

SPECIFICATION SECTION 07300 – BORED PILE

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SPECIFICATION SECTION 07300 - BORED PILE

1. DESCRIPTION

This Specification Section prescribes the construction of Bored Piles using the reverse circulation drilling method, crab type hammers, and steel casing or any other earth drill method approved by the Engineer, in accordance with this Specification Section and in conformity with the Drawings or as may be required by the Engineer.

The work to be performed as specified in this Specification Section shall be carried out after any required subsoil investigations have been completed by the Contractor in accordance with this Specification Section, the Drawings, or as may be required by the Engineer.

2. MATERIAL REQUIREMENTS

2.1 Reference Standards

The most recent edition of the following Vietnamese Standards shall be applied to the Works covered by this Specification.

Vietnamese Standard:

TCVN 9395:2012 Bored Piles- Construction, Check and Acceptance.

TCVN 9396:2012 Bored Piles – Determination of Homogeneity of Concrete - Sonic Pulse Method.

TCVN 9393:2012 Piles - Standard Test Method for Insitu Piles Under Axial Compressive Load.

International Standard:

ASTM D4945 Pile Testing Using Large Deformation Method

2.2 Materials for Piling

2.2.1 Concrete

- a) Bored Piles shall be constructed in accordance with the details shown on the Drawings and in accordance with Specification Section 07100 - Concrete and Concrete Structures.
- b) Concrete shall conform with the applicable provisions of Specification Section 07100 - Concrete and Concrete Structures

2.2.2 Reinforcing Steel

Reinforcement shall conform with the requirements of Specification Section 07500 - Reinforcing Steel

2.2.3 Temporary Casings

- a) Temporary casings shall be used to maintain the stability of pile excavation, which might otherwise collapse.

- b) Temporary casings shall be free from significant distortion. They shall have a uniform cross section throughout each continuous length. During concreting they shall be free from internal projections and encrusted concrete which might prevent the proper formation of piles.

2.2.4 Bentonite and Bentonite Slurry (Drilling Fluid)

- a) Supply
 - i) Bentonite shall be in accordance with Vietnamese Standard TCVN 9395:2012.
- b) Mixing
 - i) Bentonite shall be mixed thoroughly with clean fresh water to make a suspension which will maintain the stability of the pile excavation for the period necessary to place concrete and complete construction.
 - ii) Where chemically contaminated groundwater occurs, special precautions shall be taken to modify the bentonite in all respects for the construction of piles.

2.2.5 Submittals

- a) Prior to commencement of the Works and to complement the investigation and check tests to be performed in accordance with Specification Section 07250 - Borings for Pile Bearing Capacity, the Contractor shall submit to the Engineer, for his approval, a complete schedule for investigation of the Site and underground conditions in order to confirm the presence or absence of obstructions (e.g. existing piles, sheet piles, remaining structures or structural elements, cables, etc.).
- b) The Contractor shall submit to the Engineer, for his approval, a method statement detailing the proposed materials and methods of construction of Bored Piles using bentonite slurry or other suitable materials. The method statement shall include but not be limited to the details.
 - (i) Details of construction plant.
 - (ii) Method and sequence of pile installation, including methods of avoiding damage to adjacent piles, utilities and structures, and method to clear the base of Bored Piles.
 - (iii) Methods of controlling groundwater.
 - (iv) Anticipated; ground vibration, ground movement and groundwater drawdown and methods of instrumentation and monitoring.
 - (v) Procedures for; quality control, sampling, testing, mixing, storing, recalculation, removal of silt and sand, prevention of spillage and disposal from the Site.

- (vi) Arrangements for pile testing including vertical loading and pile integrity testing program and method.
- (vii) Methods of concreting with methods of placing concrete by tremie.
- (viii) Particulars of the proposed materials and methods of construction using bentonite slurry or other agent.
- (ix) A certificate from the manufacturer of the bentonite powder showing the type, the manufacturer's name, the date and place of manufacture and including details of the apparent viscosity range in centipoises and strength measured in N/mm^2 for solids in water.
- (x) Characteristics of the bentonite slurry in a freshly mixed condition and in the excavation immediately before concreting.
- (xi) Head of bentonite slurry, including calculations.
- (xii) The number and location of piles to be load tested shall be reviewed by and subject to the approval of the Engineer based on the boring survey results from the Contractor.

3. CONSTRUCTION REQUIREMENTS

The Contractor shall submit a method statement for the approval of the Engineer

3.1 Boring

3.1.1 Boring Near Recently Cast Piles

- a) Piles shall not be bored so close to piles which have recently been cast and which contain workable or unset concrete such that a flow of concrete could be induced from or damage caused to any of the piles.
- b) Where the Contractor intends to bore a new pile located close to a recently Bored Pile Vietnamese Standard TCVN 9395-2012 Construction and Measurement of Bored Piles shall be applied and, unless otherwise instructed by the Engineer, the work for boring the new pile shall depend on the confirmation that the compressive strength of the recently Bored Pile has reached 70% of its design strength.

3.1.2 Stability of Pile Excavation using Drilling Fluid

- a) Where the use of drilling fluid is approved for maintaining the stability of a bore, the level of the fluid in the excavation shall be maintained so that the fluid pressure always exceeds the pressures exerted by the soils and external groundwater or at not less than 1m above the level of the external groundwater. An adequate temporary casing may be required in conjunction with the method to ensure stability of the strata near ground

level until concrete has been placed.

- b) In the event of a rapid loss of bentonite suspension from the pile excavation, the excavation shall be backfilled without delay and the instructions of the Engineer shall be obtained before excavation at that location is resumed.

3.1.3 Spillage and Disposal

All reasonable steps shall be taken to prevent spillage of bentonite suspension at the Site and in areas outside the immediate vicinity of bore. Disposal of discarded bentonite shall be in accordance with the Contractor's approved environmental management plan.

3.1.4 Pumping from Bored Holes

Pumping from a bored hole will not be permitted unless a casing has been placed into a stable stratum which prevents the flow of a significant quantity of water from other strata into the bore, or unless it can be shown that pumping will not have a detrimental effect on the surrounding soil or adjacent property.

3.1.5 Cleanliness of Pile Bases

On completion of boring, loose, disturbed or remoulded soil shall be removed from the base of the pile, using appropriate and approved methods, which may include the use of compressed air and which shall clean but at the same time minimize disturbance to the ground below the pile base.

3.1.6 Inspection

- a) For a boring without casings, the diameter of the boring hole for a representative number of piles will be measured by calipers prior to the placing of concrete into it. The Contractor's quality control personnel shall do the measurement using approved equipment.
- b) The Contractor shall provide an approved means by which inspection of the verticality of Bored Piles and reinforcement cages can be performed.

3.2 Final Pile Toe Level

- a) During pile boring, the Contractor shall produce a boring log indicating approximate depths and types of the various earth layers found in the bore. Based on the existing conditions of boring, the Engineer might require the Contractor to provide disturbed samples for visual analysis.
- b) The Contractor shall immediately notify the Engineer if, during the installation of piles, the ground conditions are different from those indicated on the Drawings or observed in the prebore.
- c) The Engineer will confirm the final pile toe level after his inspection of

the earth layers penetrated by the pile.

- d) At the footing of each pile cluster the Contractor shall carry out sampling and testing at the bearing stratum in the first pile to check the bearing capacity of the ground.

3.3 Reinforcement

- a) Steel reinforcement shall be fabricated in accordance with; the grades, the sizes and dimensions shown on the Drawings and shall be placed, centered and braced in the pile hole to the approval of the Engineer.
- b) Particular care shall be taken in locating projecting column dowel bars, with a tolerance not exceeding 10 mm in any direction and pouring will not be permitted until the Engineer is satisfied that adequate provisions have been made.
- c) Adequate shoes or spacers shall be firmly anchored to the reinforcement to ensure that the reinforcement is kept centered in the concrete.
- d) The Contractor shall include in his method statement for pile construction submitted to the Engineer for his approval the working drawings and details related to the placing of the reinforcement cage, splicing procedures, measures and equipment to prevent damage to the bored hole and maintain the stability of the bore while the cage is being placed and procedures to control the verticality and consistency of the cage during placing operations.

3.4 Concreting

- a) Immediately after the activities for; boring, excavation, placement of reinforcement cage and cleaning of the borehole have been completed the Contractor shall request the Engineer's approval for the commencement of concreting.
- b) Before placing concrete measures shall be taken to ensure that there is no accumulation of silt or other material at the base of the bore.
- c) Once the Engineer's approval for the commencement of concreting has been obtained concreting shall start without delay and continue without interruption. In a boring which contains water or drilling fluid the concrete shall be placed by tremie.
- d) Concrete shall be a rich coherent mix of high workability having a maximum measured slump of 200 mm.
- e) Concrete shall be placed in such a manner that segregation does not occur.
- f) During and after concreting care shall be taken to avoid damage to the concrete due to pumping and dewatering operations.

- g) The hopper and pipe of the tremie shall be clean and watertight throughout. The pipe shall extend to the base of the pile and a sliding plug or barrier shall be placed in the pipe to prevent direct contact between the first charge of concrete and the water. The pipe shall at all times penetrate the concrete that has previously been placed and shall not be withdrawn from the concrete until completion of concreting. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the concrete pressure exceeds the water pressure. The tremie pipe shall be kept at least 2.0m but never more than 5.0m under the concrete level. The internal diameter of the tremie pipe shall not be less than 150mm for concrete made with 20mm aggregate and not less than 200 mm for concrete made with 40mm aggregate. It shall be so designed that external projections are minimized, allowing the tremie to pass through reinforcing cages without causing damage. The internal face of the pipe of the tremie shall be free from projections.
- h) Measurement of the level of concrete surface shall be taken immediately before and after any vertical movement of the tremie pipe.
- i) The Contractor shall ensure that heavily contaminated bentonite suspension, which could impair the free flow of concrete from the pipe of the tremie, has not accumulated in the bottom of the hole.
- j) A sample of the bentonite suspension shall be taken from the base of the bore using an approved sampling device. If the specific gravity of the suspension exceeds 1.25 the placing of concrete shall not proceed. In this event the Contractor shall modify or replace the bentonite as approved to meet the Specification.

3.5 Extraction of Casing

3.5.1 Workability of Concrete

Temporary casings shall be extracted while the concrete within them remains sufficiently workable to ensure that the concrete is not lifted. Should a semi dry mix be used the means of ensuring that the semi dry concrete does not lift during extraction of the casing shall be submitted to the Engineer for his approval.

3.5.2 Concrete level

- a) When the casing is being extracted a sufficient quantity of concrete shall be maintained within it to ensure that pressure from external water or soil is exceeded and that the pile is neither reduced in section nor contaminated.
- b) Concrete shall be placed continuously as the casing is extracted until the

desired concrete level is obtained. The pile shall be cast to a height, approved by the Engineer, to allow for cutting back to the required level to ensure sound, uncontaminated concrete in the head of the pile. No concrete shall be placed in the bore once the bottom of the casing has been lifted above the top of the concrete.

- c) Adequate precautions shall be taken in all cases where excess hydraulic heads could occur as the casing is withdrawn due to the displacement of water by the concrete as it flows into its final position against the walls of the shaft.
- d) The use of vibrating casing extractors shall be subject to the approval of the Engineer.

3.5.2 Water Level

The Contractor shall submit to the Engineer for his approval suitable proposals for dealing with groundwater levels higher than the required pile head casting level shown on the Drawings prior to placing concrete. The pile head shall not be left below the groundwater level unless approved precautions are taken.

3.6 Quality Control of Piling

3.6.1 General

The Contractor shall comply with his approved quality assurance plan.

3.6.2 Testing of Materials for Drilling Fluid

- a) Prior to the commencement of the work the Contractor shall propose the method and procedure of sampling and the frequency of testing drilling fluid based on the referenced standards for drilling fluids. The frequency may subsequently be varied depending on the consistency of the results obtained.
- b) Control tests shall be carried out on the bentonite suspension using suitable apparatus. The density of freshly mixed bentonite suspension shall be measured daily as a check on the quality of the suspension being formed. The measuring device shall be calibrated to read to within 0.01g/ml. Bentonite supplied to the pile bore shall be tested to determine density, viscosity, shear strength and PH values. For average boil conditions the results shall generally be within the ranges stated in the Table 1 in this Specification Section. The tests shall be continued until a consistent working pattern has been established, account being taken of the mixing process, any blending of freshly mixed bentonite suspension and previously used bentonite suspension and any process which may be used to remove impurities from previously used bentonite suspension. When the results show consistent behavior, the tests for shear strength and

pH value may be discontinued and tests to determine density and viscosity shall be carried out as approved by the Engineer.

- c) The Contractor shall submit to the Engineer for his approval the method proposed for the sampling and checking of contaminated bentonite and for the cleaning of the base of the bore. In the event of a change in the established working pattern, tests for shear strength and pH value shall be reintroduced for a period, if required.

Table 1. Testing of Materials for Drilling Fluid

No	Features	Targets	Test method
1	Density	1.05 ÷ 1.15g/cm ³	Hydrometer or Bome-meter
2	Viscosity	18 ÷ 45(s)	Hopper 500/700cc
3	Sand content	< 6%	-
4	Rate of colloidal	> 95%	Measuring cup
5	Dehydration	< 30mm/30 minutes	instruments for measuring Dehydration
6	Thickness of the clay mantle	1 ÷ 3mm/30 minutes	
7	Shear strength	* 1 minute: 20÷30mg/cm ² * 10 minutes: 50÷100mg/cm ²	Shear strength – meter
8	Stability	< 0.3g/cm ²	-
9	PH	7 ÷ 9	PH Test-paper

Source: Vietnamese Standard TCVN 9395:2012

3.6.3 Piling

The Contractor shall designate a competent and experienced technician to be in charge of the piling operations at the Site and to be responsible for the quality control of the work including, but not limited to, the following:

- Ensuring proper storage and handling of all the materials for pile fabrication.
- Ensuring proper maintenance and cleanliness of plant (including that for bentonite preparation), cranes, trucks and other equipment.
- Work in close coordination with Contractor's staff responsible for quality control under other Specification Sections.
- Continuous monitoring of the quality of bentonite and other materials used for piling.
- Proper preparation of the work before, during and after concrete pouring.
- Proper preparation and performance for piles including the preliminary test piles as stated in this Specification Section.
- Proper preparation and timely submittal of the data and reports specified in subsection 3.8 of this Specification Section.

- h) Preparation of working drawings, details, equipment related to the measures to prevent, or to correct, defective piles or to be carried out in the event that a borehole collapses during or before concreting work.

3.6.4 Integrity Testing of Piles

The number of piles to be tested to determine their integrity shall be as stated on the Drawings or instructed by the Engineer. Testing shall be by sonic test and core test as required by the Engineer.

For the purpose of testing the pile integrity by sonic test and core drilling at pile tip, all Bored Piles shall be constructed with steel pipes cast in place as detailed on the Drawings.

All the following requirements shall be satisfied:

- a) The Contractor shall submit a complete plan of testing describing the methodology and equipment to be used for testing.
- b) The length of steel piping shall extend to the limits indicated on the Drawings.
- c) All piping shall extend to at least 30 mm above the top of any permanent or temporary pile casing.
- d) The bottom of the pipe shall be permanently sealed
- e) The top of the pipe shall be provided with a screw type plug, to prevent the intrusion of foreign materials into the pipe.
- f) Pipes shall be placed continuously straight from the bottom to the top so as to allow later introduction of sonic coring and core drilling apparatus.
- g) During placement the pipes shall be kept free of all foreign materials.
- h) The Contractor shall be responsible for any corrective work necessary if testing and/or coring cannot be accomplished because of improper placement and/or the presence of obstructions in the piping.
- i) When required by the Engineer, the Contractor shall fill all tubes with an expansive grout, acceptable to the Engineer, which is capable of displacing any water in the pipes. The grout shall be continuously injected into the pipes from the bottom of the tube to the top.

3.6.5 Sonic Testing

- a) Testing shall not be carried out until the pile concrete has gained its 28 days characteristic strength.
- b) Sonic testing in accordance with Vietnamese Standard TCVN 9396:2012 shall be carried out by an approved specialist firm, from whom a full method statement shall be obtained and approved by the Engineer prior to commencement of testing. One hundred percent (100%) of piles shall be

tested.

- c) The interpretation of the results shall be carried out by competent persons and an indication of the result of all testing shall be passed to the Engineer immediately on completion of all tests. A full written report shall be provided directly to the Engineer within 10 days after the completion of the test.

3.6.6 Static Load Test on Working Piles

The contractor shall submit his proposal for conducting a load test by static load method in accordance with Vietnamese Standard TCVN 9393:2012 “Piles - Standard Test Method for Insitu Piles Under Axial Compressive Load” with minimum vertical load equivalent to 1.5 times of design working load (design working load is the load which the pile is designed to carry) to the Engineer for this approval.

Load test for Bored Pile shall be at a ratio of two (2) % of total number of working piles and more than one pile per contract package. Application of either static load test or dynamic load test shall be instructed by the Engineer.

Unless otherwise directed by the Engineer the test load shall be applied in the following sequence:

- a) Apply an initial load of 5% required to the pile – working load.
- b) Remove the initial load and set recording instruments to zero.
- c) Increase load to the required pile working load, as shown on the Drawings, in four equal increments.
- d) Deflection shall be read just after each load increment or decrement is applied and at 15 minutes intervals thereafter. The next increment or decrement shall not be applied until the rate of settlement has decreased to 0.05 cm/hour and the load has been sustained for at least one hour.
- e) The pile working load shall be maintained for at least 12 hours.
- f) Reduce load to zero by similar equal decrements.
- g) Increase load to 1.5 times the required pile working load by six equal increments and maintain at this load for at least 24 hours.
- h) Reduce load to zero by similar equal decrements.
- i) When directed by the Engineer a third test cycle shall be carried out as follows:

Increase load to 2.0 times the required pile working loads by eight equal increments and maintain at this load for 12 hours or as directed by the Engineer.
- j) For acceptance the total vertical displacement at pile top under 1.5 times

pile working load and after its subsequent removal shall not exceed the following values:

Loaded; 1.50% of the pile diameter

Unloaded; 0.75% of the pile diameter

- k) Instrumentation shall be installed as directed by the Engineer and readings taken at each increment, all in accordance with the manufacturer's recommended procedures.

3.6.7 Test Results on Working Pile

- a) The Contractors shall submit within 48 hours of the completion of the pile test to the Engineer for each pile tested a detailed record of testing and in addition, graphs showing:
 - (i) Load and pile top displacement plotted above and below a common base line of time for static load tests.
 - (ii) Pile top displacement plotted vertically against a base line of load for static load tests.
 - (iii) Top pile displacement Vs mobilized static resistance plot as assessed from dynamic load test using CAPWAP – Method.
- b) A full comprehensive written report shall be submitted to the Engineer within 10 working days for approval.
- c) After the completion of loading tests all equipment and load used shall be removed from the Site.
- d) If the results of the load tests on “working piles” shall be considered as not having complied with the criteria specified or required a further pile shall be tested. If this second pile test also does not comply with specifications or requirements the Engineer shall order changes to the pile group as he considers necessary. New pile or piles shall be installed to replace the defective pile in a position or positions as instructed by the Engineer.

3.6.8 Core Test (Humus Test at Pile Tip)

- a) As required by the Engineer core drilling shall be provided for completed piles to at least 600 mm below the bottom of the pile. The core samples obtained shall be placed in core boxes and the drill-hole identification shall be clearly marked on each respective core and box. Compression test for cored concrete samples shall be conducted for three (3) samples per pile. Core Test shall be applied to 2% of total number of piles.
- b) Upon satisfactory completion of tests, all voids formed by core drills shall

be pressure grouted with non shrink grout in accordance with this Specification Section.

3.6.9 Pile Dynamic Testing

(a) Description

The work shall consist of furnishing all materials, equipment, and labour necessary for conducting high-strain dynamic tests on piles. Piles for load tests shall be directed by the Engineer. For Bored Pile, number of piles to be tested by static load test or dynamic load test will be two (2) % of total number of working piles. The Contractor shall appoint an Independent Specialist Company (herein refer to as Company) to conduct all testing and shall supply materials, equipment and labour as specified, for work prior to, during, and after the tests all to the approval of the Engineer. Testing procedures shall conform to ASTM D4945-89 unless noted otherwise. The shaft used for the test will be instrumented and tested by the Company, as approved by the Engineer, meeting requirements outlined in the ASTM D4945-89 specification as well as those outlined below.

(b). Equipment and Material Requirements

The Contractor shall supply all labour, materials and equipment required to prepare and dynamically load the test pile, and returns the pile to a condition suitable for use in the finished structure. The Contractor's equipment and methods shall include but not be limited to:

- i) The extension of the pile top if a permanent casing has not been used to construct the pile. The extension shall be formed of a thin walled casing or equivalent and shall be at least equal to two and a half (2 ½) pile diameters such that the extended pile head can be readily accessed by the testing engineer at the time of the test. If the pile top is below grade, the Contractor shall remove the surrounding soil to expose the pile top to provide a safe working environment.
- ii) Providing a flat, level, and sound concrete top to the pile perpendicular to the vertical axis of the pile. The top of the concrete should be level with or above the casing. Prior to the test, four "windows" approximately 150mm by 150mm shall be provided in each quadrant of the casing.
- iii) Providing a drop weight in the range of one and half to two percent (1.5% to 2%) of the anticipated pile capacity approved by the Engineer.
- iv) Providing a guide allowing variable drop heights typically between 2 to 3m approved by the Engineer.
- v) Providing a shaft top cushion consisting of new sheets of plywood

with total thickness between 50mm and 150mm by the Engineer.

- vi) Providing a steel striker plate at least 50mm thick with a surface area between 70% and 90% of the area of the pile top but not less than the area of the impacting surface of the drop weight, shall be placed on top of the plywood cushion.
- vii) Where reinforcement protrudes above the top of the pile the Contractor shall:
 - Incorporate the reinforcement into the test area using a pile extension. Upon successful completion of the dynamic test the extension can be removed to make the pile suitable for use in the structure.
 - Ensure that at least 20% of the pile cross sectional area is available for sufficient length such that the ram impact will not interfere with the reinforcing bars. In such case steel striker plates and plywood cushions must be sized so that they cover as much as the impact area as possible.
- viii) Providing one (1) k of 220 Volt AC Power.
- ix) Providing a surveyor's level, laser light or equivalent for measurement of pile cluster after each impact.

(c) Specialist

Testing is to be performed by an accredited Specialist from a company with a minimum of four (4) year experience in dynamic load testing. The actual test shall be conducted and/or supervised by a practicing Geotechnical Engineer with at least five (5) years of dynamic testing experience. The Company selected by the Contractor shall be approved by the Engineer.

The Company must supply the following testing instrumentation in addition to instrumentation outlined in ASTM specification D4945-89 Section 5:

- i) Calibrated Strain Transducers
- ii) Calibrated Accelerometer

(d). Reporting Results

The Company shall promptly submit a report of the testing results to the Engineer for approval. The field results from at least one (CAPWAP) analysis (case Pile Wave Analysis Program) shall be submitted. The CAPWAP analysis shall be performed by an experienced and qualified Engineer. The report shall also provide the following:

- i) Wave Equation Analysis results obtained prior to testing
- ii) CAPWAP Analysis result.

- iii) For each impact the maximum measured force, maximum calculated tension force, transferred energy to the auger location, corresponding stresses, and the Case Method bearing capacity.
- iv) Assessment of the test result with respect to both pile capacity and integrity.

3.7 Positional Tolerance

The positional tolerances for cast insitu piles shall be as follows:

- a) The centre of the completed pile at the cut off level shall not deviate more than 80mm from the theoretically correct position shown on the Drawings.
- b) The inclination of the pile shall not deviate more than 1:100 from the required vertical alignment.
- c) After completion of all piling work and prior to casting the pile top into the pile cap or foundation the top of the reinforcement cage shall be no more than 150 mm above and no more than 75 mm below the correct position and the top of the concrete shall be within 25 mm of the correct elevation.
- d) The bottom of the shaft excavation shall be vertical to the axis of the pile within 60 mm per meter of pile diameter
- e) Where a casing is used its outside diameter shall not be less than the shaft diameter shown on the Drawings. The diameter of cast in-situ piles shall be at least 97% of the specified diameter

3.8 Reporting

3.8.1 Daily Piling Records

The Contractor shall furnish the Engineer with a detailed daily record of soils encountered during excavation and construction of the piles.

The Contractor shall keep records of the installation of each pile and shall submit two signed copies of these records to the Engineer not later than 24 hours after the pile was installed. The signed records shall be as indicated in the following Table 2.

Table 2: Records of Pile Borings:

(a)	Contract Name and Date
(b)	Pile reference number (location)
(c)	Pile type
(d)	Nominal cross sectional dimensions or diameter
(e)	Nominal diameter of under ream
(f)	Length of performed pile
(g)	Standing groundwater level

(h)	Date and time of boring
(i)	Date of concreting
(j)	Ground level at commencement
(k)	Working level
(l)	Depth from working level to pile toe
(m)	Toe level
(n)	Depth from working level to pile head level
(o)	Length of temporary casing
(q)	Verticality of borehole
(r)	Soil samples taken and in place tests carried out
(s)	Length and details of reinforcement
(t)	Concrete mix
(u)	Volume of concrete supplied to pile where this can be measured in practice and corresponding levels of concrete and casing
(v)	All information regarding obstructions, delays and other interruptions in the sequence of work
(w)	Strength of corresponding concrete cylinders
(x)	If grouting done, mix and quantity of grout used.

3.9 Testing Frequencies

Testing frequencies shall be accordance with Vietnamese Standard: TCVN 9395-2012 or other international standard subject to equivalence being demonstrated by the Contractor and to the acceptance of the Engineer:

Table 3. Frequency of Tests

Item	Test Frequency	Reference Article	Remarks
a	Material testing & preparation work before construction: (for material & quarries approval)		
	Bentonite liquid	Article 12.2 (Table 1)	
	Cement concrete for bore piles	Article 12.5	
	During construction period:		
	Boreholes checking	Article 12.3 (Table 2; Table 3)	
	Reinforcement grid tolerance	Article 12.4 (Table 4)	
	Cement concrete for bore piles	Article 12.5 (Table 5)	
	After construction period: (For acceptance of construction works)		
	Loading testing for bore plies : (static load, & PDA)	Article 12.6	
	Sonic testing	Article 12.5.2	(100%)

Source: Vietnamese Standard TCVN 9395-2012: Bored Pile - Code of Construction and Acceptance Procedure

4. MEASUREMENT AND PAYMENT

4.1 Method of Measurement

- a) The Bored Piles shall be measured for payment according to the linear meters of piles cast and accepted by the Engineer. The unit rates shall include for, inter alia, excavation, reinforcement, concrete and exposing the reinforcement at the top of the pile.
- b) Measurement shall be made from the bottom of the pile to the bottom of the foundation (the lower plane as defined for structural excavation) indicated on the Drawings. Portions of piles cast deeper than required shall not be measured for payment.
- c) The Bored Pile provisions, material requirements and construction requirements identified in this Specification Section shall be measured for payment in pay items 07300-02, 07300-03, 07300-07, 07300-08, 07300-09 and 07300-10.
- d) Any Bored Pile Works not specifically identified in this Specification Section but which are necessary for the performance of the Works shall be deemed to be included in pay items 07300-02, 07300-03, 07300-07, 07300-08, 07300-09 and 07300-10.
- e) In case that the presence of an obstruction affects the Works the Contractor shall immediately submit to the Engineer, for approval, his proposed countermeasures and detailed schedule to avoid delays to the Works. In the event that the requirements for the aforementioned investigation of the existing Site conditions are not properly carried by the Contractor neither an extension to the Time for Completion nor additional payment shall be allowed for the countermeasures and the materials and incomplete Works performed by the Contractor before encountering the obstruction shall not be subject to any payment.
- f) The quantity to be measured for payment for Dynamic pile tests shall be the number of Bored Piles tested and accepted. Any item indicated and not otherwise described hereto shall be considered subsidiary to the work item and shall not be paid for separately.
- g) The quantity to be measured for payment for Humus, Compression and Static tests shall be the number of Bored Piles tested and accepted. Any item indicated and not otherwise described hereto shall be considered subsidiary to the work item and shall not be paid for separately.
- h) The quantity to be measured for payment for Sonic test shall be the sections of Bored Piles tested and accepted. Any item indicated and not otherwise described hereto shall be considered subsidiary to the work item and shall not be paid for separately.

4.2 Basis of Payment

a) Generally

The work under this Specification Section shall be paid for in accordance with the applicable unit prices as indicated in the Bill of Quantities and given below. Payment shall constitute full compensation for performing the requirements of the Contract for the item of work as specified including furnishing all necessary labor, materials, tools, equipment, incidentals and tests.

b) Bored Piles

For the avoidance of doubt the unit prices also include:.

- i) Placing of cage for reinforcement, integrity testing tubing, protection of existing piles and structures, hauling, handling, jetting, jointing, cutting and all other incidental works related thereto
- ii) Pumps, cofferdams, braced sheet piling or any other methods approved by the Engineer;
- iii) The Contractor's observance of all rules and regulations of relevant Competent Authorities regarding the interference or maintenance of flow in the canals, water courses, channels or pipes related to the Works.
- iv) Provision for and driving and removal of sheet piles including providing certification by an Independent Engineer;
- v) Provision for placement and removal of temporary Jetty/Guide frames;
- vi) Provision for underwater works;
- vii) Provision for underwater concrete;
- viii) Provision for pumps and dewatering by submersible pumps;
- ix) Provision for all necessary barges; and
- x) Provision for all necessary tugboats and auxiliary river craft.

c) Pile Tip Tests (Humus Test, Compression Test for Core samples)

Payment shall include all expenses for furnishing all materials, equipment and instruments, technicians and experts for completion of the pile core tests.

d) Load Testing for Bored Pile (Static Load, Dynamic Test)

Payment shall include the appointment of a Company, all instrumentation, testing and testing equipment, analysis and reporting and incidentals.

e) Sonic Test Payment shall include the appointment of a Company, all instrumentation, testing and testing equipment, analysis and reporting and incidentals.

f) After having the results of 7 days concrete strength and sonic tests which are approved by the Engineer, the Contractor will certify 70% of unit price in the next Interim Payment Certificate. After completion of testing works in accordance with the contract documents and the Engineer's acceptance, the remaining 30% will be paid to the Contractor.

In case, testing results show that the pile does not comply with the Specification, the Engineer shall deduct corresponding amounts in the next payment(s) until the repairing/additional works is approved by the Engineer and completed by the Contractor.

The Contractor shall be responsible for additional costs for the repairing/additional works.

<u>Pay Item</u>	<u>Description</u>	<u>Unit</u>
07300	Bored Pile	
07300 - 02	Bored Pile 1,200 mm diameter	m
07300 - 03	Bored Pile 1,000 mm diameter	m
07300 - 07	Sonic Test	section
07300 - 08	Compression Test for Core Samples from Pile Tip	no.
07300 - 09	Humus Test at Pile Tip (in Humus Test Pipe Dia.110mm)	no.
07300 - 10	Pile Dynamic Test	no.