Origination Form

Specifications

Name:	Rodrigo Herrera	**Standard Specification Section:**	455
Email:	rodrigo.herrera@dot.state.fl.us	**Special Provision:**	
Date:	2025-06-02T14:44:35Z	**Associated Specs:**	105. That revision will be uploaded separately

Summary:

Updates made to clarify the requirements for pile driving operations, and the use of pay items for those activities.

Justification:

The previous version of the Specification had significant updates implemented regarding pile driving, particularly in the manner that payment is made for the various activities required for pile installation. The proposed updates to the current version are mostly clarification as to what those activities are, and how they are paid for.

Do the changes affect other types of specifications?

Neither

List Specifications Affected:

Other Affected Documents/Offices	Contacted	Yes/No
Other Standard Plans		No
Florida Design Manual		No
Structures Manual		No
Basis of Estimates Manual	Ashley Anderson, Cheri Sylvester, Joshua Toole, June Mobley	Yes
Approved Product List		No
Construction Office		No
Maintenance Office		No
Materials Manual		No

Traffic Engineering Manual		No

Are changes in line with promoting and making progress on improving safety, enhancing mobility, inspiring innovation, and fostering talent; explain how?

The Specifications Section 455 focuses on enabling foundation construction in a manner that is efficient, safe and reliable. The recent updates address data collection, reporting of results, clarification on terms, monitoring of stresses during pile installation, and payment items.

What financial impact does the change have; project costs, pay item structure, or consultant fees?

The clarifications made in the text, which will be followed by a more detailed explanation during the upcoming Transportation Symposium, should result in potential cost savings to the Department in terms of quantities of material and construction time.

What impact does the change have on production or construction schedules?

The updates are not likely to have a major impact on construction schedules.

How does this change improve efficiency or quality?

The goal is to produce a document that provides for an efficient and safe construction environment and results in cost effective and reliable structures. The updates made should be conducive to that end by implementing updates made regarding pile driving activities.

Which FDOT offices does the change impact?

Construction

What is the impact to districts with this change?

The updates should assist the Districts in implementing pile driving requirements in an efficient manner.

Does the change shift risk and to who?

No, the risk model remains untouched.

Provide summary and resolution of any outstanding comments from the districts or industry.

Comments and Responses are available on the Track the Status of Revisions hyperlink located on the Specifications landing page: https://www.fdot.gov/programmanagement/Specs.shtm

What is the communication plan?

Through the established specification revision process (e.g., Internal and Industry Review)

What is the schedule for implementation?

The Standard Specifications eBook and Workbook are effective July 1st every year.

STRUCTURES FOUNDATIONS
(REV 6-2-25)

SUBARTICLE 455-2.1 is deleted and the following substituted:

455-2.1 General: Employ a professional testing laboratory, or Specialty Engineer with prior load test experience on at least three projects, to conduct the load test in compliance with these Specifications, to record all data, and to submit reports of the test results to the Engineer except when the Contract Documents show that the Department will supply a Geotechnical Engineer to provide these services.

Perform data collection of strain gauges within 4 hours of completing the installation of the drilled foundation, including drilled shafts, auger cast piles, and micropiles.

Perform the load test by applying a load up to the load required in the Contract Documents or to the failure load, whichever occurs first.

Do not apply test loads to piles sooner than 48 hours (or the time interval shown in the Plans) after driving of the test pile or reaction piles, whichever occurs last.

Do not begin static load testing of drilled shafts until the concrete has attained a compressive strength of 3,400 psi. The Contractor may use high early strength concrete to obtain this strength at an earlier time to prevent testing delays.

Load test piles/shafts in the order directed by the Engineer. Unless shown otherwise in the Contract Documents, provide all equipment, materials, labor, and technical personnel required to conduct the load tests, including determination of anchor reaction member depths. In this case, provide a loading apparatus designed to accommodate the maximum load plus an adequate safety factor.

While performing the load test, provide safety equipment, and employ safety procedures consistent with the latest approved practices for this work. Include with these safety procedures, adequate support for the load test plates and jack to prevent them from falling in the event of a release of load due to hydraulic failure, test pile/shaft failure, or any other cause.

Include in the bid the cost of transporting load test equipment and instrumentation supplied by the Department from their storage location to the job site and back. Handle these items with care. The Contractor is responsible for the safe return of these items. After completion of the static load tests, return all Department furnished equipment in satisfactory operating condition. Repair all damage to the test equipment furnished by the Department to the satisfaction of the Engineer. Clean all areas of rust on structural steel items, and recoat those areas in accordance with Section 560. Return all load test equipment supplied by the Department within 30 days after completing the load tests.

The Contractor is responsible for the equipment from the time it leaves its storage area until the time it is returned. During this time, insure the equipment against loss or damage for the replacement cost thereof (the greater of $150,000 or the amount shown in the Plans) or for the full insurable value if replacement cost insurance is not available.

Notify the Engineer at the preconstruction conference, or no later than 30 days before beginning test pile installation, of the proposed testing schedule so that items supplied by the Department may be reserved. Notify the Department at least ten working days before pick-up or return of the equipment. During pick-up, the Department will complete a checklist of all equipment placed in the Contractor's possession. The Department will later use this checklist to verify that the Contractor has returned all equipment. Provide personnel and equipment to load

or unload the equipment at the Department's storage location. Provide lifting tongs or nylon slings to handle Department owned test girders. Do not perform cutting, welding, or drilling on Department owned girders, jacks, load cells, or other equipment.

SUBARTICLE 455-2.4 is deleted and the following substituted:

455-2.4 Load Test Instrumentation:

1. General: The intent of the load test instrumentation is to measure the test load on top of the pile/shaft and, when provided in the Contract Documents, its distribution between side friction and end bearing to provide evaluation of the preliminary design calculations and settlement estimates and to provide information for final pile/shaft length design. Ensure that the instrumentation is as described in the Contract Documents.

When requested by the Engineer, provide assistance during installation of any instrumentation supplied by the Department. Supply 110 V, 60 Hz, 30 A of AC electric power in accordance with the National Electric Code (NEC) to each test pile/shaft site during the installation of the instrumentation, during the load testing, and during any instrumented redrives ordered by the Engineer.

Place all of the internal instrumentation on the rebar cage before installation in the test shaft. Construct the rebar cage at least two days before it is required for construction of the test shaft. Provide assistance during installation of instrumentation supplied by the Department, including help to string, place, and tie the instrumentation and any assistance needed in moving or repositioning the cage to facilitate installation. Place the rebar cage in one segment complete with its instrumentation. The Engineer may require multiple lift points and/or a suitable "stiffleg" (length of H pile or other suitable section) to get the cage in a vertical position without causing damage to the instrumentation. Successfully demonstrate the lifting and handling procedures before the installing instrumentation.

2. Hydraulic Jack and Load Cell: Provide hydraulic jack(s) of adequate size to deliver the required test load to the pile/shaft unless shown otherwise in the Plans. Before load testing begins, submit a certificate from a reputable testing laboratory showing a calibration of gauge readings for all stages of jack loading and unloading for jacks provided. Ensure that the jack has been calibrated within the preceding six months unless approved otherwise. Recalibrate the jack after completing load testing if so directed by the Engineer. Ensure that the accuracy of the gauge is within 5% of the true load.

Provide an adequate load cell approved by the Engineer that has been calibrated within the preceding six months. Provide an approved electrical readout device for the load cell. Submit a certificate from an independent testing laboratory showing a calibration of readings for all stages of loading and unloading for load cells furnished by the Contractor and obtain the approval of the Engineer before beginning load testing. Ensure that the accuracy of the load cell is within 1% of the true load.

3. Telltales: When shown in the Contract Documents, furnish and install telltales that consist of an unstressed steel rod placed, greased for reducing friction and corrosion, with appropriate clearance inside a constant-diameter pipe that rests on a flat plate attached to the end of the pipe at the point of interest shown in the Contract Documents. Construct telltales in accordance with the Contract Documents. Install dial gauges reading to 0.001 inch with 1 inch minimum travel as directed by the Engineer to measure the movement of the telltale with respect to the top of the pile/shaft.

4. Embedded Strain Gauges: ~~When shown in the Contract Documents, f~~Furnish and install vibrating-wire strain gauges ~~in the test shaft~~ to measure the distribution of the load~~,~~ and provide a minimum of four gauges per level. ~~Ensure that the type, number, and location of the strain gauges are as shown in the Plans or as directed by the Engineer.~~ Ensure that the type, number, and location of the gauges are as shown in the Plans or as directed by the Engineer. Use strain gauges that are waterproof and have suitable shielded cable that is unspliced within the shaft.

SUBARTICLE 455-2.8 is deleted and the following substituted:

455-2.8 Required Reports: Include in the report of the load test the following information:

1. A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the pile/shaft.

2. A graphic representation of the test results, during loading and unloading of pile/shaft top movement as measured by the average of the dial gauge readings, from wireline readings and from level readings.

3. A graphic representation of the test results, when using telltales, showing pile/shaft compression and pile/shaft tip movement.

4. The estimated failure and safe loads according to the criteria described herein.

5. Remarks concerning any unusual occurrences during the loading of the pile/shaft.

6. The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.

7. All supporting data including jack and load cell calibrations and certificates and other equipment requiring calibration.

8. ~~When the Contract Document requires internal instrumentation of the pile/shaft, f~~Furnish initial strain readings and all of the data taken during the load test together with instrument calibration certifications. ~~In addition, submit a report showing an~~ Include analysis of the results of axial load and lateral load tests in which soil resistance along and against the pile/shaft is reported as a function of deflection~~,~~ strain data, soil borings and associated laboratory testing.

Submit the necessary reports prepared by the Specialty Engineer responsible for collection and interpretation of the data, except when the Contract Documents show that the Department will provide a Geotechnical Engineer.

SUBARTICLE 455-5.3 is deleted and the following substituted:

455-5.3 Pile Hammers: All equipment is subject to satisfactory field performance during and without dynamic testing. Use a variable energy hammer to drive concrete piles. Hammers will be rated based on the theoretical energy of the ram at impact. Supply driving equipment which provides the required resistance at a blow count ranging from 3 blows per inch (36 blows per foot) to 10 blows per inch (120 blows per foot) at the end of initial drive, unless approved

otherwise by the Engineer after satisfactory field trial. End of initial drive (EOID) is defined as the pile penetration that reaches the required nominal bearing resistance at or below minimum tip, practical refusal, the authorized pile length driven to 12 inches above cut off or the bearing resistance required for soil set-up in accordance with 455-5.11.7. Ensure the hammer is capable of driving to a resistance equal to at least 2.0 times the factored design load plus the scour and down drag resistance shown in the Contract Documents, without overstressing the piling in compression or tension and without reaching or exceeding 20 blows per inch. When the Engineer determines the stroke height or bounce chamber pressure readings do not adequately determine the energy of the hammer, provide and maintain a device to measure the velocity of the ram at impact. Determine the actual hammer energy in the field so that it is consistent with the hammer energy used for each bearing capacity determination. When requested, submit to the Engineer all technical specifications and operating instructions related to hammer equipment.

455-5.3.1 Air: Variable energy air hammers shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke for hammers with strokes up to 4 feet and no more than 2 feet for hammers with maximum strokes lengths over 4 feet. Operate and maintain air hammers within the manufacturer's specified ranges. Use a plant and equipment for air hammers with sufficient capacity to maintain, under working conditions, the hammer, volume and pressure specified by the manufacturer. Equip the plant and equipment with accurate pressure gauges which are easily accessible to the Engineer. The Engineer will not accept final bearing on piles the Contractor drives with air hammers unless the Contractor operates the hammers within 10% of the manufacturer's rated speed in blows per minute, unless otherwise authorized by the Engineer. Provide and maintain in working order for the Engineer's use an approved device to automatically determine and display the blows per minute of the hammer.

455-5.3.2 Diesel: Variable energy diesel hammers shall have at least three fuel settings that will produce reduced strokes. Operate and maintain diesel hammers within the manufacturer's specified ranges. Determine the rated energy of diesel hammers using measured ram stroke length multiplied by the weight of the ram for open end hammers and by methods recommended by the manufacturer for closed end hammers.

Equip closed-end (double acting) diesel hammers with a bounce chamber pressure gauge, in good working order, mounted near ground level so the Engineer can easily read it. Also, submit to the Engineer a chart, calibrated to actual hammer performance within 30 days prior to initial use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

455-5.3.3 Hydraulic: Variable energy hydraulic hammers shall have at least three hydraulic control settings that provide for predictable energy or equivalent ram stroke. The shortest stroke shall be a maximum of 2 feet for the driving of concrete piles. The remaining strokes shall include full stroke and approximately halfway between minimum and maximum stroke.

Supply hammer instrumentation with electronic read out, and control unit that allows the Engineer to monitor, and the operator to read and adjust the hammer energy or equivalent ram stroke. When pressure measuring equipment is required to determine hammer energy, calibrate the pressure measuring equipment before use.

455-5.3.4 Vibratory: Vibratory hammers of sufficient capacity (force and amplitude) may be used to drive steel sheet piles and, with approval of the Engineer, to drive steel bearing piles a sufficient distance to get the impact hammer on the pile (to stick the pile).

The Engineer will determine the allowable depth of driving using the vibratory hammer based on site conditions. However, in all cases, use a power impact hammer for the last 15 feet or more of the final driving of steel bearing piles for bearing determinations after all piles in the bent/pier have been driven with a vibratory hammer. Do not use vibratory hammers to install concrete piles, or to install support or reaction piles for a load test.

455-5.3.5 Pile Inspection Device: Provide a pile inspection device that displays and stores electronically for every hammer blow along with a timestamp: stroke for open-ended diesel hammers and blows per foot and blows per minute for all hammers. The device must auto-generate the Department's Pile Driving Record form and export the non-editable electronic data in a format compatible with the Pile Driving Record form. Use this device during the inspection of test piles and production piles.

SUBARTICLE 455-5.11.4 is deleted and the following substituted:

455-5.11.4 Set-checks and Pile Redrive:

1. Set-checks: Set-checks consist of ~~redriving~~ restriking the pile after the EOID~~a certain period of time,~~ within the time period specified~~-~~ in sections 455-11.9.1 and 455-11.9.2. ~~typically within the same day.~~ Perform set-checks as required and at the waiting periods shown in the Contract Documents. Provide an engineer's level or other suitable equipment for elevation determinations to determine accurate pile penetration during the set-checks. A pile may be accepted when a set-check shows that it has achieved the minimum required pile bearing and has met all other requirements of this Section.

2. Pile Redrive: Pile redrive consists of restriking ~~redriving~~ the pile beyond the time period specified in sections 455-11.9.1 and 455-11.9.2 ~~after the following working day from initial driving~~ to determine time effects, to reestablish pile capacity due to pile heave, or for other reasons.

3. Uninstrumented Set-Checks and Uninstrumented Pile Redrive: Piles may be accepted based on uninstrumented set-checks or uninstrumented pile redrives only when the piles are redriven for at least 24 inches. In these cases, the piles may be considered to have sufficient bearing resistance when the specified blow count criteria is achieved in accordance with 455-5~~-~~.11.1 and 455-5.11.2. Unless practical refusal is obtained as defined in 455-5.11.3, set-checks or redrives for piles redriven less than 24 inches must be instrumented for pile acceptance.

4. Instrumented Set-Checks and Instrumented Pile Redrive: ~~Use~~ Perform dynamic load tests using at least 6 hammer blows to determine whether the pile bearing is sufficient. The pile may be considered to have sufficient bearing resistance when dynamic measurements demonstrate the static pile resistance exceeds the required pile resistance for at least one hammer blow and the average static pile resistance during the next five hammer blows exceeds 95% of the required pile resistance. If the pile is advanced farther, the static pile resistance during all subsequent blows must exceed 90% of the required pile resistance.

SUBARTICLE 455-5.12.1 is deleted and the following substituted:

455-5.12.1 General: Dynamic load tests using an externally mounted instrument system and signal matching analyses or embedded gauges will be used to determine pile capacity

for all structures or projects unless otherwise shown on the Plans. Notify the Engineer two working days prior to placement of piles within the template and at least one working day prior to driving piles. ~~Do not drive piles without the presence of the Engineer.~~

SUBARTICLE 455-5.12.2 is deleted and the following substituted:

455-5.12.2 Wave Equation:

1. Use Wave Equation Analysis for Piles (WEAP) programs to evaluate the suitability of the proposed driving system (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance, in blows per 12 inches or blows per inch, to achieve the pile bearing requirements and to evaluate pile driving stresses.

Use Wave Equation Analyses to show the hammer meets the requirements described in 455-5.3 and maximum allowed pile stresses are not exceeded.

2. Required Equipment for Driving: Hammer approval is based on satisfactory field performance including dynamic load test results. In the event piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

3. Maximum Allowed Pile Stresses:

a. General: The maximum allowed driving stresses for concrete, steel, and timber piles are given below. In the event dynamic load tests show that the hammer will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. In such cases provide additional cushioning, reduce the stroke, or make other appropriate agreed upon changes.

b. Prestressed Concrete Piles: Use the following equations to determine the maximum allowed pile stresses:

$s_{apc} = 0.7 f'_c - 0.75 f_{cpe}$ (1a)

$s_{apc} = 0.6(0.7 f'_c - 0.75 f_{cpe})$ (1b) for voided piles

$s_{apt} = 6.5(f'_c)^{0.5} + 1.05 f_{cpe}$ (2a) for piles less than 50 feet long

$s_{apt} = 3.25(f'_c)^{0.5} + 1.05 f_{cpe}$ (2b) for piles 50 feet long and greater

$s_{apt} = 500$ (2c) within 20 feet of a mechanical splice

where:

s_{apc}= maximum allowed pile compressive stress, psi

s_{apt}= maximum allowed pile tensile stress, psi

f'_c= specified minimum compressive strength of concrete, psi

f_{cpe}= effective prestress (after all losses) at the time of driving, psi, taken as 0.8 times the initial prestress force divided by the minimum net concrete cross-sectional area of the pile (f_{cpe}= 0 for dowel spliced piles). Equation 1b is applicable for cylinder piles, and piles that have a void that extends all the way to the pile head (e.g., high-moment square prestressed concrete piles).

c. Steel Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 0.9 times the yield strength (0.9 f_y) of the steel.

d. Timber Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 3.6 ksi for Southern Pine and Pacific Coast Douglas Fir and 0.9 of the ultimate parallel to the grain strength for piles of other wood.

SUBARTICLE 455-5.12.3 is deleted and the following substituted:

455-5.12.3 Temporary Piles: Submit for the Engineers review, an analysis signed and sealed by a Specialty Engineer which establishes the pile lengths for temporary piles required for structures which affect public safety. Submit for the Engineers approval, a Wave Equation analysis signed and sealed by a Specialty Engineer which establishes the driving criteria for temporary piles at least five working days prior to driving temporary production piles. The required driving resistance is equal to the sum of the factored design load plus the scour and down drag resistances shown in the Plans, divided by the appropriate resistance factor or the nominal bearing resistance shown in the Plans, whichever is higher.

The maximum resistance factor is 0.45 when only wave equation analysis is performed. However, a larger resistance factor may be applicable when additional testing is provided by the Specialty Engineer in accordance with Section 3.5.6 of Volume 1 of the FDOT Structures Manual. ~~If the Contractor elects to perform 100% dynamic load testing s~~Submit a certification package meeting the requirements of section 455-5.19. ~~prepared by the Specialty Engineer. The certification package shall include a signed and sealed letter by the Specialty Engineer that certifies the piles meet the load requirements and have no integrity deficiencies. The package shall also include the dynamic load test records, all signal matching analysis performed to determine pile capacities and a summary table that indicates the final capacity of every pile.~~

SUBARTICLE 455-5.14 is deleted and the following substituted:

455-5.14 Dynamic Load Tests: Take dynamic measurements during the driving of piles designated in the Plans. Provide all personnel, materials and equipment for dynamic testing. For concrete piles, install instruments prior to driving and monitor all blows delivered to the pile. For steel production piles, the Engineer may accept instrumented set checks or redrives. Perform dynamic load tests to evaluate the following:~~The DTE will take dynamic measurements during the driving of piles designated in the Plans or authorized by the Engineer. For concrete piles,~~

~~install instruments prior to driving and assist the Engineer in monitoring all blows delivered to the pile. For steel production piles, the Engineer may accept instrumented set-checks or redrives. The Engineer will perform dynamic load tests to evaluate any or all of the following:~~

1. Suitability of the Contractor's driving equipment, including hammer, capblock, pile cushion, and any proposed follower.
2. Pile capacity.
3. Pile stresses.
4. Energy transfer to pile.
5. Distribution of soil resistance.
6. Soil variables including quake and damping.
7. Hammer-pile-soil system for Wave Equation analyses.
8. Pile installation problems.
9. Pile integrity
10. Other.

Either supply and install embedded gauges in the piles in accordance with Standard Plans, Index 455-003 or attach instruments (strain transducers to measure force and accelerometers to measure acceleration) with bolts to the pile for dynamic testing.

Make each follower and pile to be dynamically tested with externally attached instruments available to drill holes for attaching instrumentation and for wave speed measurements. Support the pile with timber blocks placed at appropriate intervals. Ensure that the pile is in a horizontal position and does not contact adjacent piles. Provide a sufficient clear distance at the sides of the pile for drilling the holes. ~~The Engineer will f~~Furnish the equipment, materials, and labor necessary for drilling holes and taking the wave speed measurements. If the Engineer directs dynamic load testing, instrumented set-checks, ~~or~~ instrumented redrives~~,~~ or verification testing, provide ~~the Engineer~~ safe access to the top of the piles for drilling the attachment holes. After placing the leads provide ~~the Engineer~~ safe access to the piles to attach the instruments and for removal of the instruments after completing the pile driving.

The DTE~~Engineer~~ will monitor the stresses in the piles with the dynamic test equipment during driving to ensure the Contractor does not exceed the maximum allowed stresses. If necessary, add additional cushioning, replace the cushions, or reduce the hammer stroke to maintain stresses below the maximum allowable. If dynamic test equipment measurements indicate non-axial driving, immediately realign the driving system. If the cushion is compressed to the point that a change in alignment of the hammer will not correct the problem, add cushioning or change the cushion as directed by the ~~Engineer~~DTE.

Drive the pile to the required penetration and resistance or as directed by the Engineer.

When directed by the Engineer, perform instrumented set-checks or redrives. Do not use a cold diesel hammer for a set-check or redrive unless in the opinion of the Engineer it is impractical to do otherwise. Warm up the hammer by driving another pile or applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

455-5.14.1 Remote Monitoring of Dynamic Load Tests: A Senior Geotechnical Technician, under the supervision of the DTO and DTE, may set up equipment on site for remote monitoring of dynamically load tested pile foundations. Remote monitoring is defined as the DTO or DTE using a remote connection to direct the dynamic load testing of piles while not on site or in direct line of sight of the pile driving operation. The DTO or DTE shall only monitor one pile at a time. The remote connection shall provide continuous and uninterrupted audio

communication and live viewing of data collection. If the remote connection is lost between the Senior Geotechnical Technician and the DTO or DTE during dynamic load testing, the Senior Geotechnical Technician shall stop the pile driving operation until a stable connection can be established.

If the Engineer determines that remote monitoring is not equivalent to on-site monitoring, then a DTO or DTE shall be on site for dynamic load testing.

SUBARTICLE 455-5.15.3 is deleted and the following substituted:

455-5.15.3 Authorized Pile Lengths: The authorized pile lengths are the lengths determined by the Engineer after reviewing the pile lengths recommended by the DTE. The Contractor may elect to provide piling with lengths longer than authorized to suit their method of installation or schedule. When the Contractor elects to provide longer than authorized pile lengths, the Department will pay for the furnished length as either the originally authorized length or the length between cut-off elevation and the final accepted pile tip elevation, whichever is the longer length.

The Engineer will provide an itemized list of authorized pile lengths within three working days after receipt of all test reports and the DTE's ~~recommended~~ pile length~~s~~ recommendation letter. Use these lengths for furnishing the permanent piling for the structure. If the Contractor is willing to start the pile driving operations in zones consisting of at least four test piles designated by the Engineer, and if the Contractor so requests in writing at the beginning of the test pile program, the Department will provide pile lengths for these designated phases within three working days after receiving all test reports and the DTE's ~~recommended~~ pile length~~s~~ recommendation letter for those designated zones.

On multiple phase projects, the Engineer will not provide pile lengths on subsequent phases until completing the piling on initial phases.

SUBARTICLE 455-5.18 is deleted and the following substituted:

455-5.18 Recording: Provide pile inspectors in accordance with 105-8.13. The qualified pile inspector shall inspect and record all the pile installation activities, including but not limited to handling, jetting, predrilling, preforming and driving on the Department's Pile Driving Record form. Steel piles and dynamically tested concrete piles in accordance with 455-5.14 will not require inspection during handling. Keep a pile driving log for each pile installed whether it is, or is not, instrumented. Submit the Pile Driving Record and dynamic testing records to the Engineer ~~W~~within one working day after ~~completing~~ EOID for each pile. Submit the Pile Driving Record and dynamic testing records to the Engineer within one working day after completing set checks and redrives for each pile.~~the installation of each pile, submit the Pile Driving Record and dynamic testing records to the Engineer.~~

SUBARTICLE 455-5.19 is deleted and the following substituted:

455-5.19 Foundation Certification Packages: Submit certification packages of pile foundations to the Engineer prior to Pile Verification Testing. A separate Foundation

Certification Package must be submitted for each foundation unit. A foundation unit is defined as all the piles within one bent or pile footing for a specific bridge for each phase of construction. Each Foundation Certification Package shall contain an original certification letter signed and sealed by the DTE certifying the piles have the required minimum tip elevation, axial capacity including compression and uplift, pile integrity, and that the inspection and testing of the pile installation was performed under the supervision of the DTE. The package shall also include all pile driving logs, dynamic testing records, all supplemental dynamic testing raw data and analyses for the foundation unit, and the signed and sealed evaluation performed to address out of tolerance piles in accordance with 455-5.16.5. The certification shall not be contingent on any future repair or testing, or any approval by the Engineer.

SUBARTICLE 455-5.20 is deleted and the following substituted:

455-5.20 Verification: One working day, excluding weekends and Department observed holidays, after receipt of the Foundation Certification Package, the Engineer will determine whether a pile in that foundation unit will be selected for verification testing. Based on its review of the certification package, the Engineer may or may not choose a pile for verification testing in any or all foundation units. ~~For the pile selected by the Engineer for verification testing, t~~The Engineer will provide the dynamic load test equipment and personnel for the Pile Verification Testing. Provide the driving equipment and pile driving crew for the Pile Verification Testing and provide support as needed to prepare the piles for testing. The Engineer will provide the results of the verification testing and identify additional needs for verification testing within one working day of testing.

If the capacity or integrity of any pile is found to be deficient, the Engineer will reject the entire certification package for the foundation unit, and the Contractor shall:

1. Correct the deficiency;
2. Correct the process that led to the deficiency;
3. Demonstrate to the Engineer that the remainder of the piles in the foundation unit are acceptable, including additional dynamic load tests to verify pile capacity and integrity, and;
4. Recertify the foundation unit.

One working day, excluding weekends and Department observed holidays, after receipt of the recertification, the Engineer shall then determine whether additional verification testing is required in that foundation unit. If the capacity or integrity of a verification pile is found to be deficient, additional cycles of deficiency correction and verification testing shall be completed until no ~~more~~ pile capacity or integrity deficiencies are detected. Piles shall not be cut-off nor bent/pier caps placed prior to successful completion of the Pile Verification Testing Program for that foundation unit. In case of disagreement of dynamic testing results, the Engineer's results will be final and will be used for acceptance.

On land foundation units or water foundation units when the pile cutoff is at least six feet above mean high water, the Contractor may cut-off piles prior to a complete submittal of the Certification Package or to a successful completion of the Pile Verification Testing Program at its own risk. If any piles in a foundation unit are cut-off prior to the submittal of a certification package or completion of the Pile Verification Testing Program and the Engineer determines that verification testing is required, the Contractor shall perform, at no expense to the Department, any work and labor required to expose any pile selected for verification to allow the installation

of the instruments in dry conditions and to provide references and access to the Engineer for such testing. Piles experiencing damage during the verification testing or requiring build-up after the verification shall be repaired by the Contractor at no expense to the Department. No pile bent/cap shall be poured prior to successful completion of the Pile Verification Testing Program for that foundation unit or notification by the Engineer that no verification will be required.

SUBARTICLE 455-10.1 is deleted and the following substituted:

455-10.1 General: Submit the completed Pile Driving Installation Plan Form (Form No. 700-020-01) with the following information at the preconstruction conference or no later than 30 days before driving the first pile.

1. The names of the CTQP qualified inspectors assigned to inspect the pile installation. If the Dynamic Testing Engineer is also a CTQP qualified pile driving inspector and is able to perform both operations, then an additional pile driving inspector is not required when driving piles using embedded sensors.

2. The quality control processes to ensure the required capacity is achieved in all piles. Include in the PIP the steps and analyses that would be performed when driving conditions change (such as unanticipated tip elevations, hammer modifications, presence of temporary piles and structures, preforming, changes, etc.).

3. The name and contact information for the single representative of the Contractor, independent of field operations personnel, to resolve to the Engineer's satisfaction conflicts in the driving procedures or interpretations of the driving criteria. This person shall be available within two hours notice, and shall have the authority to refer issues to higher levels (corporate, if needed).

4. A letter from the DTE certifying concurrence with the PIP.

Notify the Engineer of any test pile driving and production pile driving at least ~~one week~~ five working days prior to beginning the installation operations of any pile.

SUBARTICLE 455-11.2 is deleted and the following substituted:

455-11.2.1 Length: The length of precast concrete piles will be considered as the overall length from head to tip, including the additional authorized length of pile for a preplanned splice. Final pay length will be based on the casting length as authorized in accordance with 455-5.15.3 subject to provisions of 455-11.2.3, 455-11.2.4, and 455-11.8~~, 45511.9, 45511.12, and 455-11.13~~.

SUBARTICLE 455-11.3.1 is deleted and the following substituted:

455-11.3.1 Length: The length of steel piles will be considered as the overall length from head to tip. Final pay length will be based on the length as authorized in accordance with 455-5.15.3 subject to provisions of 455-11.8~~Final pay length will be subject to provisions of 455-11.8, 455-11.9, 455-11.10, 455-11.12, and 455-11.13~~.

SUBARTICLE 455-11.4 is deleted and the following substituted:

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 extensions thereof as approved by the Engineer.

Test piles left in place as permanent piles will be paid for only as test piling. The additional length of pile for drivable unplanned or planned prestressed precast pile splice~~Any extensions necessary to continue driving the pile for test purposes~~, as authorized by the Engineer, will be paid for as test piles. The additional length of pile for unplanned reinforced C-I-P pile build-up or non-drivable unplanned reinforced precast pile build-up~~Other extensions of piles~~, ~~additional length~~ will be paid for as ~~for splicing and build-ups will be included in the quantities of~~ regular piling ~~and will not be paid for as test piling~~.

SUBARTICLE 455-11.5 is deleted and the following substituted:

455-11.5 Dynamic Load Tests: Payment will be based on the number ~~of~~ and type of dynamic load tests shown in the Plans, required by the Engineer, or required in 455-5.12.7, completed and accepted in accordance with the Contract Documents. No separate payment will be made for dynamic load tests used to evaluate changes in the Contractor's driving equipment. ~~Include all costs associated with dynamically testing production piles with epoxy-bonded dowel splices under Pay Item No. 45517.~~ Additional payment will be made for dynamic load tests used for the redrive of test and production piles under Pay Item No. 455-137.

Payment for internal gauges, when shown in the Plans, will be the number of piles with internal gauges successfully installed and used for dynamic testing.

SUBARTICLE 455-11.8 is deleted and the following substituted:

455-11.8 Pile Splices: The quantity to be paid for will be the number of authorized drivable splices and build-ups ~~greater than 5 feet in length~~ in concrete production and ~~piling, and~~ test piling, which are made for the purpose of obtaining authorized pile lengths longer than shown as the maximum length in the Standard Plans or shown in the plans. Unplanned splices and build-ups required to achieve pile resistance will be paid for as unforeseen work. ~~, for obtaining greater lengths than originally authorized by the Engineer, to incorporate test piling in the finished structure, for further driving of test piling, or for splices shown in the Plans.~~

Include the cost of steel pile splices required to achieve pile resistance in the cost of steel production and test piles. ~~The quantity to be paid for will be the number of authorized splices in steel piling and test piling, for the purpose~~ Steel pile splices required for the purpose of obtaining lengths longer than the lengths originally authorized by the Engineer~~.~~ will be paid for as unforeseen work.

SUBARTICLE 455-11.9 is deleted and the following substituted:

455-11.9 Set-Checks and Redrives:

455-11.9.1 Set Checks/Test Piles: There will be no separate payment for the initial four set-checks performed the day of and the working day following ~~initial driving~~EOID. Each additional set-check ordered by the Engineer will be paid as a redrive.

455-11.9.2 Set Checks/Production Piles: There will be no separate payment for the initial set-check performed the day of ~~initial driving~~EOID. Each additional set-check ordered by the Engineer will be paid as a redrive.

455-11.9.3 Redrives and Verification Tests: The quantity of redrives to be paid for, when shown in the Plans, will be the number of redrives, each, authorized by the Engineer. Redrives required by the Engineer, when not shown in the Plans, will be paid for as Unforeseeable Work. The quantity of verification tests to be paid will be the number of piles tested and accepted.

SUBARTICLE 455-11.17 is deleted.

SUBARTICLE 455-12.5 is deleted and the following substituted:

455-12.5 Dynamic Load Tests:

455-12.5.1 Dynamic Load Tests / For Test Piles: ~~All test piles will require dynamic load tests.~~ Payment will be full compensation for all costs associated with engaging a Dynamic Testing Engineer, performing the dynamic load tests, analysis and reporting. ~~Include all costs associated with engaging a specialty engineer and perform the dynamic load tests in the pay items for test piles.~~

455-12.5.2 Dynamic Load Tests~~/~~ For Production Piles: Payment will be full compensation for all costs associated with engaging a ~~specialty~~ Dynamic Testing E~~e~~ngineer, ~~and~~ performing the dynamic load tests, analysis and reporting.

455-12.5.3 Dynamic Load Tests For Redrive of Test Piles and Production Piles: Payment will be full compensation for all costs associated with engaging a Dynamic Testing Engineer, performing the dynamic load tests, analysis and reporting.

455-12.5.~~3~~ 4 ~~Dynamic Load Tests/~~Internal Gauges For Dynamic Load Tests: Payment will be full compensation for all costs associated with supplying and installing internal gauges for dynamic load testing.

SUBARTICLE 455-12.7 is deleted and the following substituted:

455-12.7 Concrete Sheet Piling: Price and payment will be full compensation for all labor, equipment, and materials required for furnishing and installing concrete sheet piling, including reinforcing steel, grouting, filter ~~fabric~~geotextile, and installation.

SUBARTICLE 455-12.14 is deleted and the following substituted:

455-12.14 Verification Tests: Payment will be full compensation for all costs associated with assisting the Engineer in performing the dynamic load tests to verify the resistance and integrity of the tested pile. Verification testing will be paid for as pile redrive.

SUBARTICLE 455-12.15 is deleted and the following substituted:

455-12.15 Pre-planned Pile Splices: Price and payment will be full compensation for all labor, equipment, and materials required to perform this work.

ARTICLE 455-12 is expanded by the following:

455-12. ~~15~~ 16 Payment Items: Payment will be made under:

Item No. 455- 2-	Treated Timber Piling - per foot.
Item No. 455- 14-	Concrete Sheet Piling - per square foot.
Item No. 455- 15-	Preformed Pile Holes
Item No. 455- 17-	Pre-planned Pile Splices - each.
Item No. 455- 20-	Pile Inspection - each.
Item No. 455- 34-	Prestressed Concrete Piling - per foot.
Item No. 455- 35-	Steel Piling - per foot.
Item No. 455- 36-	Concrete Cylinder Piling - per foot.
Item No. 455-115-	Pile Redrive - each.
Item No. 455-119-	Test Loads - each.
Item No. 455-120-	Point Protection - each.
Item No. 455-133-	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.