ALABAMA DEPARTMENT OF TRANSPORTATION

DATE: August 20, 2020 Special Provision No. 18-0830

EFFECTIVE DATE: December 1, 2020.

SUBJECT: Piling (Allowable Stress Design).

Alabama Standard Specifications, 2018 Edition, SECTION 505 shall be replaced by the following:

SECTION 505
PILING

505.01 Description.

This Section shall cover the work of furnishing and driving foundation piles of the type and dimensions designated including cutting off or building up foundation piles, when required. Piling shall be furnished and installed in accordance with the requirements given in these specifications at the location, tip elevation, penetration and/or bearing shown on the plans or as directed by the Engineer.

505.02 Materials.

(a) **General**

All materials shall meet the requirements specified in applicable portions of Section 834, Piling.

(b) Galvanized Piling

1. General.

Where required on the plans, steel piles shall be hot dip galvanized. If swaybracing is used on these piles, the swaybracing will also be hot dip galvanized.

2. Surface Preparation.

The galvanizer shall pre-clean the material to be galvanized in accordance with accepted methods to produce an acceptable surface for hot dip galvanizing.

3. Shop Galvanizing.

Hot dip galvanizing of iron and structural steel shapes shall be produced utilizing lead free technology. Steel piles shall be hot dip galvanized in accordance with the latest ASTM A 123 Specification to provide a uniform minimum coating thickness of 3.5 mils (89 µm). Shop repair of coatings not meeting the above minimum thickness requirements will not be allowed.

Galvanizing practices and procedures shall protect against possible embrittlement of the steel as described in ASTM A 143.

Inspection and testing of hot dip galvanized coatings shall be done under the requirements of ASTM A 123.

The galvanizer shall supply certified test reports for the galvanized coating. These test reports shall accompany the piling manufacturer's test reports for certification of materials.

Galvanized members shall be stored, protected, handled and loaded in accordance with industry standards to protect the coating

505.03 Construction Requirements.

(a) Hammers for Driving Piles.

1. General.

Piles shall be driven with air, steam, diesel and hydraulic hammers with the exception that prestressed concrete piles 20 inches {510 mm} and larger shall not be driven with diesel

hammers unless approved by the Engineer. All hammers shall be furnished with a means for adjusting the amount of energy that is delivered to the pile.

Gravity hammers will be allowed if approved in writing by the Engineer.

2. Gravity Hammers.

When gravity hammers are permitted, the ram shall weigh between 3000 and 4000 pounds {have a mass between 1360 kg and 1815 kg} and the height of drop shall not exceed 10 feet {3 m}.All gravity hammers shall be equipped with hammer guides to insure concentric impact on the drive head.

3. Steam and Air Hammers.

The plant and equipment furnished for steam and air hammers shall have sufficient capacity to maintain, under working conditions, the volume and pressure specified by the manufacturer of the hammer. The plant and equipment shall be equipped with accurate pressure gages which are easily accessible to the Engineer. The weight {mass} of the striking parts of air and steam hammers shall not be less than 1/3 the weight {mass} of the drive head and pile being driven, and in no case shall the striking parts weigh {have a mass} less than 2750 pounds {1250 kg}.

4. Diesel Hammers.

Open-end (single acting) diesel hammers shall be equipped with a device such as rings on the ram or a scale (jump stick) extending above the ram cylinder to permit the Engineer to visually determine hammer stroke at all times during pile driving operations. Closed-end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge in proper working order, mounted near ground level so as to be easily read by the Engineer.

5. Hydraulic Hammers.

Hydraulic hammers shall have a built-in monitoring system which determines the ram velocity just before impact. The contractor shall verify that the correct ram weight is entered in the monitoring system.

(b) Driving Appurtenances.

1. Blow Count Monitoring Equipment.

Equipment shall be furnished by the Contractor for displaying the blow count rate and stroke height during driving with all hammers except gravity and double acting hammers. This equipment shall be operated at ground level to allow the Engineer to monitor the blow count rate.

2. Hammer Cushion.

Where required by the hammer manufacturer, impact pile driving equipment, except gravity hammers, shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to insure uniform driving behavior. Hammer cushions shall be made of durable, manufactured materials, provided in accordance with the hammer manufacturer's guidelines except that all wood, wire rope, and asbestos hammer cushions are specifically disallowed and shall not be used. A striker plate, as recommended by the hammer manufacturer, shall be placed on the hammer cushion to insure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the Engineer when beginning pile driving at each structure and after each 100 hours of pile driving. A hammer cushion whose thickness has been reduced to less than 75 percent of the original thickness shall be replaced by the Contractor before driving is permitted to continue.

3. Pile Drive Head.

Piles driven with impact hammers require an adequate drive head to distribute the hammer blow to the pile head. The drive head shall be axially aligned with the hammer and the pile. The drive head shall be guided by the leads and not be free-swinging. The drive head shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

For steel piling, the pile heads shall be cut squarely and a drive head, as recommended by the hammer manufacturer, shall be provided to hold the axis of the pile in line with the axis of the hammer.

For prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the drive head.

For special types of piles, appropriate driving heads, mandrels or other devices shall be provided in accordance with the manufacturer's recommendations so that the piles may be driven without damage.

4. Pile Cushion.

A concrete pile's head shall be protected by a wooden pile cushion. The minimum thickness placed on the pile head prior to driving shall not be less than 4 inches {100 mm}. A new pile cushion shall be provided for each pile. In addition the pile cushion shall be replaced if during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn to the extent that flame is visible. The pile cushion dimensions shall equal or exceed the cross sectional area of the pile top, and shall be appropriately sized to fit the dimensions of the pile cap.

5. Leads.

Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to insure concentric impact for each blow. Leads may be either fixed or swinging type. Swinging leads, when used, shall be fitted with a pile gate at the bottom of the leads. The pile section being driven shall not extend above the leads. The leads shall be adequately embedded in the ground or the pile constrained in a structural frame such as a template to maintain alignment. The leads shall be of sufficient length to make the use of a follower unnecessary and shall be so designed as to permit proper alignment of batter piles.

(c) Driving Aids.

1. General.

Driving aids such as jets, pilot holes and followers shall not be used unless either specifically permitted in writing by the Engineer or stated in the contract documents. When permitted, driving aids shall be used for installing production piles only after the pile tip elevation for safe support of the pile load is established by load testing and/or test piles driven with the same aids and methods. The Contractor shall perform, at his cost, any extra load tests and/or extra work required to drive test piles as determined by the Engineer as a condition of approval of the driving aids.

2. Jetting.

Jetting shall only be permitted if approved in writing by the Engineer or when specifically stated in the contract documents. The Contractor shall determine the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The jetting plant shall have sufficient capacity to permit installation to the required elevation, location, and alignment within specification tolerances. The Contractor shall decide when jetting should be discontinued above the prescribed tip elevation so that the pile will attain the required capacity at the required tip elevation established in the plans when driven with the approved hammer.

The Contractor shall control, treat if necessary, and dispose of all jet water in a manner satisfactory to the Engineer and in compliance with all regulatory guidelines.

Upon completion of jetting a pile, any voids around the pile shall be filled with clean sand and saturated with water (unless driven under water). The Contractor shall be responsible for all damage to the site caused by unapproved or improper jetting operations.

When driving concrete piles, if 240 blows per foot {300 mm} (20 blows per inch {25 mm}) is reached before the concrete pile reaches the required minimum tip elevation, then jetting may be used, when approved in writing by the Engineer, to facilitate the advancement of the concrete pile. Jetting shall be performed in a manner that allows the pile to continue on the previously established linear path of advancement by eroding the material adjacent to the concrete pile. Jetting a concrete pile may be done through internal pipes cast in the pile. Internal jet pipes shall be steel pipes for a pile that is solid concrete for the full length of the pile. Internal jet pipes shall be either steel or PVC for a pile that is cast with a void in the interior of the pile.

Once driving of the concrete pile resumes, the lowest stroke of the hammer shall be used until the Contractor and Engineer are satisfied that the original driving resistance has

resumed. Under no circumstances shall driving and jetting concrete piling be allowed simultaneously.

3. Pilot Holes.

Augering, wet-rotary drilling or other methods of boring pilot holes shall be used only when approved by the Engineer or shown on the plans. When permitted, such procedures shall be carried out in a manner which will not impair the load bearing capacity of the piles already in place or the safety of existing adjacent structures. Pilot holes shall be of a size smaller than the diameter or diagonal of the pile cross section that is sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as boulders or rock layers are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. The use of spuds, a short strong driven member which is removed to make a hole for inserting a pile, shall not be permitted in lieu of pilot holes.

After a pile is placed in a pilot hole the voids around the pile shall be filled with clean sand before the pile is driven. After driving, additional sand shall be added to the hole to fill the voids left by the settlement of the sand during driving. Water shall then be added to the hole to saturate the final placement of sand. Pilot holes that terminate in rock shall be backfilled to the top of the rock with substructure concrete after seating the pile. The remainder of the hole may be filled with either sand or concrete.

The Contractor shall decide when the pilot hole will be terminated above the prescribed tip elevation so that the pile will attain the required bearing capacity at the required tip elevation established in the plans when driven with the approved hammer. Where piles are to be end-bearing on rock or hardpan, pilot holes may be carried to the surface of the rock or hardpan unless otherwise noted on the plans. The piles shall then be driven with an impact hammer to insure proper seating.

If the Engineer determines that pre-excavation has disturbed the load bearing capacities of previously installed piles, those piles that have been disturbed shall be restored to conditions meeting the requirements of this specification by redriving or by other methods acceptable to the Engineer. Redriving or other remedial measures shall be instituted after pilot hole excavation operations in the area have been completed. The Contractor shall be responsible for the costs of any necessary remedial measures unless the pilot hole excavation method was specifically included in the contract documents and properly executed by the Contractor.

4. Followers.

Followers shall only be used when approved in writing by the Engineer or when specifically stated in the contract documents. In cases where a follower is permitted, the first pile in each bent and every tenth pile driven thereafter shall be driven full length, without a follower, to verify that adequate pile length is being attained to develop the desired pile capacity. The follower and pile shall be held and maintained in equal and proper alignment during driving. The follower shall be of such material and dimensions to permit the piles to be driven to the length determined necessary from the driving of the full-length piles. The final position and alignment of the first two piles installed with followers in each substructure unit shall be verified to be in accordance with the location tolerances given in this Section before additional piles are installed.

(d) Approval of Pile Driving Hammer.

1. General.

The Contractor shall submit proposed pile driving equipment data for evaluation no less that 30 calendar days prior to the date that the equipment is proposed for use. This data shall be submitted to allow the Materials & Tests Engineer to evaluate the proposed driving equipment. The Contractor shall send the submittal directly to the Materials and Tests Engineer. The Contractor shall also send a copy of the submittal to the Engineer (Project Manager) at the same time that the submittal is sent to the Materials and Tests Engineer. The proposed driving equipment submittal shall be:

- Pile hammer operator's manuals from the hammer manufacturers.
- Completed Pile and Driving Equipment Data Form (Form C-14) for each proposed hammer.
- Charts from the hammer manufacturers shall be submitted with the data form for diesel hammers. For single acting diesel hammers, data equating stroke, blows per

minute, and potential energy shall be shown on the charts. For double acting diesel hammers, data equating bounce chamber pressure to either equivalent energy or stroke of the hammer shall be shown on the charts. The measurements required for the calibration data shown on the charts for double acting diesel hammers shall have been made no more than 90 calendar days prior to the beginning of the driving of the piles.

- If more than one hammer is submitted to drive the same size piling, the hammers shall be prioritized in the order of probable use.

Initial approval of pile driving equipment will be given by the Materials & Tests Engineer after an evaluation (usually a wave equation analysis) of the pile driving equipment data. Final approval will be based on the satisfactory performance of the equipment and successful installation of representative test piles. The representative test pile shall be the first production pile if payment for a test pile is not included in the contract. The pile driving equipment shall not be used until approval of the Engineer (Project Manager) has been given in writing.

Pile driving equipment shall be maintained in proper working condition and shall be sized so that the piles are driven with reasonable effort to the required penetration without damage.

Any change in the driving system will only be considered after the Contractor has submitted a revised Pile and Equipment Data Form for a revised wave equation analysis. The Engineer will notify the Contractor of the acceptance or rejection of the revised driving system within 7 calendar days of receipt of a revised Pile and Driving Equipment Data Form. The time required for submission, review, and approval of a revised driving system shall not constitute the basis for a contract time extension to the Contractor.

2. Wave Equation Analysis Program (WEAP).

The Department, or the Consultant Engineer provided by the Department, will perform all WEAP analyses for each pile driving hammer that the contractor may propose to use. The Department will use the information provided by the Contractor on the Pile and Driving Equipment Data Form to run a wave equation analysis. A Pile and Driving Equipment Data Form will be included in the contract documents or supplied by the Engineer.

The hammer shall be capable of driving the pile to the required tip elevation with a blow count of between 20 and 80 blows per foot or in the case of drive to refusal the blow count must be less than 20 blows/inch {25 mm} (5 blows / ¼ in {25 mm}). The tensile and compressive driving stresses shall be less than the following maximum values:

Pile Type	Maximum Allowable Compressive Stress	Maximum Allowable Tensile Stress
Steel	0.90 Fy	0.90 Fy
Prestressed Concrete	0.85 f'c – (effective prestress).	(3 times the square root of f'c) + effective prestress

The effective prestress may be obtained from the approved shop drawings.

If the hammer is approved, a blow count/bearing capacity graph with an acceptance criteria will be provided. The blow count and hammer stroke required to achieve the required minimum bearing capacity (equal to twice the design load) will be given with the blow count/bearing capacity graph.

During pile driving operations, the Contractor shall use the system submitted and reviewed by the Department. The submitted hammer must successfully install test piles. If the hammer does not successfully install the representative piles, the Engineer will require the Contractor to repair that hammer or submit another pile driving hammer with the analyses as outlined above. No variations in the driving system will be permitted without notifying the Engineer in writing, with the exception of increasing the pile cushion thickness and reducing the energy delivered to the pile to control driving stresses. Any changes in the driving system will only be considered after the Contractor has submitted a revised Pile and Driving Equipment Data Form. If changes are made to the driving system, the Contractor shall perform a load test at no additional cost to the Department unless this requirement is waived by the Materials & Tests Engineer.

In such cases where a WEAP analysis cannot be performed, a dynamic load test will be required to verify that the pile driving hammer is capable of successfully installing a representative test or production pile to the required depth without damage.

(e) Pile Driving Preparation

1. Location and Alignment Tolerance.

Piles shall be driven as nearly as possible in the exact position designated; however, a maximum deviation of 1.5 inches {40 mm} from exact position will be permissible in pile trestle bents and pile abutments, and a maximum deviation of 3 inches {75 mm} from exact position will be allowed for a foundation pile in footings of piers or abutments. Care shall be taken during driving to prevent and correct any tendency of concrete or steel piles to twist or rotate. Footings and encasements shall be formed around the piles to give at least the minimum concrete cover shown on the plans. Piles that are to be swaybraced shall be aligned as necessary so that swaybracing can be properly welded to the piles. After all piling in a bent are aligned within the specified tolerances, the bent cap shall be placed on the piles in exact position.

If the location or alignment tolerances are exceeded, the error will be evaluated by the Bridge Engineer. The Engineer will require corrective work by either:

- stipulating what will be required by the Bridge Engineer for the corrective work or;
- requiring the submittal from the Contractor of proposed details and design calculations for the corrective work. The signature, seal, and date of signature shall be placed on all submittal details and design calculations by a Professional Engineer that is licensed in the State of Alabama and not employed by the ALDOT.

Corrective work shall not be performed until allowed by the Engineer after the Bridge Engineer has either stipulated what will be required or has approved the Contractor's proposed repair. There will be no payment for the cost of corrective work, including the costs of submittals and delay costs.

2. Installation Sequence.

The order of placing individual piles in pile groups shall be starting from the center of the group and proceeding outwards in both directions, unless an alternate installation sequence is approved by the Engineer. If starting the installation from the center and proceeding outwards cannot be done because of battered piles, the Contractor shall submit a proposed sequence of installation to the Engineer for approval.

3. Inspection.

The Project Manager shall be given 24 hour notice before the driving of any test pile or production pile. No pile shall be driven except in the presence of a Department Inspector. An accurate driving record will be kept by the Engineer on Form C-16. Each production pile driving record will be kept by the Engineer and entered into the Engineer's daily log book. The Test Pile Driving Record Form C-15 will be completed by the Engineer each time a test pile is driven. This form includes the number of hammer blows per foot {300 mm} for the entire driven length, the driven length, cutoff elevation, penetration in ground, driving problems, significant time delays, whether or not the test pile was dynamically monitored and any other pertinent information obtained by the Engineer. If a redrive is necessary, the Engineer will record the number of hammer blows per inch {25 mm} of pile movement.

(f) Pile Driving.

1. General.

The Contractor shall be responsible for driving piles with the approved equipment and in accordance with the procedures approved by the Engineer.

2. Test and Production Piles.

A representative test pile shall be driven in the designated location and loaded to verify the minimum bearing capacity. The minimum bearing capacity shall be verified by static testing methods. Correlation between static and dynamic test results will be required prior to using a dynamic test to verify minimum bearing capacity of other test and production piles. The correlation shall also consist of applying a dynamic restrike to the test pile within 48 hours after completion of the static load test using the approved hammer system.

The capacity determined by either test method is assumed to represent the minimum bearing capacity for each of the production piles that the test pile represents. A test pile

represents a specific group of production piles that have the same size, design loading and site soil conditions. The test pile locations and the groups of production piles that each test pile represents will be shown on the plans.

Test piles shall be driven at the locations shown on the plans unless the locations are changed in writing by the Materials & Tests Engineer. Unless otherwise directed, test piles shall be driven at such locations as will permit their use in the finished structure. In no case shall test piles driven out of permanent pile locations be pulled and redriven as production piles. Test piles specified to be used as permanent piles in a structure shall have sufficient length to be cut off at plan grade for top of pile. In general, the specified length of test piles will be greater than the estimated length of production piles in order to provide for variation in soil conditions. Precast concrete test piles shall be a minimum of 10 feet {3 m} longer than the estimated length of piling shown on the plans. Steel piles shall be provided such that 10 additional feet {3 additional meters} of driving would not require an additional splice.

Upon completion of the load testing, any test or anchor piling not a part of the finished structure shall be removed or cut off at least 1 foot {300 mm} below either the bottom of footing or the finished ground elevation (if not loaded within the footing area).

The driving equipment, aids and methods used for driving test piles shall be identical to that which the Contractor proposes to use on the production piling. Approval of driving equipment shall conform with the requirements of these specifications. If piling are to be driven in a pile footing, then the Contractor shall excavate the ground at each test pile footing location to the elevation of the bottom of the footing, before the pile is driven, unless shown on the plans or directed otherwise by the Engineer.

3. Test Pile with Static Load Testing.

Test piles shall be driven to the minimum tip elevation when provided. Test piles shall be driven to a hammer blow count given on the blow count/bearing capacity graph. This graph shall be used as an estimate of the test pile's bearing capacity which uses the required minimum bearing capacity (equal to twice the design load) and stroke to obtain the required blow count for the test pile. Once the required blow count (and minimum tip elevation, when provided) is reached, the bearing capacity shall be proven (after a 7 day wait for concrete piles and a 36 hour wait for steel piles) with a Static Load Test. This blow count and stroke, or the equivalent blow count and stroke, recorded during the last foot {300 mm} of driving of a passing Static Load Test Pile shall be used as the acceptance criteria for the production piling represented by this test pile. A revised bearing graph will be provided by the Materials & Tests Engineer that reflects the actual capacity of the test pile which shall be used to determine the bearing capacity of all production piles represented by this test pile.

The Static Load Test indicates a failure if the bearing capacity determined from the load test is not equal to or greater than the required minimum bearing capacity. If the load test is a failure, the test pile shall be redriven. The blow count for the redrive shall be obtained by determining the blow count required for a theoretical increased bearing capacity. The blow count for the redrive shall be taken from the blow count/bearing capacity graph in accordance with the following formula:

Load For Obtaining Redrive Blow Count = [2 X (A – B)] + A
A = Minimum Bearing Capacity, B = Load At Failure

The test pile shall then be reloaded. This process shall be repeated as many times as necessary until the load test is determined to be a passing load test.

Test piles driven to plan grade and not having the hammer blow count required may also be spliced and driven until the required bearing is obtained. Concrete splices must be approved by the Engineer.

4. Test Pile with Dynamic Load Testing.

Dynamic load testing may be used to supplement static load testing. All dynamic load tests shall be correlated by a minimum of one representative static load test.

If shown on the plans or in the proposal or a change is requested by the contractor and approved by the Materials and Tests Engineer, dynamic measurements will be taken by the Engineer during the driving of piles designated as dynamic load test piles.

The Contractor shall notify the Engineer when the Contractor is ready to drive a dynamic test pile seven days in advance of driving the test pile. If the Contractor changes or delays

the date of the dynamic testing, then the Contractor shall pay for all costs associated with the time delay to the dynamic testing Engineer.

Test piles shall be driven to the minimum tip elevation when provided. Test piles shall be driven to the depth at which the dynamic test equipment indicates the required minimum bearing capacity (equal to twice the design load) has been achieved unless directed otherwise by the Materials and Tests Engineer. The stress in the piles will be monitored during driving with the dynamic testing equipment to insure that the values determined do not exceed the values in Item 505.03(d)2. If deemed necessary by the Engineer, the Contractor shall reduce the driving energy transmitted to the pile by using additional cushions, reducing the energy output of the hammer, or other appropriate methods in order to maintain stresses below the values in Item 505.03(b)2. If non-axial driving is indicated by dynamic test equipment measurements, the Contractor shall immediately realign the hammer system. The Engineer will notify the Contractor or their pile driving Subcontractor if their pile driving procedures violated any of the referenced requirements during the installation of the dynamically tested pile.

The Materials & Tests Engineer may use dynamic measurements to adjust tip elevations after insuring that minimum tip requirements are satisfied. The Materials & Tests Engineer will review the dynamic test data and provide the acceptance criteria for the production piling that are represented by the test pile. A revised bearing graph will be provided by the Materials & Tests Engineer that reflects the actual capacity of the test pile which shall be used to determine the bearing capacity of all production piles represented by this test pile.

For correlation of a static load test with a dynamic load test the Contractor shall, within 48 hours of the static load test, perform a restrike dynamic load test. A cold hammer shall not be used for the restrike. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The sequence shall consist of striking the designated pile for 50 blows or until the pile penetrates an additional three inches {75 mm}, whichever occurs first. In the event the pile movement is less than 1/4 inch {6 mm} during the restrike, the restrike may be terminated after 20 blows. After restrike, the Materials and Tests Engineer will either accept the tip elevation or specify additional pile penetration and testing.

5. Restrike for Production Piles

If dynamic load tests have been correlated to at least one static load test then dynamic load testing may be used to perform a re-strike to verify minimum bearing capacity of production piles.

The Materials & Tests Engineer will direct the Contractor (after waiting seven days for a concrete pile and 36 hours for a steel pile) to perform a restrike dynamic load test. A cold hammer shall not be used for the restrike. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The sequence shall consist of striking the designated pile for 50 blows or until the pile penetrates an additional three inches {75 mm}, whichever occurs first. In the event the pile movement is less than 1/4 inch {6 mm} during the restrike, the restrike may be terminated after 20 blows. Dynamic load test restrike for production piles may be used to verify minimum bearing capacity of piles that fail to achieve the required blow counts determined by test pile installation and static load testing.

6. Driving to Refusal.

No test pile is required for a pile to be driven to refusal, unless shown on the plans. The only exception is when a pile will be dynamically monitored because of an inability to perform a WEAP analysis. Refusal is defined as 20 blows/inch {25 mm} (5 blows / ¼ in {25 mm}). Refusal shall only be used when rock is expected to be encountered. A load test will be required for all other situations.

7. Heaved Piles.

Level readings to check on pile heave after driving shall be made at the start of pile driving operations and shall continue until the Engineer determines that such checking is no longer required. Level readings shall be taken immediately after the pile has been driven and again after piles within a radius of 15 feet {5 m} have been driven. If pile heave is observed, accurate level readings referenced to a fixed datum shall be taken on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All piles that have been heaved more than 0.25 inches {6 mm} shall be

reseated by driving to original position prior to heave. Reseating shall be done without additional compensation. Reseated piles shall be driven to the required resistance or penetration. Concrete shall not be placed in pile casings until pile driving has progressed beyond a radius of 15 feet {3 m} from the pile to be encased.

(g) Loading Methods

1. Static Load Testing Method

a. Description.

Static load testing shall be used to verify the axial load bearing capacity of pile groups or individual piles. Static load testing should be used after a test pile has been driven to the minimum tip elevation (if shown on the plans) and has met the bearing capacity estimate based on blow count and hammer stroke from the provided bearing curves. A static load test may also be used in conjunction with a dynamic load test when verifying axial load bearing capacity of piling.

b. General.

When required, the length of piles to be driven shall be determined by the actual loading tests of any designated pile (Test or Production) in the structure. The test shall be performed as defined by ASTM D 1143, Standard Test Method for Piles Under Static Axial Compressive Load using the Quick Load Test Method. In general, these tests shall consist of the incremental application and removal of static pressure exerted on the pile through approved rigging, together with suitable apparatus for accurately determining the superimposed weight {mass} of pressure and pile settlement under each increment of load. The safe allowable load shall be determined by the Engineer from the settlement versus load curve generated by the incremental loading based on Davisson's failure criterion, explained in Subitem 505.03(g)1.c.

A minimum 7 day waiting period shall be observed between the driving of a concrete load test pile and the commencement of the load testing unless otherwise specified in the contract or authorized by the Materials and Tests Engineer. For piles other than concrete this waiting period shall be 36 hours. The Contractor may extend the waiting period as deemed necessary before performing a static load test to allow for maximum soil set up time.

If the Quick Load Test is performed using adjacent production piles as reaction piles for the test pile, the involved production piles should be checked for any permanent upward displacement. If any upward displacement is found, then all production piles used as reaction piles for the Quick Load Test shall be redriven as necessary to correct any possible axial load bearing capacity problem with the involved piles. This redrive shall be performed at the Contractor's expense.

c. Static Load Test Procedure.

The apparatus for applying the load shall be subject to the approval of the Engineer and have a capacity of 1000 tons {8900 kN} or 300 percent of the design load, whichever is less. Incremental loads of 10% of the design load shall be placed on the pile at 2.5 minute intervals until continuous jacking is required to maintain the incremental load or the capacity of the load frame is reached.

All loading tests will be continually inspected by the Engineer. Time, load, and settlement data will be recorded on Form C-15B immediately before and after the application of each load increment and at intermediate time intervals as specified. When the maximum load has been applied, readings will be taken and recorded when jacking has stopped. Additional readings will be taken after 2.5 minutes and again at 5 minutes. If a longer holding period is specified, additional readings will be taken as required. The load shall be removed after the required holding period in 4 equal parts, with time and rebound readings taken at each unloading increment. Readings will be taken immediately following each load removal, allowing 2.5 minutes between increments. Upon removal of the entire load, time and rebound readings will be taken and recorded. Additional time and rebound readings will be taken after 2.5 minutes and again at 5 minutes.

Load test data will be plotted by the Engineer in the form of settlement in inches {millimeters} (ordinate, positive down) versus applied load in kips {kN} (abscissa).

Ultimate capacity predictions will be based upon Davisson's failure criterion as applied to the aforementioned settlement curve, as per FHWA's Manual on Design and Construction of Driven Pile Foundations. In this method, the elastic shortening of the pile (QL/AE, in inches {millimeters}) is superimposed on the settlement curve. In the elastic shortening equation, "Q" represents load in kips {kN}, "L" represents length of pile from settlement instrumentation to tip elevation in inches {meters}, "A" represents cross-sectional area in square inches {square meters} (at voided section, if a void is present), and "E" represents elastic modulus in ksi {MPa} (elastic modulus for concrete piles is preferably obtained from dynamic load testing, but may be calculated as 60,000 {5000} times the square root of the design compressive strength, in psi {MPa}, when dynamic load testing is not performed. The elastic modulus for steel piles may always be assumed as 29,000 ksi {200,000 MPa}).

The aforementioned elastic shortening curve is then increased or offset, by 0.15+D/120 in inches {3.81+D/120 in millimeters} (where D = pile diameter or width in inches {mm}). The point in which the offset elastic shortening curve intersects the settlement curve is considered the ultimate pile capacity.

d. Hydraulic Jacks and Load Gages.

When hydraulic jacks and gages are to be used for the superimposed load, the jacks, gages and hydraulic pumps shall have been calibrated with each other within the last 6 months by an independent laboratory that has been approved by the Materials and Tests Engineer or by a Department laboratory. If multiple jacks are to be used with one gage, the calibration shall be performed at an approved independent laboratory. All jack calibrations shall be conducted in accordance with ALDOT-358 and shall be valid for a period of 6 months from the date of calibration; however, should the Engineer have any doubt of their accuracy he may require a check of their calibration using ALDOT equipment. All calibration checks shall be within 5% of the applied load. When a jack, gage and hydraulic pump are calibrated they shall be used as a unit, and changing any one of the three components shall require a recalibration. Gages shall be of the size that will provide ease of reading (approximately 4.5 inch {115 mm} diameter) with gradations for 2 tons {18 kN} or less for loads under 100 tons {890 kN} and gradations of 5 tons {44 kN} or less for loads over 100 tons {890 kN}.

Calibrated jacks, gages and pumps shall have identifiable serial numbers to insure traceability to calibration tests.

2. Dynamic Load Testing Method.

a. Description.

Dynamic Load Testing shall be used to verify that the pile (test or production) is not overstressed while being driven and to determine the axial load bearing capacity. A Dynamic Load Test may also be used in conjunction with a Static Load Test when verifying the axial load bearing capacity of piling.

b. General.

When required, the length of piles to be driven shall be determined by the actual Dynamic Loading Test of any pile (test or production) in the structure. The test shall be performed as defined by AASHTO T 298, Standard Method of Test for High-Strain Dynamic Testing of Piles. Dynamic measurements shall be taken by the Engineer during the driving of piles designated as dynamic load test piles and/or production piles. In general, Dynamic Load Testing involves attaching two strain transducers and two accelerometers to the pile approximately 2 to 3 pile diameters below the pile head before initial driving (or at a convenient location during restrike dynamic load testing). The dynamic test is performed during actual pile driving. Dynamic load testing shall be performed, when required, on test or production piles only after a WEAP analysis has been performed.

When directed by the Engineer, the Contractor shall (after waiting seven days for a concrete pile and 36 hours for a steel pile) perform a restrike dynamic load test. A cold hammer shall not be used for the redrive. The hammer shall be warmed up before redrive begins by applying at least 20 blows to another pile or other fixed object. After redriving, the Engineer will either accept the tip elevation or specify additional pile penetration and testing.

c. Process

Prior to placement in the leads, the Contractor shall make each designated concrete pile available for taking of wave speed measurements and for predrilling the required instrument attachment holes. Since there must be room on either side of the pile to drill instrumentation holes, the Contractor may be required to move piles to attain adequate clearance. Predriving wave speed measurements will not be required for steel piles, however steel piles must be available for predrilling instrument attachment holes. When wave speed measurements are made, the piling shall be in a horizontal position and not in contact with other piling. When required, the Contractor will furnish the equipment, materials, and labor necessary for drilling holes in the piles for mounting the instruments. The instruments will be attached near the head of the pile with bolts placed in masonry anchors for concrete piles or through drilled holes on steel piles. In no case shall the pile to be dynamically tested be picked up before the pile has been predrilled.

The Contractor shall provide the Engineer with a safe, stable access to the top of the pile installed in the leads. The access shall conform to OSHA requirements. The access system shall be assembled and/or operated by the Contractor and shall provide a working area of not less than 16 square feet {1.5 square meters}. The Contractor shall furnish the Engineer details of the access system with the aforementioned Pile and Driving Equipment Data Form submittal.

The Contractor shall furnish electric power for the dynamic test equipment. The power supply at the outlet shall be 10 Amp, 115 Volt, 55-60 cycle, A.C. only. Field generators used as the power source shall be equipped with functioning meters for monitoring voltage and frequency levels.

(h) Piling Length.

1. Estimated Lengths of Piles.

The estimated length of piles shown on the plans and in the proposal are for bid purposes only. The Contractor shall be responsible for providing the lengths of these piles necessary to obtain the bearing and penetration required as determined from results obtained in driving representative test piles or other pertinent data. It is expected that there will be variations in final tip elevations due to differences in driving resistance because of differing soil conditions.

2. Pile Tip Elevation.

The final tip elevation of each pile will be determined by the Engineer during the driving operation but in general, the minimum penetration for any pile shall be not less than 10 feet {3 m} into natural ground and not less than 1/3 the length of the pile. When minimum tip elevations are specified by contract documents, the Contractor shall drive piles to a depth that satisfies this requirement in addition to required minimum bearing capacity.

3. Proposed Pile Lengths.

a. Steel Piles.

The Contractor shall furnish to the Engineer, for review, the proposed steel pile lengths for use in each bent of a structure before driving the piles.

b. Concrete Piles.

The Contractor shall furnish to the Engineer, for review, the proposed concrete pile lengths for use in each bent of a structure before casting the piles. The lengths of concrete piles will be approved by the Engineer before the casting of the piles.

(i) Unsatisfactory Piles.

Approval of a pile hammer relative to driving stress damage shall not relieve the Contractor of responsibility for the piles damaged because of misalignment of the leads, failure of the cap block or cushion material, failure of splices, malfunctioning of the pile hammer, pile manufacturer's errors, or other improper construction methods. Piles damaged for such reasons shall be rejected and replaced at the Contractor's expense when the Engineer determines that the damage impairs the strength of the pile.

The method used in driving piles shall not subject the piles to excessive or undue abuse producing crushing, cracking, or spalling of concrete or deformation of the steel. Misaligned piles shall not be forced into proper position. Any pile damage during driving by reason of internal

defects, or by improper driving, or driven out of its proper location, or driven below the designated cutoff elevation shall be corrected at the Contractor's expense by a method approved by the Engineer.

Piles which have been bent during installation shall be considered unsatisfactory unless the bearing capacity is proven by load tests performed at the Contractor's expense. If such tests indicate inadequate capacity, corrective measures as proposed by the contractor and approved by the Bridge Engineer, shall be taken such as installation of additional piles, strengthening of bent piles, or replacement of bent piles.

A concrete pile will be considered defective if a visible crack or any defect is observed which, as determined by the Engineer, affects the strength or life of the pile.

(j) Splicing Piles.

1. General.

Full length piles shall be used wherever practical. When splicing is necessary and cannot be avoided, the approved method shown on the plans shall be used. If details are not shown on the plans, the contractor's proposed method of pile splicing shall be submitted to the Bridge Engineer for review and distribution.

2. Precast Prestressed Concrete Piles.

When necessary, the contractor shall submit proposed pile splicing details and design calculations to the Bridge Engineer for review and distribution. The details shall be checked, stamped approved, and signed by a Professional Engineer licensed by the Alabama Board of Licensure for Professional Engineers. This Professional Engineer shall not be an employee of the ALDOT. Any driving splice for a concrete pile will require dynamic testing during the driving to verify the performance of the splice. Payment for this requirement will be made under the item for Dynamic Loading Tests.

3. Steel Piles and Steel Shells for Cast-In-Place Concrete Piles.

Splicing of these piles shall be made in accordance with details shown on the plans or furnished. The Department has established the Miscellaneous Approved Products List which includes approved pile splicers. Information concerning this list is given in Subarticle 106.01(f) and in the Materials, Sources and Devices with Special Acceptance Requirements Manual (Qualified Products List). Only approved pile splicers shown on this list or approved by the State Construction Engineer shall be used. Welded connections for splices shall be used. All work shall be done with approved methods, materials, and experienced personnel who have been ALDOT certified 3F (qualification for fillet welding in a vertical position). Welding shall be in accordance with the Department's current Welding Specification.

Not more than three pieces (two splices) of steel pile will be permitted in making up one full length of proposed pile. Pile splices shall only be used below ground with the exception of test piles. In addition to meeting the requirements of the Specifications, the Contractor shall submit documentation of the identification (heat numbers for steel piles) of all portions of a built-up pile.

Splicer material shall be hot dip galvanized in accordance with the requirements listed in Subarticle 505.02(b) as follows:

- For above ground splices of galvanized test piles.
- For below ground splices of all galvanized piles if the plans require the piling to be galvanized down to the estimated or minimum tip elevation.

Before welding, the galvanization shall be removed from the weld area by mechanical means. Once all welding is complete, the weld area shall be cleaned and painted with a cold galvanization material from List III-1 of the Materials, Sources, and Devices with Special Acceptance Requirements Manual.

(k) Pile Points.

Pile points shall be furnished and installed as shown on the Plans or as directed by the Engineer. The type of required pile points will be designated on the Plans or by the Engineer. If pile points with cutting teeth are required it will be noted on the Plans and the Contractor shall furnish the required type of pile point with cutting teeth.

The types of pile points designated for use will be classified as follows:

- Type A-Heavy pile points.
- Type B-Light pile points.

Type A pile points may be used as a direct substitution for the Type B pile points.

The Department has established an Approved Materials List for pile points. Information concerning this list is given in Subarticle 106.01(f) and in Materials, Sources and Devices With Special Acceptance Requirements, List II-2. Only pile points shown on this list shall be used.

The pile points shall be welded to the ends of the piles in accordance with the following requirements:

- The welds for the attachment of a pile point shall be partial penetration single bevel groove welds placed full flange width along the outside of each pile flange.
- Either the pile point or the outside of each flange of the pile shall be beveled 45 degrees. The depth of the bevel shall be 3/8" minimum for HP10 and HP12 piles, and 7/16" minimum for HP13 and HP14 piles {10 mm minimum for HP250 and HP310 piles and 11 mm minimum for HP360 piles}. The width of weld at the outside face of the pile flange shall be the same as the beveled depth.
- E70XX welding rods shall be used.
- All welds shall be made in the flat position. The welder shall be ALDOT certified 1G (qualification for groove welding in flat position). Welding shall be in accordance with the Department's current Welding Specification.

(l) Cut-Off Lengths.

The tops of all permanent piles and pile casings shall be cut-off at the elevation shown on the plans or as ordered by the Engineer. All cut-off lengths not used in the structure shall become the property of the Contractor and shall be removed by the Contractor from the site of the work.

(m) Pile Painting and Protection.

All exposed surfaces of new steel piling and steel bracing members attached to the piling shall be coated after installation in accordance with the details shown on the plans and the requirements given in Section 521. The containment system and the submittal of a surface preparation plan described in Section 521 will not be required. Storage and handling of piles shall be in accordance with Article 834.11.

Field repair of galvanized coatings may be used to repair damaged areas, weld areas at pile splices, weld areas at sway braces to piles or other areas of coating damage. All field repairs shall be made in accordance with ASTM A 780. The Engineer shall be the sole judge of damaged areas that require field repair of the galvanized coating.

When galvanized members are to be field welded the Contractor shall clean the area at the weld location for a distance sufficient to provide an area free of coating for the weld metal to be deposited. The Contractor's cleaning method shall be pre-approved by the Engineer and cleaned areas shall be inspected and approved prior to field welding.

(n) Permanent Sheet Piling.

1. General.

Permanent sheet piling shall be new piling and shall be furnished and driven by the Contractor as provided on the plans or as designated by the Engineer.

2. Construction Details, Permanent Steel Sheet Piling and Concrete Sheet Piling.

All construction methods for steel sheet piling and precast concrete sheet piling shall conform to the respective requirements prescribed herein for steel and precast concrete bearing piling and as directed. Precast Concrete sheet piling may require the use of some tapered units in order to maintain vertical alignment of the sheet pile wall. Sheet piling shall be driven to the appropriate elevations. Where necessary, cutting off driven sheet piling shall be done by approved methods and in a satisfactory manner.

(o) Temporary Steel Sheet Piling.

Temporary steel sheet piling wall shall be designed, furnished and driven at the locations shown on the plans or as directed by the Engineer, and removed when no longer needed. Working drawings and design calculations for the sheet pile walls shall be submitted in accordance with the requirements given in Article 105.02 for the submittal of Working Drawings. The design shall be in accordance with the current AASHTO Standard Specifications for Highway Bridges.

The piling shall be driven to an adequate depth and/or so braced or tied back as to protect the work from damage and workmen from danger of injury and to also protect the newly constructed work from failure.

(p) Protection of Existing Structures and Utilities.

The Contractor shall control his operations to prevent damage to existing structures and utilities as outlined in Article 107.12. Preventive measures shall include, but are not limited to, selecting construction methods that will limit ground disturbance such as vibrations from pile driving operations and other construction related activities. Photographic, video and other surveys of surrounding structures and utilities could be made prior to driving to serve as documentation of the conditions prior to driving.

505.04 Method of Measurement.

(a) Test Piles.

The actual number of acceptable test piles driven as directed in conformity with these Specifications, will be measured complete in place. Piles paid for as test piles will not be included in the measurement of the linear feet {meters} of production piles. No measurement or direct payment will be made for test pile cut-offs or splices necessary to lengthen test piles.

(b) Static Loading Tests.

The number of static loading tests measured will be the actual number of accepted static loading tests ordered and completed in conformity with this Specification. If the pile does not carry the load satisfactorily after the load is placed according to the Specifications, and it becomes necessary to redrive the pile and place another load, this will be deemed an additional stage of loading. Each time the pile is driven to additional penetration and load tested again, each loading will be measured as an additional stage of loading, not as an additional loading test.

(c) Dynamic Loading Tests.

The number of dynamic loading tests measured will be the actual number of accepted dynamic loading tests ordered and completed in conformity with the specifications. There will be no additional payment for a restrike dynamic loading test performed on a designated test pile. Restrike dynamic loading tests required on production piles will be included for measurement as dynamic loading tests.

(d) Pile Points.

Pile points will be measured per each point installed on the end of an accepted pile.

(e) Steel Pile Splices.

No measurement or payment will be made for steel pile splices.

(f) Steel Piling Furnished and Driven.

The accepted lengths of steel piling furnished and driven to remain in the finished structure will be measured in linear feet, complete in place.

No measurement for payment will be made of steel pile cut-offs.

No measurement will be made for steel pile splices.

Pile cap plates, cap channels, and sway bracing will be measured and paid for as Structural Steel, per pound {kilogram}.

Piling damaged by the Contractor in handling or driving will not be accepted.

The cost of galvanizing, if required, shall be included in the pay item for steel piling. The cost of galvanizing sway bracing shall be included in the cost of the Structural Steel.

(g) Concrete Piling Furnished.

The approved lengths of concrete piling (lengths approved by the Engineer for casting) will be measured in linear feet {meters}.

(h) Concrete Piling Driven.

The approved casting lengths of concrete piling remaining in the finished structure (casting lengths minus any cut-offs) will be measured in linear feet {meters}.

(i) Concrete Pile Splice.

The build-up of a pile, where the pile will not be driven with the build-up, will be measured in linear feet {meters} from the joint at the bottom of the build-up to the top of the pile. The linear feet {length in meters} of build-up will be included in the quantity of Concrete Piling Furnished. The splicing of this build-up will be measured as 30 additional linear feet {10 additional meters} of Concrete Piling Furnished.

The build-up and splicing of a pile, where the pile will be driven with the build-up, will not be measured for payment under a contract pay item but will be paid for as Extra Work.

(j) Concrete Pile Cut-Off.

Each cut-off of a concrete pile will be measured as 6 additional linear feet {2 additional meters} of Concrete Piling Furnished.

(k) Permanent Sheet Piling.

The quantity of permanent steel or concrete sheet piling to be measured for payment shall be the quantity in linear feet {meters} of such piling actually remaining in the completed structure and accepted. In computing the linear feet {meters}, the lengths shall be those lengths under cutoffs.

(l) Pilot Holes.

Pilot holes will be measured for payment by the linear foot {meter}. Pilot Holes will be measured from the top of the material where the auger or drill begins the excavation to the bottom of the hole.

(m) Temporary Steel Sheet Piling.

Temporary steel sheet piling will be measured for payment in units of square feet {square meters}. This square foot {square meter} quantity will be determined from the length and width of individual sheet piles. The length of a sheet pile will be measured from the embedded tip to 1 foot {300 mm} above the existing ground or placed fill, whichever is appropriate. The width of a sheet pile will be the distance from centerline of the interlock on one side to the centerline of the interlock on the other side. The width of a sheet pile will be measured along the line of the sheets, not adding for bends or corrugations. The square foot {square meter} quantity for which payment will be made will be the sum of the square foot {square meter} areas of the individual sheet piles.

505.05 Basis of Payment.

(a) General.

The contract unit price bid for the various type piling covered by this Section shall be full compensation for furnishing and installing all materials required by each item of work, and for all equipment, tools, labor and incidentals necessary to complete the work. Each pay item includes fabrication, treatment, transportation, handling, driving, jetting, spudding, capping, painting and finishing where necessary and as required by other portions of the specifications and the plans. The pay item for steel piling includes the splicing and cutting off of the piles. Additional payment will be made for splicing and cutting off concrete piles. All cut-offs shall become the property of the Contractor. No payment will be made for falsework piling and no additional payment will be made for driving piles on a batter.

(b) Static Loading Tests.

Accepted static loading tests will be paid for at the contract unit price for static loading tests per each, complete in place, which shall be payment in full for all materials, equipment and labor incidental to constructing the loading platform, instrument shelter, procuring and placing the loading material, and/or equipment, and removing and disposing of the platform and material and/or equipment to the satisfaction of the Engineer.

Payment will be made for each additional stage of loading described in Subarticle 505.04(b). Payment will be the percentage of the contract price for a Loading Test given in the following table.

Design Load Shown On Plans (tons) {metric tons}	Percentage of Contract Price for a Loading Test
Up to 50 {45}	50%
Over 50 {45} to 75 {70}	75%
Over 75 {70}	100%

(c) Dynamic Loading Tests.

Accepted dynamic loading tests will be paid for at the contract unit price for Dynamic Loading Tests per each, complete in place, which shall be payment in full for all equipment and labor incidental to aiding the Engineer in the performance of this test and for all costs associated with down time while setting up equipment, making dynamic measurements, down time while waiting to perform a restrike dynamic test, and the restrike dynamic test.

(d) Permanent Sheet Piling.

The quantity of acceptable sheet piling in place after all cut-offs have been made will be paid for at the respective contract price for the type of sheet piling listed. The contract unit price bid for this item shall also include any necessary excavation unless an item of excavation is provided in the contract.

(e) Pile Points.

Pile Points will be paid for at the contract unit price per each. This payment shall be full compensation for furnishing the points and all materials, labor and incidentals necessary to install the points.

(f) Concrete Pedestal Foundations.

Where hardmarl, solid rock or other conditions are encountered that make it necessary or desirable to place piles in concrete pedestal foundations, the net length of piling so placed in the structure will be paid for at the contract unit price for the respective kinds of piling. The additional work required for construction of the pedestal foundations will be paid for as extra work as outlined in Article 104.03, Extra Work.

(g) Pilot Holes.

The contract unit price per linear foot {meter}, measured as noted above, shall be payment in full for all materials, equipment and labor required to excavate the pilot hole. It shall also be payment in full for the disposal of excavated material and for filling the voids in pilot holes around the piles with sand or concrete.

(h) Temporary Steel Sheet Piling.

The quantity of temporary steel sheet piling acceptably placed, measured as noted above, will be paid for at the unit bid price which includes furnishing the design and piling, driving, bracing, and removing the piling. The piling, after removal, shall remain the property of the Contractor.

(i) Steel Piling Furnished and Driven.

The accepted lengths of steel piling in the finished structure will be paid for at the respective contract price for steel piling furnished and driven. The extra length (beyond estimated length) of steel pile that may be required to complete a structure will be paid for at the contract price for steel piling furnished and driven. No payment will be made for cut-offs or splices of steel piling.

(j) Concrete Piling Furnished.

The approved lengths of concrete piling (lengths approved by the Engineer for casting) will be paid for at the respective contract price for concrete piling furnished.

Non-driven pile build-ups and cut-offs will be paid for at the designated rate for concrete piling furnished.

(k) Concrete Piling Driven.

The approved casting lengths of concrete piling remaining in the finished structure (casting lengths minus any cut-offs) will be paid for at the respective contract price for concrete piling driven. No payment for build-ups, either driven or non-driven, will be made under this item.

(l) Payment will be made under Item No.:

505-A Type Test Piles (*)(***) – per each
505-B Static/Dynamic Loading Tests (*)– per each
505-E Permanent Steel Sheet Piling - per linear foot {meter}
505-F Permanent Concrete Sheet Piling (width) – per linear foot {meter}
505-G Pile Points (**) – per each
505-H Pilot Holes – per linear foot {meter}
505-I Temporary Steel Sheet Piling – per square foot {square meter}
505-M Steel Piling Furnished and Driven (*)(***) – per linear foot {meter}
505-N Concrete Piling Furnished (*) – per linear foot {meter}
505-O Concrete Piling Driven (*) – per linear foot {meter}

* Pile Designation/Size
** Type/Size of Pile Point
Example: 505-G Pile Points (Type A 10”)
*** Galvanized (If Required)