



**SPECIAL PROVISIONS
FOR
CONCRETE DRILLED SHAFT – NOISE WALL**

Polk County
IMN-235-2(614)4--0E-77
IMN-235-2(615)4--0E-77
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Effective Date
April 20, 2010

**THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING
MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL
PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

090060.01 DESCRIPTION

Concrete drilled shaft foundation shall consist of reinforced concrete placed in a drilled shaft as shown on the plans.

The elevations, dimensions, and depth of the drilled shafts shall be as specified in the plans.

090060.02 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 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 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 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 (kg/m ³)	Slurry Density Materials I.M. 387	1030 to 1200
Viscosity (sec/L)	Marsh Funnel and Cup Materials I.M. 387	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 Special Provisions. 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 (kg/m ³)	Slurry Density Materials I.M. 387	995 to 1010
Viscosity (sec/L)	Marsh Funnel and Cup Materials I.M. 387	36 to 60 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 200 mm ±40mm.

Air entrainment shall: apply Section 2403.

Mid-range water reducer is required according to 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.

090060.03 CONSTRUCTION

All submittals shall be in electronic format.

A. CONSTRUCTION TOLERANCES.

1. The drilled shaft shall be within 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 20 mm/m of depth.
3. Full depth reinforcing steel cages shall be set at no less than 150 mm above the bottom of the excavated shaft prior to placement of concrete.

4. Reinforcing steel shall be set as detailed in the plans.
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 25 mm or minus 50 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 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. 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.

C. 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 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 15 mm of sediment at the time of concrete placement. The maximum depth of sediment or debris at the base of the shaft shall not exceed 25 mm.

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.

D. 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.

E. 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 and supported so that the reinforcing steel will remain within allowable tolerances given in these Special Provisions. 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 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 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.

F. CONCRETE PLACEMENT.

Shaft concrete shall be placed within 24 hours of the start of excavation. 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 less than 250 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 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 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 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 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.

All temporary casing shall be removed.

090060.04 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Drilled shaft construction is incidental to the Precast Noise Wall bid item. Method of measurement and basis of payment shall be as stated in the plans.