with the Fabrication Drawings complete details of the proposed method(s) for approval.

The fabricator shall provide one automatic temperature recorder for each precast concrete structure component. The recorder shall continuously record curing temperature for the entire curing period. Temperature sensors shall be carefully placed within the curing enclosure to ensure that ambient temperatures are measured at typical locations. Recorder accuracy shall be certified at least once every 12 months, and the certificate displayed with the recorder. Calibration and certification shall be performed by either the manufacturer, the supplier, or an independent laboratory. Random temperature checks of each recorder may be made by an Agency representative. Each recorder chart shall indicate the casting bed, date of casting, time of start and finish of record, and the mark number of the precast concrete structure component being cured. At the completion of the curing period, the recorder charts shall be given to the Agency representative. Temperatures recorded on the charts shall be used to determine whether the precast concrete structure components have been cured in accordance with the specifications and the approved Fabrication Drawings.

Regardless of the curing method chosen the following requirements shall apply:

- (1) Except as allowed in Subsection 540.08(b), precast concrete structure components shall be cured by one of the methods specified in Subsection 501.17 until design strength has been achieved.
- (2) MSE wall panels shall have an approved curing compound applied to the back face of the panel immediately following finishing.
- (3) The precast concrete shall not be subjected to temperatures less than 20 °C (36 °F) until the design strength has been achieved.
- (4) After the curing period, the temperature of the precast concrete shall be gradually lowered to that of the surrounding atmosphere. The cooling rate shall not exceed 10°C/hr (50°F/hr) and the precast concrete shall not be more than 5°C (40°F) warmer than the ambient air temperature when removed from a curing enclosure.

(b) Curing with Low-Pressure Steam or Radiant Heat.

- (1) Immediately upon completing placement of the concrete for each precast concrete structure component, an enclosure shall be placed over the forms. This enclosure shall be suitable for containing the live steam or heat. The fabricator shall make these covers available for inspection prior to casting.
- (2) When low pressure steam methods are used for curing, precautions shall be taken to prevent live steam from being directed on the concrete or forms in such a way as to cause localized high temperatures.
- (3) When radiant heat is used for accelerated curing, all exposed precast concrete surfaces shall be covered with plastic sheeting. Radiant heat may be applied by means of a circulation pipe containing steam, hot oil or hot water, or by electric heating elements.
- (4) The precast concrete shall be allowed to attain its initial set before commencing accelerated curing. This waiting period shall not exceed four hours from time of placement for concrete with no retarder added, or eight hours from the time of placement for concrete with retarder. During this initial curing period, while waiting for the initial set to take place, the temperature within the enclosure shall be maintained between 10 and 27°C (50 and 80°F).
- (5) During the initial application of heat or steam, the ambient air temperature within the enclosure shall increase at a rate not exceeding 20°C (36°F) per hour until the maximum curing temperature is reached. The maximum curing temperature shall not exceed 82°C (180°F). The selected curing range shall be as approved on the Working Drawings. The maximum temperature shall be held until the concrete has reached a minimum of 80 percent of $f'c$, unless otherwise specified in the Contract.

540.09 HANDLING, STORAGE, AND SHIPPING. All precast concrete shall be handled, stored and shipped in such a manner as to minimize chipping, cracks, fractures, discoloration and excessive bending stresses. Units damaged by handling, storage, or shipping shall be replaced at the Contractor's expense.

MSE wall panels shall be stored and shipped in stacks, front face down. Firm blocking of sufficient thickness to prevent the reinforcement attachments from contacting the adjacent panels shall be used. Lifting inserts shall be installed on the top edge of the MSE wall panels to permit lifting at the project site. Reinforcement connection inserts (tie strips) shall not be used for lifting or handling the panel at the project site.

Precast concrete will not be considered for shipment until it has been accepted. This acceptance shall include verification that the pieces are free from defects and all specification requirements including the compressive strength and tolerance requirements have been achieved. In addition, precast concrete will not be considered for shipment for a minimum of 72 hours following the completion of casting.

540.10 INSTALLATION.

- (a) Methods, Equipment and Erection. Cranes, lifting devices, and other equipment for precast concrete structure erection shall be of adequate design and capacity to safely erect, align and secure all members and components in their final positions without damage. The Contractor is solely responsible for the methods and equipment employed for the erection of the precast concrete structure components.

Construction Drawings for precast concrete structure component erection shall be submitted in accordance with Section 105. The erection plan shall include the necessary computations to indicate the magnitude of stress in the units during erection and to demonstrate that all of the erection equipment has adequate capacity for the work to be performed, and provisions for all stages of construction, including temporary stoppages.

Submittal of the erection plan is for the Agency's documentation only and shall in no way be construed as approval of the proposed method of erection. The Contractor shall follow the erection plan as submitted.

- (b) When included in the Contract Documents, the installation of MSE wall panels shall be as specified in the MSE wall specification.

540.11 GROUT.

- (a) Grout shall be used to fill shear keys, leveling screw voids, transverse tie anchor recesses, dowel holes, and for fairing joints as detailed in the Contract or as ordered by the Engineer.

Grout shall be Mortar, Type IV. Acceptable grout materials shall be those included on the Approved Products List on file with the Agency's Materials and Research Section. Additional aggregates shall not be added to the material during field mixing.

The Contractor, with written permission from the Engineer, has the option to use ready mixed mortar for the grouting process. The Contractor shall prepare and submit for approval the mix design for the grout. The maximum quantity that can be delivered in a single load is one cubic meter (1.25 cubic yards), which must be delivered and placed within the time limits specified by the manufacturer.

For testing, 6 neat 50 mm (2 inch) cubes shall be molded and cured in accordance with AASHTO T 106 (ASTM C 109). The average compressive strength of 3 cubes shall be a minimum of 7 MPa (1000 psi) at 3 days and a minimum of 35 MPa (5000 psi) at 28 days.

- (b) The surface to be grouted shall be thoroughly cleaned, wetted, and free of all standing water.

The grout shall be mixed using a mechanical mixer according to the manufacturer's recommendations and shall be readily pourable so that it completely fills the shape of the shear keys or holes, depending on the product being installed. The placement of the grout shall be continuous. The grouting of each shear key shall be completed in its entirety within a single working day.

- (c) Grout shall be placed between precast concrete structure components as required for fairing out any unevenness between adjacent components. Mortar, Type IV shall be used.

The mortar shall be placed to the thickness necessary to eliminate unevenness, forming a smooth surface from the higher beam edges to the lower surface. The finished surface shall be feathered smoothly and be free of depressions or sharp edges.

- (d) All exposed grout shall be cured for a period of not less than three days by the wetted burlap method in accordance with Section 501. Curing shall commence as soon as practical after grout placement.

540.12 POST-TENSIONING. Post-tensioning strands shall not be bonded to the concrete. Post-tensioning strands shall be double protected against corrosion as specified in the Contract.

Post-tensioning of strands shall not commence until a minimum compressive strength of 10 MPa (1500 psi) has been attained in the grout and the grout has cured for three days.

540.13 METHOD OF MEASUREMENT. The quantity of Precast Concrete Structure of the type and size specified to be measured for payment shall be on a lump sum basis. The lump sum shall include all of the precast concrete structure components in the complete and accepted work for each location specified in the Contract.

MSE wall panels will not be measured separately for payment, but will be considered in the measurement for the Mechanically Stabilized Earth (MSE) Wall item in the Contract.

540.14 BASIS OF PAYMENT. The accepted quantity of Precast Concrete Structure of the type and size specified will be paid for at the Contract lump sum price, which price shall be full compensation for designing, detailing, fabricating, repairing, transporting, handling, and erecting the material specified, for furnishing and implementing the erection plan, and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Any grouting work, such as fairing out unevenness between adjacent precast concrete structure components and filling leveling screw holes, shear keys, transverse anchor recesses, and dowel holes, is considered incidental to the work for Precast Concrete Structure.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
540.10 Precast Concrete Structure	Lump Sum