Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS
FOR
CONCRETE DRILLED SHAFT FOR SUPPORT STRUCTURES

Effective Date
August 18, 2009

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01129.01 DESCRIPTION

Concrete drilled shaft foundation shall consist of reinforced concrete placed in a drilled shaft that is seated in bedrock or soil and with or without rock socket as shown on the plans. The reference to “rock” and “rock socket” through out this document is only applicable to shafts that are seated into bedrock with rock socket as specified on the plans.

The elevations, dimensions, and depth of the drilled shafts and possible rock sockets shall be as specified in the plans. The bottom of shaft elevation may be adjusted by the Design Engineer if bearing strata are encountered at different elevations or are judged to be of a different quality.

01129.02 Materials

All submittals shall be in electronic format.

A. Slurry

Only mineral or polymer slurries shall be used in the drilling process unless other drilling fluids are approved in writing by the Engineer. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. In the event of a sudden significant loss of slurry to the excavation, the construction of the foundation shall be stopped until either methods to stop slurry loss or an alternate construction procedure has been approved by the Engineer.

All tests specified below shall be performed when the slurry temperature is above 40°F (4°C).

Mineral slurry or polymer slurry shall be premixed thoroughly with clean, fresh water, and adequate time (as prescribed by the manufacturer) allotted for hydration in slurry tanks. Slurry tanks of adequate capacity will be required for slurry circulation, storage, treatment, and disposal. No excavated slurry pits will be allowed. The Contractor shall draw sample sets from the slurry tanks and test the samples for conformance with the specified material properties prior to introduction into the shaft excavation. A sample set shall be composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the slurry tanks.

The Contractor shall sample and test all slurry in the presence of the Engineer, unless otherwise directed. The date, time, names of the persons sampling and testing the slurry, and the results of the tests shall be recorded. A copy of the recorded slurry test results shall be submitted to the Engineer

at the completion of each shaft, and during construction of each shaft when requested by the Engineer.

Sample sets of all slurry, composed of samples taken at mid-height and within 2 feet (0.6 m) of the bottom of the shaft, shall be taken and tested during shaft excavation as necessary to verify the control of the properties of the slurry. As a minimum, sample sets shall be taken and tested at least once every 2 hours after beginning slurry use. When the test results show consistent specified properties, sample sets shall be taken and tested at least once every 4 hours of slurry use. Slurry shall be recirculated, or agitated with the drilling equipment, when tests show that the sample sets do not have consistent specified properties.

When samples are found to be unacceptable, the Contractor shall clean, recirculate, desand, or replace the slurry to maintain the required slurry properties. Cleaning of the bottom of the excavation and placement of the concrete shall not begin until tests show that the sample sets have consistent specified properties.

The Contractor shall demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, the Contractor shall immediately take action to stabilize the shaft. The Contractor shall submit a revised installation plan, which corrects the problem and prevents future instability. The Contractor shall not continue with shaft construction until receiving the Engineer's approval of the revised shaft installation plan.

1. Mineral Slurry

Mineral slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 kg/m^3))	Slurry Density, Materials I.M. 387	64 to 75 (1030 to 1200)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup, Materials I.M. 387	104 to 201 (27.5 to 53)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note*
* The sand content of mineral slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than or equal to 4.0%.		

2. Polymer Slurry

Polymer slurry shall be used in conformance with the manufacturer's recommendations and these Supplemental Specifications. The Contractor shall submit the name and telephone number of the manufacturer's representative to the Engineer. The manufacturer's representative shall provide technical assistance in the use of the polymer slurry as needed.

Polymer slurry shall conform to the following requirements:

Property	Test Method	Requirements
Density (lb/ft^3 kg/m^3))	Slurry Density, Materials I.M. 387	62 to 63 (995 to 1010)
Viscosity (sec/gal (sec/L))	Marsh Funnel and Cup ,Materials I.M. 387	136 to 227 (36 to 60) 231 to 252 (61 to 66.5) (dry sand/gravel)
pH	pH Paper	8 to 11
Sand Content (%)	Sand Content Test, Materials I.M. 387	See note *
* The sand content of polymer slurry prior to placing the reinforcing steel cage and immediately prior to placing concrete shall be less than 2.0%.		

The Contractor shall wait 30 minutes, after the last drilling and scouring, to allow contaminants to settle out before taking and testing a sample set of slurry. After the reinforcing steel cage is placed in the excavation, a sample set of slurry shall be taken and tested immediately prior to concrete placement.

B. Concrete
All materials, proportioning, air entraining, mixing, slump, and transporting of PCC shall be in accordance with Section 2403 of the Standard Specifications except as modified herein.

The water/cement ratio shall not exceed 0.45.

The concrete for construction of drilled shafts shall be a Class D PCC mixture with a slump of 8 inches ±1.5 inches (200 mm ±40mm).

The Contractor shall use a mid-range water in accordance with Materials I.M. 403.

Retarder shall be required in accordance with Materials I.M. 403 to maintain workable concrete. Portland cement shall meet the requirements of ASTM C 150 Type I / II and Section 4101, of the Standard Specifications.

Ground Granulated Blast Furnace Slag (GGBFS) shall not be used.

C. Grout
Materials I.M. 388 shall apply.

01129.03 Construction
All submittals shall be in electronic format.

A. CONSTRUCTION TOLERANCES.

1. The drilled shaft shall be within 3 inches (75 mm) of plan position at the top of shaft.

2. The vertical alignment of shaft excavation shall not vary from the plan alignment by more than 1/4 inch/foot (20 mm/m of depth).

3. Full depth reinforcing steel cages shall be set at no less than 6 inches (150 mm) above the bottom of the excavated shaft prior to placement of concrete.

4. After all the concrete is placed; the top of the reinforcing steel cage shall be no more than 6 inches (150 mm) above and no more than 2 3/4 inches (70 mm) below plan position.

5. The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe.

6. The top elevation of the shaft may have a tolerance of up to plus 1 inch (25 mm) or minus 3 inches (75 mm) from the plan top of shaft elevation. Sufficient reinforcement bar splice length for splices above the shaft shall be attained.

7. Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of 3/8 inch/foot (30 mm/m) of diameter.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor shall be responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance drilled shaft excavations shall be furnished without either cost to the Contracting Authority or an extension of the completion dates of the project.

B. DRILLED SHAFT INSTALLATION PLAN

Two weeks prior to the pre-construction conference, the Contractor shall submit a list containing at least three projects completed in the last three years on which the Contractor has installed drilled shafts of a diameter and length similar to those shown on the plans. The list of projects shall contain names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects. The Contractor shall also submit a signed statement that they have inspected the project site and all the subsurface information made available in the contract documents.

No later than 1 month prior to constructing drilled shafts, the Contractor shall submit a drilled shaft installation plan for review by the Engineer. This plan shall provide information on the following:

1. Name and experience record of firm(s) and associated personnel for the following:
- **a.** driller
- **b.** drilled shaft superintendent
- **c.** site exploration
- **d.** confirmation boring
- **e.** crosshole sonic logging (CSL)

2. List of proposed equipment to be used including cranes, drills, augers, bailing buckets, grooving equipment, scouring equipment, final cleaning equipment, core sampling equipment, confirmation boring equipment, tremies or concrete pumps, casing, slurry equipment, airlift pumps, etc.

3. Details of overall construction operation sequence and the sequence of shaft construction in bents or groups.

4. Details of shaft excavation methods.

5. Details of casing and forms, including installation and removal.

6. Details of the type and methods to mix, circulate, desand, test, and dispose of slurry (if applicable). If polymer slurry is proposed, submit data on load transfer and manufacturers requirements for slurry control.

7. Details of methods to clean the shaft excavation, including air lift methods and spin bucket methods as applicable.

8. Details of reinforcement placement including support and cage centering methods.

9. Reinforcing steel cage splicing method, if proposed, including details of dimensions, installation, splice location, support and cage centering methods, and estimated time required for splicing.

10. Details of concrete placement including procedures for tremie or pumping methods and method to prevent slurry intrusion at the discharge end.

11. Concrete mix proposal.

12. Details of methods to control cuttings, water, slurry, etc. with adjacent traffic conditions (vehicular or railroad if applicable).

13. Details of CSL testing including location and attachment methods of the steel access pipes.

14. Details of methods used to groove the sides of the drilled shaft length within the bedrock supporting stratum, if present, and methods of scouring and verification of grooving.

15. Details of final discharge of concrete at top of shaft, of removing contaminated concrete, and verifying concrete uniformity for site specific conditions.

16. When casing is required, details on casing to be used, including specific length/depth of all casing proposed, and specific evaluation and determination of casing (size, depth, etc.) required to prevent any shaft installation procedure from having an effect or impact on adjacent structures, railroads, etc.

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract documents. Within 14 calendar days after receipt of the plan, the Engineer will notify the Contractor of additional information required and/or changes necessary to meet the contract requirements. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the contract documents.

A pre-drilling conference will be required for this work prior to the start of shaft excavation. The Contracting Authority, Contractor, and drilling staff shall discuss the anticipated shaft process.

C. CONTROL AND DISPOSAL OF MATERIALS

Disposal of excavated material, as well as slurry and/or water removed from the shaft excavation, shall be the responsibility of the Contractor. All slurry and water, displaced during final cleaning and concrete placement, shall be collected and properly disposed off site. Open pits for collection of materials will not be allowed. All excavated material, slurry, water, and other matter shall be controlled by the Contractor so that at no time it enters or encroaches upon the adjacent travel lanes, railroad, water ways, etc.

D. SHAFT EXCAVATION

The drilled shafts shall be constructed by either the wet, dry, or casing method as necessary to produce sound, durable concrete foundation shafts free of defects.

Surface and subsurface obstructions shall be removed by the Contractor. Special tools and/or procedures may be required. No separate payment will be made for removing obstructions.

The Contractor shall extend drilled shaft tip elevations if the Engineer determines that the material encountered during excavation and/or present at tip elevation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

The Contractor shall maintain a drilling log during shaft and possible socket excavation. The log shall contain information such as elevation, depth of penetration, drilling time in each of the strata, material description, and remarks. Two copies of the log, signed by the Contractor, shall be furnished to the Engineer within 1 week after completion of the excavation.

1. Wet Method

The wet method consists of keeping the shaft filled with slurry a minimum of 4 feet (1.3 m) above the highest expected water table during drilling and excavation, desanding of the slurry when required, final cleaning of the excavation by means of a bailing bucket, air lift, pump or other approved device and placing shaft concrete which displaces the slurry.

In the event that layers susceptible to cave-ins are encountered which cannot be controlled by slurry, the Contractor shall install temporary removable casing in accordance with Article SS-01129.03, D, 3.

2. Dry Method

The dry method shall be used only at sites where the ground water level and soil and rock conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where

the sides and bottom of the shaft can be visually inspected by the Engineer prior to placing the concrete. The dry method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, placing the reinforcing cage, and concreting the shaft in a relatively dry excavation.

The dry method shall only be approved by the Engineer when the shaft excavation demonstrates that less than 12 inches (0.305 m) of water accumulates above the base over a 1 hour period when no pumping is permitted; the sides and bottom of the hole remain stable without detrimental caving, sloughing, or swelling between completion of excavation and concrete placement; and any loose material and water can be satisfactorily removed prior to inspection and concrete placement. Less than 3 inches (75 mm) of water will be permitted in the bottom of the shaft excavation at the time of concrete placement. The Contractor shall use the wet or casing method for shafts that do not meet the dry method requirements.

3. Casing Method

The casing method is used to advance the hole through unstable material. Over-reaming to the outside diameter of the casing may be required. Before the casing is to be removed, the level of fresh concrete shall be a minimum of 5 feet (1.5 m) above the bottom of the casing so that fluid trapped behind the casing is displaced upward. As the casing is withdrawn, the concrete level shall be maintained so that fluid trapped behind the casing is displaced upward without contamination or displacing shaft concrete.

The Contractor shall determine the appropriate depth where the temporary casing is terminated to ensure the stability of the shaft. The purpose of the temporary casing is to stabilize the shaft walls during drilling to prevent cave-ins as the result of potential vibrations. The purpose of the casing is also to prevent any shaft installation procedure from having an impact on adjacent structures, railroads, etc.

Permanent casing, if required, will be specified in the contract documents.

After the shaft excavation has been completed, the Contractor shall immediately proceed with shaft construction.

E. GROOVING SIDEWALLS

Grooving, if required, will be identified in the project plans. The sidewalls of the drilled shaft within the possible rock socket shall be grooved so as to produce channels with approximate dimensions of 2 inch (50 mm) depth by 3 inch (75 mm) height at intervals of 1 foot (0.3 m). Prior to grooving, excessive smearing of soft material that occurred on the possible rock socket wall shall be removed by a method approved by the Engineer and the base of the shaft shall be cleaned by spin bucket and air lift. Grooving shall be performed prior to final cleaning of the base of the shaft.

F. FINAL CLEANING

If a slurry cake builds up on the shaft sidewalls, the Contractor shall remove it prior to concrete placement at no additional cost. If mineral slurry is used, the shaft sidewalls above the possible rock socket shall be reamed prior to placement of reinforcement. The Contractor shall adjust operations so that the maximum time that the slurry is allowed to remain in the shaft is 24 hours.

The Contractor shall clean the base of each shaft so that a minimum of 50% of the base will have less than 1/2 inch (15mm) of sediment at the time of concrete placement. The maximum depth of sediment or debris at the base of the shaft shall not exceed 1 inch (25mm).

For dry shafts, visual inspection shall be performed by the Engineer.

For slurry shafts, the Contractor shall use an air lift to clean the bottom of the shaft. After a wait period equal to the time to set the reinforcing steel cage and concrete placement setup, the Contractor shall measure the amount of sediment in the bottom of the shaft. If the amount of sediment meets the

above requirements, the Contractor shall clean the base of the shaft a second time with the air lift and immediately proceed with shaft construction. If after the described wait period the amount of sediment exceeds the requirements, the Contractor shall clean the shaft by air lift and repeat the above procedure until the sediment accumulation meets the requirements. The Engineer may approve, at no additional cost to the Contracting Authority, an alternate method to clean the bottom of the shaft.

G. EXCAVATION INSPECTION.
The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment of the shaft under construction shall be verified by the Contractor under the direction of the Engineer. Final shaft depths shall be measured with a suitable weighted tape or other approved methods after final cleaning.

H. REINFORCING STEEL CAGE CONSTRUCTION AND PLACEMENT.
The reinforcing steel cage consisting of longitudinal bars, ties, cage stiffener bars, spacers, cage centering devices, and other necessary appurtenances, shall be completely assembled and placed immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. If approved by the Engineer, the reinforcing steel cage, as approximately two equal units, may be joined together in the shaft excavation after the first unit has been inserted.

The reinforcing steel in the shaft shall be tied at intersections and supported so that the reinforcing steel will remain within allowable tolerances given in this specification. Concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient intervals, near the top and bottom and at intervals not exceeding 10 feet (3 m) along the shaft, to ensure concentric spacing for the entire cage length. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to ensure a minimum distance of 3 inches (75 mm) between the cage and the excavated hole. When a full depth reinforcing steel cage is used, it shall be supported at the bottom by approved cylindrical feet to ensure that the bottom of the cage is maintained at the proper distance above the base. When a partial depth reinforcing steel cage is used, the Contractor shall design and furnish a support system.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the reinforcing cage is not maintained within the specified tolerances, corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional shafts shall be constructed until the Contractor has modified the reinforcing cage support in a manner satisfactory to the Engineer.

I. CONCRETE PLACEMENT.
Shaft concrete shall be placed within 24 hours of the start of excavation of the rock socket if present. Concrete shall be placed as soon as possible after reinforcing steel placement. The Contractor shall coordinate batching and delivery of the concrete with the batch plant so that the time limits, as stated in the Standard Specifications, between batching and delivery are not exceeded. Concrete placement shall be continuous. Concrete placement shall continue after the shaft excavation is full until good quality concrete is evident at the top of shaft. Remove a sufficient volume of concrete to ensure elimination of all contaminated concrete at the top of shaft before continuing with column construction. Concrete shall be placed either through a tremie or concrete pump.

1. Placement of Concrete by Tremie:
The tremie used to deposit concrete shall be constructed so that it is watertight and will readily discharge concrete. The tremie shall not be more than 12 inches (300 mm) in diameter, and there shall be no aluminum parts in contact with concrete. The discharge end of the tremie shall be constructed to prevent water or slurry intrusion and permit the free flow of concrete during placement operations. The tremie shall have sufficient mass that it will rest on the shaft bottom before start of concrete placement. The length of the tremie shall be sufficient to extend to the bottom of the shaft. The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. The tremie shall be supported so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. The flow of the concrete shall be continuous and the concrete in the tremie shall maintain a

positive pressure differential at all times to prevent introduction of air pockets or contaminants into the concrete.

2. Placement of Concrete by Pump
Concrete pumps and lines may be used for concrete placement. All pump lines shall have a minimum 4 inch (100 mm) diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

A plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or be of a material, approved by the Engineer, which will not be a detriment to the shaft if not removed.

The discharge orifice shall be maintained between 5 feet and 10 feet (1.5 m and 3.0 m) below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

The pumping operation shall be performed in a manner that prevents introduction of air pockets into the concrete. If breaking of the pump line is required, the discharge orifice shall be temporarily positioned 3 feet to 5 feet (1.0 m to 1.5 m) below the surface of the fluid concrete in the hole. Additional methods to eliminate introduction of air into the concrete may be proposed by the Contractor.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 3 hours. All admixtures, when approved for use, shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 3 hour placement limit. For construction of shafts larger than 6 feet (2 m) in diameter, the Contractor may propose placement time over 3 hours provided the Contractor submits trial mix documentation that all concrete in the shaft will retain a minimum 4 inch (100 mm) slump for the entire placement period.

All temporary casing shall be removed.

J. CROSSHOLE SONIC LOG (CSL) TESTING.
The Contractor shall coordinate with an independent testing agency to perform CSL testing in accordance with ASTM D 6760; and provide analysis and interpretation on each completed shaft.

The procedure in ASTM D 6760 will be followed with the following exceptions:

1. Plastic access ducts and drilled boreholes will not be allowed unless approved by the Engineer.

2. A minimum of 4 access ducts are required.

3. The Crosshole Sonic Log (CSL) testing shall be performed after the shaft concrete has cured at least 48 hours but no later than 7 calendar days.

4. The access ducts shall be grouted after approval of the testing results by the Engineer.

5. The waterfall diagram (which is a nesting of ultrasonic pulses in an ultrasonic profile) shall be included in the report.

The Contractor shall furnish and install one access pipe per 1 foot (0.3 m) of shaft diameter but no less than four per shaft, with external couplings for CSL testing. The access pipes shall be 2 inch (51 mm) diameter, Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S. The access pipes shall have a round, regular inside diameter free of defects and obstructions, including all

pipe joints, in order to permit the unobstructed passage of 1 3/8 inch (35 mm) maximum diameter source and receiver probes used for the CSL tests. The access pipes shall be watertight and free from corrosion with clean internal and external faces to ensure a good bond between the concrete and the access pipes. The access pipes shall be fitted with a watertight cap on the bottom and a removable, watertight cap on the top to prevent debris from entering the pipes. Any joints required to achieve the specified length shall also be watertight.

The Contractor shall securely attach the access pipes to the interior of the reinforcing cage such that each pipe is equally spaced within the reinforcing cage. If a partial depth reinforcing cage is specified, the Contractor shall design and furnish a support system to secure and properly align the CSL access pipes.

The access pipes shall be installed in straight alignment and parallel to the vertical axis of the reinforcing cage. The access pipes shall have 2 inch (50 mm) concrete cover at the bottom of the shaft or extend to the top plate of a load cell placed at the bottom of the shaft. When a load cell is located above the bottom of the shaft, the access pipes shall be fitted with watertight slip joints between the load cell bearing plates. The access pipe shall extend at least 2 feet (600 mm) above either the top of the continuous concrete placement operation or the top of the shaft. Care shall be taken to prevent damaging the access pipes during the reinforcing steel cage installation.

The access pipes shall be filled with clean water prior to concrete placement. Each access pipe shall be resealed immediately after water placement to prevent debris from entering the pipe. The Contractor, prior to CSL testing, shall flush any access pipes containing debris, refill with water of similar temperature, and reseal. Water of similar temperature shall be used to avoid debonding of access pipes with surrounding concrete. All access pipes shall be dewatered and filled with grout after the tests are completed, and the shaft has been accepted by the Engineer. The grout shall meet the requirements of Materials I.M. 388.

The test results, analysis, and interpretation submittal for the shafts shall be provided to the Engineer by the Contractor within 7 calendar days of testing. The Engineer will determine final acceptance of each shaft, based on the CSL test results and analysis for the tested shafts, and will provide a response to the Contractor within 5 working days after receiving the test results and analysis submittal.

The Contractor shall not commence subsequent shaft excavations until receiving the Engineer’s approval and acceptance of the first shaft; based on the results, analysis, and interpretation of the CSL testing for the first shaft.

The Contractor shall not commence subsequent construction of the structure until receiving the Engineer’s approval and acceptance of the supporting shaft; based on the results, analysis, and interpretation of the CSL testing for the supporting shaft.

For all shafts determined to be unacceptable, the Contractor shall submit a plan for remedial action to the Engineer for approval. All remedial correction procedures and designs shall be submitted to the Engineer for approval. The Contractor shall not begin repair operations until receiving the Engineer’s approval of the remedial action plan.

01129.04 METHOD OF MEASUREMENT.

A. Concrete Drilled Shaft for Support Structures

The Engineer will measure in feet (meters), to the nearest 6 inches (0.15 m), the length of Concrete Drilled Shafts for Support Structures constructed.

B. Reinforcing Steel

Reinforcing Steel will be measured in accordance with Section 2404 of the Standard Specifications.

01129.05 BASIS OF PAYMENT

A. Concrete Drilled Shaft for Support Structures

For the number of feet (meters) of Concrete Drilled Shaft for Support Structures the Contractor will be paid the contract unit price per foot (meter). This payment shall be full compensation for all equipment, labor, and materials (except reinforcing steel) necessary to satisfactorily construct the shafts; including drilling and excavation of shaft and possible rock socket, casing, installation and removal of temporary casing, furnishing and placing concrete, CSL pipe and testing, shaft inspection, disposal of excavated materials and water, and all other materials.

B. Reinforcing Steel

Reinforcing Steel will be paid for in accordance with Section 2404 of the Standard Specifications.