455 STRUCTURES FOUNDATIONS.
(REV 10-2-07) (FA 10-17-07) (7-08)

ARTICLE 455-4 (Page 501) is deleted and the following substituted:

455-4 Classification.

The Department classifies piling as follows:

(1) Treated timber piling.
(2) Prestressed concrete piling.
(3) Steel piling.
(4) Test piling.
(5) Sheet piling.
    (a) Concrete sheet piling.
    (b) Steel sheet piling.
(6) Fiberglass Structurally Reinforced Composite Piles (see Section 973 for material requirements).

SUBARTICLE 455-5.15.4 (Page 515) is deleted and the following substituted:

455-5.15.4 Elevation: Ensure that the final elevation of the pile head is no more than 1 1/2 inches above, or more than 4 inches below, the elevation shown in the plans. Do not embed the pile less than 6 inches below the elevation shown in the plans unless a minimum penetration requirement is shown.

For fender piles, cut off piles at the elevation shown on the plans to a tolerance of +0.0”/-2.0” using sawing or other means as approved by the Engineer to provide a smooth level cut.

SUBARTICLE 455-7.7.1 (Pages 518 and 519) is deleted and the following substituted:

455-7.7.1 General: Where splices and build-ups for concrete piles are necessary, such splices and build-ups to be driven, or those 21 feet or longer, are to be prestressed precast sections. Ensure that build-ups less than 21 feet in length and not to be driven consist of a non-prestressed reinforced section meeting the requirements of 455-7.7.3. The Contractor may construct build-ups less than 2 feet in length in accordance with 455-11.9. When splicing a prestressed precast section onto the original pile and, after driving, the length of spliced section below cut-off elevation is 4 feet or less, remove the pile concrete to the cut-off elevation and leave the dowels in place to be incorporated into the cap as directed by the Engineer. The Contractor may cut the length of dowels which becomes exposed to a length of 48 inches from the plane of pile-splice.

These requirements are not applicable to specially designed piling. Make splices for special pile designs as shown in the plans.

SUBARTICLE 455-8.3 (Pages 520 and 521) is deleted and the following substituted:

455-8.3 Pile Splices: Order and use the full authorized pile length where practicable. Do not splice to obtain authorized lengths less than 40 feet except when shown in the plans. When

approved by the Engineer, perform splicing to obtain authorized lengths between 40 and 60 feet. The Engineer will permit splicing to obtain authorized lengths in excess of 60 feet.

Where the pile length authorized is not sufficient to obtain the required bearing value or penetration, order an additional length of pile and splice it to the original length.

Make all splices in accordance with the plan details. Payment for pile splicing will be limited as specified in 455-11.9.

ARTICLE 455-11 (Pages 524-527) is deleted and the following substituted:

455-11 Method of Measurement (All Piling).

455-11.1 Treated Timber Piling: The quantity to be paid for will be the length, in feet, furnished, placed, and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

455-11.2 Prestressed Concrete Piling:

455-11.2.1 General: The quantity to be paid for will be the length, in feet, of Prestressed Concrete Piling furnished, driven and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

455-11.2.2 Furnished Length: The furnished length of precast concrete piles will be considered as the overall length from head to tip. Final pay length will be based on the casting length as authorized in accordance with 455-5.14.3 subject to provisions of 455-11.2.3 through 455-11.2.12, 455-11.9 and 455-11.10

455-11.2.3 Build-ups: The lengths of pile build-ups authorized by the Engineer, measured from the plane of cutback or the joint between the sections, to head of build-up, will be included in the quantities of Piling.

455-11.2.4 Piles Requiring Cut-offs: No deduction from the length, in feet, of Piling will be made if cut-offs are required after the pile has been driven to satisfactory bearing.

455-11.2.5 Piles Driven Below Cut-off Elevation: Where a pile is driven below cut-off elevation and satisfactory bearing is obtained so that no further driving is required, the length of pile driven will be measured from cut-off elevation to tip of the pile.

455-11.2.6 Driving of Splice: If a pile is driven below cut-off and satisfactory bearing is not obtained, and additional driving is required after construction of a satisfactory splice, an additional 10 feet of piling will be paid for the additional driving. This compensation for driving of splice, however, will not be allowed for test piles that are spliced and redriven.

455-11.2.7 Replacing Piles: In the event a pile is broken or otherwise damaged to the extent that the damage is irreparable, in the opinion of the Engineer, the Contractor shall extract and replace the pile at no additional expense to the Department. In the event that a pile is mislocated by the Contractor, the Contractor shall extract and replace the pile at no expense to the Department except when a design change proposed by the Contractor is approved by the Department as provided in 455-5.15.5.

In the event that a pile is driven below cut-off without obtaining the required bearing, and the Engineer elects to have the pile pulled and a longer pile substituted, it will be paid for as Unforeseeable Work. In the event a pile is damaged or mislocated, and the damage or mislocation is determined to be the Department's responsibility, the Engineer may elect to have the pile extracted, and it will be paid for as Unforeseeable Work. If the extracted pile is undamaged and driven elsewhere the pile will be paid for at 30% of the Contract unit price for Piling. When the Department determines that it is responsible for damaged or mislocated pile,

and a replacement pile is required, compensation will be made under the item for Piling, for both the original pile and replacement pile.

The Contractor may substitute a longer pile in lieu of splicing and building-up a pile. In this event, the Contractor will be paid for the original authorized length of the pile, plus any additional length furnished by the Contractor up to the authorized length of the build-up, as Piling. No payment will be made for extracting the original pile furnished or will any payment be made for a pile splice.

455-11.2.8 Underwater Driving: When the Contractor selects one of the optional underwater driving methods, payment will be made by selecting the applicable method from the following:

(a) Using a pile longer than the authorized length: Payment for piling will be made only for the authorized length at that location unless the length of pile from cut-off elevation to the final tip elevation is greater than the authorized length, in which case payment for piling will be made from cut-off elevation to final tip elevation. No payment will be made for pile splice, when this option is selected, unless the pile is physically spliced and the splice is driven below cut-off elevation to achieve bearing. When making and driving a pile splice below cut-off elevation to achieve bearing, the length to be paid for piling will be the length between cut-off elevation and final pile tip elevation.

(b) Using an underwater hammer: Payment for piling and pile splices will be in accordance with 455-11.2.1 through 455-11.2.7 and 455-11.2.10. The Contractor shall furnish additional lengths required to provide the full length confirmation pile at no expense to the Department. Payment for piling for the full length confirmation pile will be the authorized length of the pile, unless the length driven below cut-off elevation is greater than the authorized length, in which case the length to be paid for will be the length between cut-off elevation and the final tip elevation. Splices in confirmation piles will be paid for only when the splice is driven below cut-off elevation.

(c) Using a pile follower: When a pile follower is used with a conventional pile driving system, the method of payment will be the same as shown above in 455-11.2. 8(b).

455-11.2.9 Set-Checks/Test Piles: As described in 455-5.12.1, there will be no separate payment for the initial four set-checks performed within 72 hours of initial driving. For each additional set-check performed within 72 hours of initial driving, an additional quantity of 10 feet piling will be paid.

455-11.2.10 Set-Check/Production Piles: As described in 455-5.10.4(a), there will be no separate payment for one initial set-check. For each additional set-check performed within 72 hours from the end of initial driving, an additional quantity of 10 feet of piling will be paid.

455-11.3 Steel Piling:

455-11.3.1 General: The quantity to be paid for will be the length, in feet, of Steel Piling furnished, spliced, driven and accepted, up to the authorized length, including any additions and excluding any deletions thereto as approved by the Engineer.

455-11.3.2 Point Protectors: The quantity to be paid for will be each for the total of point protectors authorized, furnished, and properly installed.

455-11.4 Test Piles: The quantity to be paid for of test piles of various types, will be the length, in feet, of Test Piling furnished, driven and accepted, according to the authorized length list, and any additions or deletions thereof as approved by the Engineer.

Where a test pile is left in place as a permanent pile, it will be paid for only as Test Piles. Any extensions necessary to continue driving the pile for test purposes, as authorized by the Engineer, will be paid for as Test Piles. Other build-ups made only to incorporate the pile into the structure as a permanent pile will be included in the quantities of regular Piling and will not be paid for as Test Piling.

455-11.5 Dynamic Load Tests: The quantity to be paid for will be the number of dynamic load tests as shown in the plans or authorized by the Engineer, actually applied to piles, completed and accepted in accordance with the Contract Documents. Dynamic load tests may be applied to test piles and/or production piles.

No separate payment will be made for dynamic load tests used to evaluate the Contractor's driving equipment. This will generally be done on the first test pile or production pile driven on a project with each combination of proposed hammer and pile size and/or a separate pile to evaluate any proposed followers, or piles driven to evaluate proposed changes in the driving system.

The price for Dynamic Load Tests will include all costs related to dynamic testing as described in 455-5.13 including the initial instrumented drive, up to two set-checks, and two additional instrumented set-checks within 72 hours after the initial driving of a dynamic load test pile. In the event the Engineer requires an instrumented redrive of a pile previously instrumented more than 72 hours after initial driving, it will be paid for at 1/2 the bid price for a Dynamic Load Test.

455-11.6 Steel Sheet Piling: The quantity to be paid for will be the plan quantity area, in square feet, measured from top of pile elevation to the bottom of pile elevation and longitudinally along the top of the sheet piles as shown in the plans. Sheet piling used in cofferdams and to incorporate the Contractor's specific means and methods, and not ordered by the Engineer, will be paid for as required in Section 125.

455-11.7 Concrete Sheet Piling: The quantity to be paid for will be the product of the number of such piles satisfactorily completed, in place, times their lengths in feet as shown in the plans or authorized by the Engineer. This quantity will be based upon piles 2 1/2 feet wide.

When the Engineer approves, the Contractor may furnish the concrete sheet piling in widths wider than shown in the plans; then the number of piles shall be the actual number of units completed times the width used divided by the width in the plans.

455-11.8 Fiberglass Structurally Reinforced Composite Piles: The quantity of fiberglass structurally reinforced composite piles to be paid will be the length in feet furnished and driven to the authorized lengths, as approved by the Engineer.

455-11.9 Pile Splices: Authorized splices in concrete piling, steel piling and test piling, which are made for the purpose of obtaining greater lengths than originally authorized by the Engineer, or to incorporate test piling in the finished structure, or for further driving of test piling, will be paid for as described in 455-12.13. No separate payment will be made for splices required to obtain the authorized length.

For concrete piles, where the head of the pile to be spliced is not more than 2 feet below the elevation of cut-off, the Contractor, if he so elects, may cast the pile build-up with the cap, under the following conditions:

(a) Reinforcing steel and pile dimensions will conform in every respect to a standard splice.

(b) 9 feet of piling, will be paid for as compensation for drilling and grouting the dowels and reinforcing steel and concrete used for-build up and all other costs for which provision has not otherwise been made.

455-11.10 Pile Redrive: The quantity to be paid for will be the number of redrives, each, authorized by the Engineer. Pile Redrive is defined in 455-5.10.4(b). Payment for any pile redrive ordered by the Engineer will consist of 20 feet of additional piling. The size of the pile redriven will be the same size as the furnished item for payment.

Pile Redrive will be paid under any of the following conditions:

(a) When the Engineer directs the Contractor to redrive a pile to determine its capacity as described in 455-5.10.4.

(b) When the Engineer orders the Contractor to redrive piles to reestablish their capacity as the result of pile heave as described in 455-5.10.5.

455-11.11 Pile Extraction: Piles authorized to be extracted by the Engineer and successfully extracted as provided in 455-11.2.9 will be paid for as Unforeseeable Work. No payment for extraction will be made for piles shown in the plans to be extracted or piling damaged or mislocated by the Contractor that are ordered to be extracted by the Engineer.

455-11.12 Protection of Existing Structures: The quantity to be paid for will be at the Contract lump sum price. When the Contract Documents do not include an item for protection of existing structures, the cost of settlement monitoring as required by these Specifications will be included in the cost of the piling items; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

455-11.13 Static Load Tests: The quantity to be paid for will be the number of static load tests of the designated tonnages, each, as shown in the plans or authorized by the Engineer, actually applied to piles, completed and accepted in accordance with the plans and these Specifications.

455-11.14 Preformed Pile Holes: The quantity to be paid for will be 30% of one foot of piling for each foot of completed Preformed Pile Holes acceptably provided, complete for the installation of the bearing piles, regardless of the type of pile installed therein. Only those holes authorized to be paid for, as provided in 455-5.9.3, will be included in the measurement for payment. The Engineer will authorize payment for Preformed Pile Holes only when the pile has been placed in proper position and has achieved the required penetration.

ARTICLE 455-12 (Pages 527-529) is deleted and the following substituted:

455-12 Basis of Payment (All Piling).

455-12.1 Treated Timber Piling: Price and payment will be full compensation for furnishing all materials, including collars, metal shoes, copper cover sheets, preservatives and tar, and for wrapping pile clusters with wire cable, where so shown in the plans.

455-12.2 Prestressed Concrete Piling: Price and payment will be full compensation for the cost of furnishing and placing all reinforcing steel, predrilled holes, furnishing the material for and wrapping pile clusters with wire cable where so shown in the plans and grouting of preformed pile holes when shown in the plans. Payment will be made in two increments: 70% of the unit price for Prestressed Concrete Piling for each foot fabricated and accepted as stockpiled materials, and 30% of the unit price for Prestressed Concrete Piling for the entire authorized length upon completion of driving.

455-12.3 Steel Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing Steel Piling, including welding

and painting as specified and the cost of predrilling pile holes described in 455-5.1.1. The cost of any sand or concrete fill and reinforcing steel in pipe piles will be included in the price for Steel Piling. Payment will be made in two increments: 70% of the unit price for Steel Piling for each foot (meter) fabricated and accepted as stockpiled materials, and 30% of the unit price for Steel Piling for the entire authorized length upon completion of driving.

Bracing and other metal parts attached to or forming a part of piling or bracing and not otherwise classified, will be measured and paid for as provided in Section 460.

455-12.4 Test Piles: Price and payment will be full compensation for all incidentals necessary to complete all the work of this item except splices, build-ups, pile extractions and preformed pile holes authorized by the Engineer and paid for under other pay items or payment methods. The cost of all additional work not listed above necessary to ensure required penetration and attain required bearing of the test piles will be included in the price bid per foot of Test Pile, including driving and all other related costs. Payment will be made in two increments: 70% of the unit price for Test Piles for each foot fabricated and accepted as stockpiled materials, and 30% of the unit price for Test Piles for the entire authorized length upon completion of driving.

455-12.5 Dynamic Load Tests: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.6 Steel Sheet Piling:

455-12.6.1 Permanent Sheet Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing steel sheet piling including preformed holes, but will not include furnishing and placing anchors when an anchored wall system is designed and detailed in the plans. In such cases, furnishing and installing anchors will be paid for separately.

455-12.6.2 Temporary Sheet Piling: For critical temporary steel sheet pile walls, walls which are necessary to maintain the safety of the traveling public or structural integrity of nearby structures, roadways and utilities during construction, that are detailed in the plans, price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing steel sheet piling including preformed holes, and including wales, anchor bars, dead men, soil anchors, proof tests, creep tests, and other incidental items when an anchored wall system is required. Removal of the sheet piling, anchors, and incidentals will be included in the cost per square foot for Steel Sheet Piling (Critical Temporary). When the temporary steel sheet pile walls are not detailed in the plans, the cost of furnishing and installation shall be incidental to cost of other related items and no separate payment shall be made. If the wall is not shown in the plans, but deemed to be critical as determined by the Engineer, then a design shall be furnished by the Department and paid for separately under Steel Sheet Piling (Critical Temporary).

455-12.7 Concrete Sheet Piling: Price and payment will be full compensation for furnishing all materials, including reinforcing steel, grouting, plastic filter fabric, preformed holes and installation.

455-12.8 Fiberglass Structurally Reinforced Composite Piles: Price and payment will be full compensation for all labor, equipment and materials required to furnish and install the piles to the elevation shown in the plans. No separate payment will be made for pile cut-offs.

455-12.9 Preformed Pile Holes: There will be no separate pay item for Preformed Pile Holes. Payment will be made as the unit price for Piling of the applicable pile type (excluding sheet pile) for 30% of each foot of hole which is preformed when authorized by the Engineer.

Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.10 Protection of Existing Structures: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.11 Point Protectors: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.12 Static Load Tests: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

455-12.13 Pile Splices: The quantity of this item will be determined as provided in 455-11.9. Payment for each Steel Pile Splice authorized by the Engineer will be made as 20 feet of additional steel piling. Payment for each Concrete Pile Splice authorized by the Engineer will be made as 30 feet of additional prestressed concrete piling.

455-12.14 Prestressed Concrete Pile Cut-Off: There will be no separate pay item for pile cut-off. Payment for each cut-off will be made as 5 feet of additional piling furnished.

455-12.15 Payment Items: Payment will be made under:

Item No. 455- 2-	Treated Timber Piling - per foot.
Item No. 455- 14-	Concrete Sheet Piling - per foot.
Item No. 455- 18-	Protection of Existing Structures - lump sum.
Item No. 455- 34-	Prestressed Concrete Piling - per foot.
Item No. 455- 35-	Steel Piling - per foot.
Item No. 455- 37-	Fiberglass Structurally Reinforced Composite Piles-per foot.
Item No. 455-119-	Test Loads- each.
Item No. 455-120-	Point Protection - each.
Item No. 455-133-	Steel Sheet Piling - per square foot.
Item No. 455-137-	Dynamic Load Tests - each.
Item No. 455-143-	Test Piles (Prestressed Concrete) - per foot.
Item No. 455-144-	Test Piles (Steel) - per foot.
Item No. 455-145-	Test Piles (Concrete Cylinder) - per foot.

SUBARTICLE 455-15.6 (Pages 534 and 535) is deleted and the following substituted:

455-15.6 Excavations: When pilot holes and/or load tests are performed, the Engineer will use the pilot hole and/or load test results to determine the authorized tip elevations and/or the authorized installation criteria of the drilled shafts. Drilled shaft construction shall not begin until pilot hole and/or load test reports are approved by the Engineer. Shaft tip elevations based on pilot hole results and/or load tests may vary from the Tip Elevations presented in the plans. Extend drilled shaft excavations deeper by extra depth excavation when the Engineer determines the material encountered while drilling the shaft excavation is unsuitable and/or is not the same as anticipated in the design of the drilled shaft.

455-15.6.1 Pilot Hole: When pilot holes are shown in the plans core a pilot hole, prior to shaft excavation, in accordance with ASTM D 2113 Standard Practice for Diamond Core Drilling for Site Excavation and the Department's Soils & Foundations Handbook using a double or triple wall core barrel through part or all of the shaft, to a depth of 3 times the diameter of the drilled shaft below the tip elevation shown in the plans, as directed by the Engineer. The Engineer may require the Contractor to cut any core to a total depth below the bottom of the drilled shaft excavation of up to 5 times the diameter of the drilled shaft.

455-15.6.2 Cores: Take cores when shown in the plans or directed by the Engineer to determine the character of the material directly below the shaft excavation. Provide equipment to retrieve the core from a depth of 5 times the diameter of the drilled shaft below the bottom of the drilled shaft excavation in accordance with ASTM D 2113 Standard Practice for Diamond Core Drilling for Site Excavation. Cut the cores with an approved core barrel to a minimum depth of 3 times the diameter of the drilled shaft below the bottom of the drilled shaft excavation after completing the shaft excavation, as directed by the Engineer. The Engineer may require the Contractor to cut any core to a total depth below the bottom of the drilled shaft excavation of up to 5 times the diameter of the drilled shaft.

For cores or pilot holes, use only a double or triple wall core barrel designed:

(a) to cut a core sample from 4 to 6 inches in diameter, at least 5 feet in length, and,

(b) so that the sample of material cored can be removed from the shaft excavation and the core barrel in an undisturbed state, and

The Engineer will inspect the cores and determine the depth of required excavation. When considered necessary by the Engineer, take additional cores. Place the core samples in suitable containers, identified by shaft location, elevation from and to, and job number, and deliver to the Department within 48 hours after cutting. When called for in the plans, substitute Standard Penetration Tests (SPT) for coring. In such cases, supply these tests at no additional cost per foot to the Department above that bid for core (shaft excavation).

Provide areas for the disposal of unsuitable materials and excess materials as defined in 120-5 that are removed from shaft excavations, and dispose of them in a manner meeting all requirements pertaining to pollution.

When shown in the plans, excavate bells to form a bearing area of the size and shape shown. Bell outlines varying from those shown in the plans are permissible provided the bottom bearing area equals or exceeds that specified. If the diameter of the bell exceeds three times the shaft diameter, drill the excavation deeper as directed and form a new bell footing. Excavate bells by mechanical methods.

Furnish the additional drilled shaft concrete over the theoretical amount required to complete filling any excavations for bells and shafts which are larger than required by the plans or authorized by the Engineer, at no expense to the Department.

SUBARTICLE 455-16.4 (Page 543) is deleted and the following substituted:

455-16.4 Cross-Hole Sonic Logging (CSL) Tubes: Install CSL access tubes full length in all drilled shafts from the tip of shaft to a point high enough above top of shaft to allow cross-hole-sonic-logging testing, but not less than 30 inches above the top of the drilled shaft, ground surface or water surface, whichever is higher. Equally space tubes around circumference of drilled shaft. Securely tie access tubes to the inside of the reinforcing cage and align tubes to be parallel to the vertical axis of the center of the cage. Access tubes must be Schedule 40 steel with a minimum inside diameter of 1.5 inches. Couple tubes as required with threaded couplers, such that inside of tube remains flush. Seal the bottom and top of the tubes with threaded caps. The tubes, joints and bottom caps shall be watertight. Seal the top of the tubes with lubricated, threaded caps sufficient to prevent the intrusion of foreign materials. Stiffen the cage sufficiently to prevent damage or misalignment of access tubes during the lifting and installation of the cage. Repair or replace any unserviceable tube prior to concreting. Exercise care in removing the caps

from the top of the tubes after installation so as not to apply excess torque, hammering or other stress which could break the bond between the tubes and the concrete.

Provide the following number and configuration of crosshole sonic logging access tubes in each drilled shaft based on the diameter of the shaft.

Shaft Diameter	Number of Tubes Required	Configuration around the inside of Circular Reinforcing Cage
36 to 48 inches	4	90 degrees apart
Greater than 48 inches	1 tube per 12 inches of Shaft Diameter	360 degrees divided by the Number of Tubes

Insert simulated or mock probes in each cross-hole-sonic access tube prior to concreting to ensure the serviceability of the tube. Fill access tubes with clean potable water and recap prior to concreting. Repair or replace any leaking, misaligned or damaged tubes as in a manner acceptable to the Engineer prior to concreting.

ARTICLE 455-42 (Pages 558 and 559) is deleted and the following substituted:

455-42 Mixing and Pumping Cement Grout.

Meet the following requirements:

1. Only use pumping equipment approved by the Engineer in the preparation and handling of the cement grout. Before using the mixers, remove all oil or other rust inhibitors from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout.

2. Accurately measure all materials by volume or weight as they are fed to the mixer. Place the materials in the mixer in the following order: 1) water, 2) fluidifier, 3) other solids in order of increasing particle sizes. The fluidifier may be added at the option of the Contractor.

3. Use a quantity of water and mixing time that will produce a homogenous grout having a consistency of 21 seconds minimum, when tested with a flow cone in accordance with ASTM C 939, with a frequency at the discretion of the Engineer. Mix the grout at least one minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2.5 hours at grout temperatures below 70ºF; two hours for temperatures from 70 to 100ºF. Do not place cement grout when its temperature exceeds 100ºF. If there is a lapse in the operation of grout injection, recirculate the grout through the pump, or through the mixer drum or agitator.

4. Use mixers capable of combining components of the cement grout into a thoroughly mixed and uniform mass, free from balls or lumps of cementitious material and capable of discharging the concrete with a satisfactory degree of uniformity. The Engineer's approval of grout mixers and all other equipment will be conditioned on proper performance during construction of the demonstration pile and subsequent production work.

5. Use a screen no larger than 3/4 inch mesh between the mixer and pump to remove large particles which might clog the injection system.

6. Use a positive displacement piston type grout pump capable of developing displacing pressures at the pump up to 350 psi.

7. Use a grout pump/system equipped with a pressure gauge to accurately monitor the pressure of the grout flow. Test and calibrate the equipment during construction of the demonstration pile to demonstrate flow rate measurement accuracy of ±3% over the range of grouting pressures anticipated during this work. Provide a pump stroke counter in good working condition on the grout pump. Also calibrate the equipment any time the Engineer suspects that the grout pump performance has changed.

ARTICLE 455-43 (Page 559) is deleted and the following substituted:

455-43 Testing Cement Grout.

The Engineer will cast four 4"x8" cylinders in accordance with ASTM C 31 for each LOT, considered to be 50 yd^3 of cement grout placed, or one day of pile placement. The Department will test two cylinders at seven days and two cylinders at 28 days, in accordance with ASTM C 39. The minimum required strength for the LOT will be specified on the plans. When a cement grout acceptance strength test falls more than 10% or 500 psi below the specified minimum strength, whichever is less deviation from the specified minimum strength, perform one of the following:

(a) Remove and replace the cement grout represented by the LOT in question at no additional cost to the Department, or

(b) Submit a structural analysis performed by the Contractor's Engineer of Record. If the results of the analysis, approved by the Department, indicate adequate strength to serve the intended purpose with adequate durability, the cement grout may remain in place. Otherwise, remove and replace the grout represented by the LOT in question, at no additional cost to the Department.

All low strength cement grout accepted by the Engineer will be subject to reduced payment as follows: \$0.80/yd^3 for each 10 psi of strength test value below the specified minimum strength.

Reduction in pay will be applied to the entire length of all piles containing low strength cement grout, in any quantity. The quantity of cement grout affected by the price reduction may exceed the quantity of cement grout contained in the LOT. The dollar reduction will be equated to an equivalent length of pile not to exceed the total pile length constructed utilizing the subject LOT based on the following formula:

PLR = RC/UC

Where: PLR = Equivalent Pile Length Reduction in feet
RC = Total Reduction in payment, dollars
UC = Unit Cost of Pile, dollars/foot

ARTICLE 455-48 (Page 562) is deleted and the following substituted:

455-48 Inspection and Records.

The Engineer will monitor pile installation.