SECTION 31 62 16.16

STEEL H-PILES
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2015) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A572/A572M	(2015) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM D1143/D1143M	(2007; R 2013) Piles Under Static Axial Compressive Load
ASTM D4945	(2012) High-Strain Dynamic Testing of Piles

1.2 BASIS FOR BIDS AND PAYMENT

1.2.1 Measurement and Payment

Requirements for "FAR 52.211-18, Variation in Estimated Quantity" shall not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which shall include items incidental to furnishing and driving the piles including: mobilization and demobilization, vibrating, probing, redriving uplifted piles, an additional 10 feet in furnished length for any test pile not driven beyond estimated pile length and cutting off piles at the cutoff elevation. Payment shall be made for production and test piles at the bid unit price for the length of pile, from tip to final cutoff, actually provided, excluding buildups directed by the Contracting Officer to be made. Should the cumulative pile length driven (tip to cutoff) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of "FAR 52.236-2, Differing Site.

1.2.2 Pulled Piles

Piles required to be pulled at no fault of the Contractor will be paid for at the bid unit price for furnishing and driving the pile in its original position plus 25 percent of the amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 25 percent of the bid unit price for the length driven.

1.2.3 Pile Cut-Off

Where the tip to cutoff is less than that calculated from the results of the test pile driving and load testing, payment for that portion of pile not driven will be made at 75 percent of the bid unit price and no other payment will be made for making the cut-off.

1.2.4 Pile Load Test

Payment for each acceptably provided complete test loading of a single pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing equipment, and placing and removing test loads.

1.3 PILE REQUIREMENTS

The Contractor's Geotechnical Consultant will determine and list "calculated" tip elevations and recommended production pile driving criteria for each pile from test pile data. Submit to the Contracting Officer for review and approval the list and recommended production pile driving criteria with a summary discussion of the test pile results and basis for recommendations. Provide test pile driving records and dynamic pile analyses to support the recommendations. The Contracting Officer will review the list and recommendations no later than 7 business days after receipt of a complete submittal. Use this list as a basis for ordering the piles. Do not order piles until the list is provided by the Government. Test piles shall be 10 feet longer than the bid length.

1.4 QUALITY ASSURANCE

1.4.1 Material Certification

For each shipment, submit certificates identified with specific lots prior to installing piling. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.

1.4.2 Installation Procedures

a. Submit information on the type of equipment proposed to be used, proposed methods of operation, pile driving plan including proposed sequence of driving, and details of all pile driving equipment and accessories.

b. Provide details of pile driving equipment and Wave Equation Analysis of pile driveability for selection of the hammer along with a statement of driving procedures. The Wave Equation Analysis is to be completed by the Contractor's Geotechnical Consultant for each test pile location indicated on the project drawings and is to include the following information pertaining to the proposed pile driving equipment:

   1. Complete Pile and Driving Equipment Data Form (which can be downloaded at: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf (under 31 62 13.20)

   2. Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis shall be run at

the estimated tip elevation as well as other required elevations to define the maximum stress levels in the pile during driving.

c. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description shall explain how specific information of pile performance will be evaluated.

1.4.3 Geotechnical Consultant Documentation

The services of an independent, Registered Professional Geotechnical Engineer, experienced in soil mechanics and Pile Dynamic Analysis (PDA), shall be hired by the Contractor to observe test pile installation and production pile installation as specified herein. The Geotechnical Consultant shall be licensed in the Commonwealth of Virginia. The Geotechnical Consultant shall be independent of the Contractor and shall have no employee of employer relationship which could constitute a conflict of interest.

1.4.4 Preconstruction Survey

Photo and video document the exterior condition of all existing structures within 200 feet (plan distance) of planned pile locations at least one week prior to installation of any piles.

1.4.5 Vibration Monitoring

Perform vibration monitoring with at least two seismographs continuously during test and production pile installation at any existing building within 200 feet (plan distance) of pile installation activities. The seismographs shall be a portable multi-channel type seismograph units. The units shall provide data output, including: time of event; frequency (Hz); peak particle velocity (PPV) in the longitudinal, vertical and transverse direction readings in inches per second; and resultant peak particle velocity (RPPV). The seismographs units shall have calibration certificates performed within one year of use on site. Seismographs shall be strategically placed at adjacent structures closest to pile installation operations at the discretion of the Contractor's Geotechnical Consultant. The pile installation operations will be modified as necessary to limit vibrations at nearby structures to less than 0.5 inch per second (resultant peak particle velocity (RPPV). Should these vibration levels be exceeded, the Contractor shall take whatever means necessary to reduce vibrations to within acceptable levels.

1.4.6 Installer Qualifications

The Contractor shall be fully experienced in all aspects of Steel H-Pile installation having a minimum 5 years' experience in performing this type of work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

Geotechnical Consultant Documentation; G

Wave Equation Analysis; G

Order List; G

SD-02 Shop Drawings

Pile splices; G

Submit detail drawings of pile splices prior to fabrication.

Test and Production Pile Location Plan; G

Submit pile placement plan at least 30 days prior to delivery of piles to the job site.

SD-03 Product Data

Pile driving equipment; G

Submit descriptions of pile driving equipment at least 30 days prior to commencement of work.

Pile driving records; G

Submit the proposed form for compiling pile driving records 30 days prior to commencement of work.

Delivery, storage, and handling; G

Submit delivery, storage, and handling plans for piles at least 30 days prior to delivery of piles to the job site.

Compressive Load Test; G

Submit pile load test at least 30 days prior to installing any test piles. Approval of the plan shall not relieve the Contractor of the responsibility of structural and operational adequacies of the testing system.

SD-04 Samples

Test piles; G

SD-05 Design Data

Submit wave equation analysis.

SD-06 Test Reports

Test pile driving; G

Submit pile driving test data within one (1) day after each test is completed.

Load Tests; G

Pile driving analyzer; G

Submit pile driving analyzer data within one (1) day after each test is completed.

Dynamic Pile Analysis; G

Production Piles

Submit complete and accurate pile records for production piles within one (1) day of installation. Interim as-driven pile surveys shall be performed within one (1) day following the installation of 35 percent, 75 percent and 100 percent of the piles. The as-driven surveys shall measure the actual location and top elevation of each acceptably driven pile. Measurements shall be performed in such a manner as to provide the horizontal deviation from plan location in two perpendicular directions and the top of pile elevation to the nearest half inch. Provide each interim as-driven survey to the Contracting Officer within 3 days following the surveying work for each increment. The as-driven surveys must be submitted and approved prior to performing any pile cut-off work or beginning any pile cap/grade beam installation work.

SD-11 Closeout Submittals

Pile driving records

Submit to the Contracting Officer complete and accurate test and job pile driving records as specified in paragraph entitled "Records" of this section, within 15 calendar days after completion of driving.

1.6 DELIVERY, STORAGE, AND HANDLING

Conform all delivery, storage, and handling of materials to the requirements specified herein. Develop and submit plans for the delivery, storage, and handling of piles.

1.6.1 Delivery and Storage

Stack piles during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length (ends inclusive) to prevent exceeding the maximum camber or sweep. Do not stack piles more than 5 feet high.

1.6.2 Handling

Lift piles using a cradle or multiple points pick-up to ensure that the maximum permissible camber or sweep is not exceeded due to insufficient support, except that a one-point pick-up may be used for lifting piles that are not extremely long into the driving leads. Point pick-up devices must be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned in the flanges or webs of piles above the cutoff length for lifting piles into the leads. Do not drag piles across the ground.

Inspect piles for excessive camber and sweep and for damage before

transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Camber, curvature in the pile in the direction normal to the pile flanges, must be measured with the pile flange base laying on a flat surface and is the distance between the flange base at the mid-length of the pile and the flat surface. Sweep, curvature in the pile in the direction parallel to the pile flanges, must be measured with the pile flange tips laying on a flat surface and is the distance between the flange tips at the mid-length of the pile and the flat surface. The maximum permissible camber or sweep is 2 inches over the length of the pile. Piles having excessive camber or sweep will be rejected.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 H-Piles

ASTM A572/A572M, Grade 50. Provide test piles identical to those used elsewhere in the project. Provide square and blunt pile tips, as received from the mill. Coat top 25 feet of piles in accordance with Section 09 97 13.26 COATING OF STEEL WATERFRONT STRUCTURES. Provide H-piles of the shape and sections shown. Determine lengths of piles as specified in paragraph "Installation," subparagraph "Lengths of Job Piles."

2.1.2 Pile Splices

ASTM A572/A572M, Grade 50 for splice.

2.1.3 FABRICATION

Fabrication must conform to the requirements shown and as specified herein and in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.1.3.1 Pile Splices

Submit detail drawings of splices in accordance with paragraph "Submittals." Splices are not permitted within 50 feet below cut-off elevation and within 30 feet of nearest splice.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

a. Prior to driving any pile, the Contractor shall submit a pile Wave Equation Analysis, performed by his Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses shall take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity.

b. The Wave Equation Analysis shall demonstrate that the piles will not be damaged during driving, shall indicate that the driving stresses will be maintained within the limits below and indicate the blow count necessary to achieve the required ultimate static pile capacities.

Allowable Driving Stresses

Steel Piles

Compression - 0.9 fy
Tension - 0.9 fy

where fy is yield strength of steel

c. Upon completion of the dynamic and static testing programs outlined in this specification section, a refined Wave Equation Analysis shall be performed taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Production pile driving criteria shall be developed based on the results of the refined Wave Equation Analysis, considering re-strike and load test data.

d. All pile driving equipment furnished by the Contractor shall be subject to the approval of the Contractor' s Geotechnical Consultant. Complete the attached pile and driving equipment data form, including hammer information, in full as part of the submittal of the results of the wave Equation Analyser.

e. The cost of performing the Wave Equation Analyses shall be paid for by the Contractor and included in the base bid.

3.1.1 Order List

The Contractor shall submit to the Contracting Officer for approval an itemized list for piles prior to placing the order with the supplier. The list shall be based on the approved submittal to the Contracting Officer of "calculated" tip elevations and driving criteria for production piles of paragraph PILE REQUIREMENTS. The list shall indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile. The Contractor shall review the order list periodically during the driving of production piles, and adjust it as necessary to reduce the number of cut-offs, and the amount of build-ups, subject to the approval, and/or upon the direction of the Contracting Officer. Load testing and refined wave equation analysis shall be completed prior to submission of an order list.

3.2 PILE DRIVING EQUIPMENT

Select the proposed pile driving equipment, including hammers and other required items, and submit complete descriptions of the proposed equipment in accordance with paragraph "Submittals." Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be allowed after the equipment has been approved except as directed. No additional contract time will be allowed for Contractor proposed changes in the equipment.

3.2.1 Pile Driving Hammers

Provide vibratory and impact type pile driving hammers.

3.2.1.1 Impact Hammers

Provide steam, air, or diesel-powered impact pile hammers of the

single-acting, double-acting, or differential-acting type. The size or capacity of hammers must be as recommended by the hammer manufacturer for the total pile weight and the character of the soil formation to be penetrated. Hammers must be capable of hard driving in excess of 25 blows per inch. Provide boiler, compressor, or engine capacity sufficient to operate hammers continuously at the full rated speed. Hammers must have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air and steam hammers. This gage must be operational during the driving of piles and be mounted in an accessible location for monitoring by the Contractor and the Contracting Officer. Obtain driving energy by use of a heavy ram and a short stroke with low impact velocity, rather than a light ram and a long stroke with high impact velocity. Position a pile cap or drive cap between the pile and hammer. Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block must have consistent elastic properties, minimize energy absorption, and transmit hammer energy uniformly and consistently during the entire driving period. In accordance with paragraph "Submittals," submit the following information for each impact hammer proposed:

a. Make and model.

b. Ram weight (pounds).

c. Anvil weight (pounds).

d. Rated stroke (inches).

e. Rated energy range (foot-pounds).

f. Rated speed (blows per minute).

g. Steam or air pressure, hammer, and boiler or compressor (psi).

h. Rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch).

i. Pile driving cap, make, and weight (pounds).

j. Cushion block dimensions and material type.

k. Power pack description.

3.2.2 Pile Driving Leads

Support and guide hammer with fixed extended leads or fixed underhung leads. Provide two intermediate supports for the pile in the leads to reduce the unbraced length of the pile during driving and pulling.

3.3 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Handle piles so as to protect pile coatings. Repair damage or defects in pile coatings as specified. Cut piles at cutoff grade by an approved method. Where cutoff is below existing ground or mudline elevation, complete excavation, sheeting, and dewatering before driving pile to cutoff elevation.

3.3.1 Driving Piles

Notify Contracting Officer 10 days prior to driving of test and production piles and load test. The Contractor's Geotechnical Consultant shall be present during pile driving operations. Drive production piles based on the approved production pile driving criteria established by the revised wave equation analyses (WEAP). During initial driving and until pile tip has penetrated beyond layers of very soft soil, use a reduced driving energy of the hammer as required to prevent pile damage. Refusal criteria shall be established by the Contractor's Geotechnical Consultant.

If a pile fails to reach indicated tip elevation, or if a pile reaches tip elevation without reaching required driving resistance, notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB. Piles may be driven without pile guides or leads providing a hammer guide frame is used to keep the pile and hammer in alignment.

3.3.2 Pile Driving Records

Develop a form for compiling pile driving records, which must be approved for recording pile driving data. Preprinted forms can be downloaded at: www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf (under 31 62 13.20)

Compile and submit accurate records of the pile driving operations on the approved form in accordance with paragraph "Submittals." Include in driving records for each pile date driven, pile identification number, cross section shape and pile dimensions, location, deviations from design location, original length, ground elevation, top elevation, tip elevation, description of hammer used, number of blows required for each foot of penetration throughout the entire length of the pile and for each inch of penetration in the last foot of penetration, total driving time in minutes and seconds, and any other pertinent information as required or requested such as unusual driving conditions, interruptions or delays during driving, damage to pile resulting from driving, heave in adjacent piles, redriving, weaving, obstructions, jetting, vibrating and depth and description of voids formed adjacent to the pile.

Additional data required to be recorded for impact hammers includes the rate of hammer operation, make, size, and the length of the bounce hose. Additional data required to be recorded for vibratory hammers includes hammer power pack description, make, size, horsepower applied to pile, and hammer operating frequency.

3.3.3 Pile Placement and Tolerances in Driving

Develop and submit a pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles. Accurately place piles in the correct location and alignments, both laterally and longitudinally, and to the vertical lines indicated. Establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations prior to driving job piles and maintain during the installation of the job piles.

A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted for vertical piles. Manipulation to move piles into position will be permitted only within the aforementioned tolerance to return the pile to the design location,

however, do not manipulate piles more than 1.5 percent of the exposed length above the surface. A variation of not more than 0.25 inch per foot of pile length from the vertical for vertical piles will be permitted. In addition to complying with the tolerances stated herein, the clear distance between the heads of piles and the edges of caps must be not less than 6 inches. With prior approval of the Contracting Officer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of pile caps or additional work required due to improper location of piles is the responsibility of the Contractor. Inspect piles for heave. Redrive heaved piles to the required tip elevation. Maintain the correct relative position of all piles by the use of templates or by other approved means. Piles damaged or not located properly or exceeding the maximum limits for rotation, lateral and vertical deviation, and variation in alignment must be pulled and new piles redriven, or provide additional piles, at a location directed at no additional cost to the Government.

3.3.3.1 Survey Data

Provide interim as-driven surveys in accordance with requirements provided in paragraph SUBMITTALS. After the driving of each pile interim group is complete and before superimposed concrete is placed, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. Do not proceed with placing concrete until the Contracting Officer has reviewed the survey and verified the safe load for the pile group driven. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest half inch. Survey must be prepared and certified by a licensed land surveyor.

3.3.4 Pile Penetration Criteria

The controlling tip elevation for production piles will be based on the approved production pile driving criteria established by the revised Wave Equation Analysis (WEAP).

3.3.5 Pile Driving

Notify the Contracting Officer 10 days prior to the date pile driving is to begin. Do not drive piles within 100 feet of concrete less than 7 days old. Drive production and test piles with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. Operate hammers at all times at the speed and under the conditions recommended by the manufacturer. Prior to driving and with the pile head seated in the hammer, check each pile to ensure that it has been aligned correctly and that the orientation of the web about the centerline is as shown. Once pile driving has begun, keep conditions such as alignment and batter constant. Check and monitor the alignment of battered piles during driving with an accurate batter board level. Drive each pile continuously and without interruption until a splice is required or the required tip elevation has been attained. Deviation from this procedure will be permitted only when driving is stopped by causes that reasonably could not have been anticipated. A pile that can not be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and drifting, must be pulled and redriven or cut off and abandoned, whichever is directed by the Contracting Officer. After piles are driven, cutoff square as required at the indicated cutoff elevation. Backfill any voids around piles or abandoned holes for pulled piles with sand and compact to the same density as the

surrounding soil. If, in driving, it is found that pile is not of sufficient length to give the capacity specified, notify the Contracting Officer, who will determine the procedure to be followed.

3.3.5.1 Splicing Piles

A pile that has not reached the required refusal blow count when the top has been driven to the cutoff elevation must be spliced and driven to a sufficient depth to develop the required refusal blow count. When approved, provide splices of the full penetration butt weld type or approved proprietary prefabricated splicer sleeves. Splices are not permitted within 50 feet below cut-off elevation and within 30 feet of nearest splice. Construct splices to maintain the true alignment and position of the pile sections. Splices must develop the full strength of the pile in both bearing and bending.

3.3.5.2 Jetting

Jetting of piles is not permitted.

3.3.5.3 Predrilling

Predrilling will not be permitted.

3.3.5.4 Vibrating

The pile shall be initially installed with a vibratory type hammer. Pile installation with a vibratory hammer shall be terminated a minimum 20 feet above the required tip elevation. The remaining portion of driving shall be completed with an impact hammer.

3.3.5.5 Heaved Piles

When driving piles in clusters or under conditions of relatively close spacing, perform observations to detect heave of adjacent piles. Backdrive heaved piles to original tip elevation refusal without additional cost to the Government.

3.3.5.6 Pulled Piles

Pull and replace piles damaged or impaired for use during driving with new piles, or cut off and abandon and drive new piles as directed without additional cost to the Government. The Contracting Officer may require that any pile be pulled for inspection. Redrive piles pulled as directed and found to be in suitable condition at another location as directed. Replace piles pulled as directed and found to be damaged with new piles at the Contractor's expense.

3.3.5.7 Long Piles

Handle and drive piles of a high slenderness ratio carefully to prevent overstress. Provide pile driving rig with rigid supports so that leads remain accurately aligned. Where a high degree of accuracy is required, erect templates or guide frames at or close to the ground or water surface.

3.3.5.8 Welding

Conform to AWS D1.1/D1.1M. All splices shall use an approved splicer on the pile prior to welding. All splices shall be inspected by a

AWS D1.1/D1.1M Certified Welding Inspector.

3.4 FIELD QUALITY CONTROL

3.4.1 Test Piles

Use test piles of type, and drive as specified for piling elsewhere in this section. Order test piles in lengths as indicated on the drawings. The additional test pile length shall be driven only at the direction of the Contracting Officer. The Contractor's Geotechnical Consultant will use test pile data to determine recommended pile tip elevations and necessary driving resistance. Drive test piles at the locations indicated. Drive test piles to the penetration criteria established by the Wave Equation Analysis (WEAP). A pile dynamic analyzer shall be provided and operated as specified in paragraph DYNAMIC PILE ANALYSIS during the driving of each test pile. Modify driving as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer.

3.4.2 Compressive Load Test

Perform one pile compressive load test in accordance with ASTM D1143/D1143M. Apply a compressive load of 140 tons (200 percent of design allowable load) to each compressive load test pile.

3.4.3 Dynamic Pile Analysis

The purpose of dynamic testing is to provide supplemental information for evaluating pile hammer performance, driving stresses, and bearing capacities. Dynamic testing shall be conducted during the entire time piles are initially driven or redriven and during pile restrike testing. Use test piles of type as specified elsewhere in this section. Equipment to obtain dynamic measurements, record, reduce and display its data shall be furnished and meet the requirement of ASTM D4945. The equipment shall have been calibrated within 12 months of use throughout the contract duration. Drive test piles at the locations indicated. The Contractor shall employ an independent inspection firm, hereinafter referred to as the "Contractor's Geotechnical Consultant", experienced in the pile driving process, monitoring of test pile installation, and in the use of the Pile Driving Analyzer and its related equipment. Dynamic pile analysis shall be performed as follows:

a. Each dynamic pile analysis shall be performed in two steps. The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being driven for the soil types encountered as the piles are driven. This initial monitoring shall determine whether pre-augering is appropriate, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving. With each blow of the pile the information listed below shall be electronically recorded and analyzed by the Pile Driving Analyzer.

    1. Blow number
    2. Blow rate per minute and/or stroke.
    3. Input and reflected values of force and velocity.
    4. Value of upward and downward traveling force wave with time.
    5. Maximum and final transferred energy to pile, hammer system

efficiency.
6. Maximum compressive stress, velocity, acceleration and displacement.
7. Maximum tensile stress in pile.
8. Pile structural integrity, damage detection, extent and location.
9. Bearing Capacity of pile by Case method.

If the pile, hammer and soil performance evaluation recommends changes to the hammer stroke, pile cushioning, or any other aspect for the pile driving operation, these changes shall be incorporated into production pile driving in an effort to control excessive stresses and pile damage. Test piles damaged or broken during installation shall be replaced, incorporating driving modifications as determined by the Contractor's Geotechnical Consultant and reviewed and approved by the Contracting Officer. This procedure shall be repeated until allowable compressive stresses are achieved in the pile and/or pile damage is minimized. Selected initial driving records shall be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and estimation of anticipated gain/loss factors.

b. Upon completion of test pile driving the piles shall be allowed to set-up for 7 to 14 calendar days. After evaluation of pile, hammer and soil performance by the Contractor's Geotechnical Consultant, the second step of the dynamic pile analysis may proceed. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times or as directed by the Contractor's Geotechnical Consultant using the same hammer which was used for the test pile driving and which shall be used for production pile driving. In addition to those items listed above, selected restrike driving records (as directed by the Contractor's Geotechnical Consultant) are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

c. Performance Report:

1. Upon satisfactory completion of each dynamic load test a minimum of three copies of a Pile Performance Report shall be submitted for the Contractor by the Contractor's Geotechnical Consultant. The submittal shall be prepared and sealed by a Professional Engineer registered in the State of Virginia and shall be made within three working days of the completion of the dynamic load test.

2. The report for the Dynamic Pile Analysis shall contain the following information:

(a) Bearing capacity of pile from Case Pile Wave Analysis Program (CAPWAP). Information resulting from analysis of a selected restrike blow.

(b) Maximum and final transferred energy, hammer system efficiency during pile installation.

(c) Maximum compressive stress, velocity, acceleration and displacement.

(d) Maximum tensile stress in pile.

(e) Pile structural integrity, damage detection, extent and location.

(f) Blows per minute and blow number.

(g) Input and reflection values of force and velocity, upward and downward traveling force wave with time.

(h) Pile skin friction and toe resistance to pile.

(i) Maximum Energy transferred to pile.

3. The maximum allowable pile design load shall be proposed by the Contractor's Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile driven as specified herein and shall include the effects of load transfer to the soil above the foundation stratum.

d. The equipment to be used for dynamic testing of the pile hammer and soil performance and for dynamic load testing of the test pile shall be either a model GCPC or a PAK Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent.

e. All services of the Contractor's Geotechnical Consultant shall be paid for by the Contractor. The Contractor's Geotechnical Consultant shall be available throughout the pile driving operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, shall be at the Contractor's expense.

3.4.4 Static Load Tests

Perform compressive load test on 1 test pile at location shown on project drawings in accordance with ASTM D1143/D1143M (standard loading procedure) as modified herein. Allow a minimum of 7 days following final test pile driving for pile set-up prior to load testing. Provide apparatus for applying vertical loads as required by method, using load from weighted box or platform or reaction frame attached to sufficient uplift piles to safely take required load applied to pile by hydraulic jack. Increase load in increments until rapid progressive settlement takes place or until application of total compressive load of 140 tons for compressive load tests. Perform load tests at locations indicated on the project drawings and as directed by the Contracting Officer. Additional load tests, at Government expense, may be required by the Contracting Officer. Loading, testing, and recording and analysis of data must be under the direct supervision of a Registered Professional Engineer, registered in the Commonwealth of Virginia, and provided and paid for by the Contractor.

3.4.4.1 Safe Design Capacity

The safe design capacity of a test pile as determined from the results of load tests shall be the lesser of the two values computed according to the following:

a. One-half of that load which causes a net settlement after rebound of not more than 0.01 inch per ton of total test load.

b. One-half of the load that causes a gross settlement of not more than 1 inch, provided the load settlement curve shows no sign of failure.

3.4.5 Pile Records

The Special Inspector shall keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, batter alignment, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, obstructions, and any driving interruptions. A preprinted pile driving log for recording pile driving data and pile driving equipment data form is included at the end of this section.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC RESISTING SYSTEMS

Perform special inspections and testing or seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --