Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
DRILLED-IN PILES

Linn County
NHSX-100-1(63)--3H-57

Effective Date
April 15, 2014

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120172.01 DESCRIPTION.

A. A concrete drilled-in pile foundation consists of a drilled shaft with a steel H-pile core seated in bedrock then filled with concrete and includes a rock socket as shown in the contract documents.

B. As shown in the contract documents, the drilled-in piles are encased in concrete up to 15 feet below the bottom of abutment footing, then encased in sand for 5 feet, then encased in bentonite for 10 feet.

C. Ensure elevations, dimensions, and depth of the soil shafts and rock sockets are as specified in the contract documents. If bearing strata are encountered at different elevations or are judged to be of a different quality, the Engineer may adjust the socket elevation.

120172.02 MATERIALS.

A. Concrete.
Comply with the following:

1. All materials, proportioning, air entraining, mixing, slump, and transporting of PCC shall be according to Section 2403 of the Standard Specifications, except as modified herein.

2. Water/cement ratio: not to exceed 0.45.

3. Drilled-in pile construction: use Class D PCC mixture with a slump of 8 inches ±1.5 inches.

4. Portland cement: meet the requirements of ASTM C 150 Type I / II and Section 4101 of the Standard Specifications.

5. Air entrainment: apply Section 2403 of the Standard Specifications.

6. Retarder is required according to Materials I.M. 403 to maintain workable concrete.

7. Mid-range water reducer is required according to Materials I.M. 403.

8. Do not use Ground Granulated Blast Furnace Slag.

B. Grout.
Apply Materials I.M. 388.

C. Steel H-Pile Core.

1. Conform to Section 4167 of the Standard Specifications.

2. Storing, transporting, and handling shall be performed in a manner to prevent bending stresses, or other damage.

3. Pile Order Lengths.
- **a.** The order length of the production piles shall be developed after successful completion of at least one probing per pile locations.
- **b.** The Contractor shall develop their schedule such that all the probes can be performed as early as possible and the record of the air-track probes shall be turned to the Engineer for evaluations and issuance of the final drilled-in piles. The Contractor shall allow the Engineer 15 working days to evaluate and issue the final tip elevations.

D. Sand.
Apply Section 4133 of the Standard Specifications.

E. Bentonite.
Apply Article 2501.03, Q of the Standard Specifications.

120172.03 CONSTRUCTION.

A. Construction Sequence.

1. Drill one 2 inch minimum air-track test probe at each drilled-in pile location. It shall be drilled prior to H-pile ordering or drilled-in pile installation.

2. Advance the drilled-in pile excavation to the tip elevation of the concrete socket per the approved installation plan.

3. Clean the drilled-in pile to ensure that no fines or sediments are present per the approved installation plan.

4. Steel H-pile core shall be placed with centralizers in the excavated drilled-in pile.

5. Place the concrete using tremie pipe immediately after excavation bottom is approved by the Engineer.

6. The Contractor shall install corrugated metal pipe (CMP) to support the ground above the top of the concrete to facilitate the placement of sand and bentonite. The cost and installation effort of the CMP is considered incidental and part of the cost of the drilled-in piles.

B. Construction Tolerances.
Drilled-in pile excavations and completed drilled-in piles not constructed within the required tolerances will be considered unacceptable. Correct all unacceptable excavations and completed drilled-in piles to the Engineer’s satisfaction. Furnish materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance excavations

(without either cost to the Contracting Authority or an extension of the working days for the project).

1. Ensure the drilled-in pile is within 3 inches of plan position at the top of drilled-in pile.

2. Ensure the vertical alignment of the excavation does not vary from the plan alignment by more than 1/4 inch per foot.

3. Set full depth steel H-pile core section at the bottom of the excavated prior to concrete placement.

4. Ensure that, after all the concrete is placed, the top of the steel H pile core is no more than 3 inches above and no more than 3 inches below plan position.

5. Casing dimensions are subject to American Pipe Institute tolerances applicable to regular steel pipe.

6. The top elevation of the concrete may have a tolerance of plus or minus 3 inches from the plan top of concrete elevation. Ensure sufficient steel H-pile core section length for embedment into abutment.

7. Use excavation equipment and methods that ensure the completed excavation will have a planar bottom. Ensure the excavation equipment cutting edges are normal to the equipment's vertical axis within a tolerance of 3/8 inch per foot of diameter.

C. Drilled-In Pile Installation Plan.

1. 2 weeks prior to the pre-construction conference, submit a list containing at least three drilled shafts or drilled-in pile projects, of similar diameter and length to those shown on the plans, completed in the last 3 years. In the list of projects include names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects. In addition, submit a signed statement that the Contractor has inspected the project site and all the subsurface information made available in the contract documents.

2. No later than 1 month prior to constructing drilled-in pile, submit a drilled-in pile installation plan for the Engineer to review. In this plan provide the following information:

- **a.** Name and experience record of firm(s) and associated personnel for the following:
  - **1)** Driller.
  - **2)** Drilled-in pile superintendent.
  - **3)** Qualified Geotechnical Inspector.
  - **4)** Site exploration.
  - **5)** Confirmation boring.
- **b.** 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, test probe equipment, tremies, casing, airlift pumps, and so forth.
- **c.** Details of overall construction operation sequence and the sequence of drilled-in pile construction in bents or groups.
- **d.** Details of excavation methods.
- **e.** Details of casing and forms, including installation and removal.
- **f.** Details of methods to clean the excavation, including air lift methods and spin bucket methods as applicable.
- **g.** Details of H-pile core placement, including support and centering methods.
- **h.** Detail of centralizer and the way it is attached to the H-pile core.
- **i.** Details of concrete placement including procedures for tremie and method to prevent water or sediment intrusion at the discharge end.

j. Concrete mix proposal.
k. Details of methods to control cuttings, water, and so forth with adjacent traffic conditions (vehicular or railroad if applicable).
l. Details of final discharge of concrete at top of drilled-in pile, of removing contaminated concrete, and verifying concrete uniformity for site specific conditions.
m. When casing is required, include 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 all drilled-in pile installation procedures from having an effect or impact on adjacent structures, railroads, and so forth.

3. The Engineer will evaluate the drilled-in pile 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 or changes necessary to meet the contract requirements, or both. Field test the Engineer's procedural approvals. These approvals do not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the contract documents.

4. A pre-drilling conference, in which the Contracting Authority, Contractor, and drilling staff discuss the anticipated drilled-in pile process, will be required for this work prior to the start of excavation.

D. Geotechnical Inspector
A qualified geotechnical engineer shall be hired by the Contractor and subject to review by the Contracting Authority and Engineer.

1. The geotechnical engineer shall have a minimum of 5 years of relevant experience and have overseen a minimum of three drilled shaft and/or drilled-in pile projects of similar size and scope in similar ground conditions.

2. The geotechnical engineer is responsible for ensuring that the drilled shafts are constructed in accordance with the Standard Specifications and this Special Provision.

E. Air-Track Probes.

1. Drill 2 inch minimum diameter probe to a depth as shown in the plans. Drill one test probe at the center of each drilled-in pile location.

2. Air-track probe all drilled-in piles prior to start of drilled-in pile excavation. Provide the logs of probing for Engineer to develop final drilled-in pile tip elevation. The probe log shall record rate of advance per foot. Down pressure applied if any, rod drops, and any observation regarding the cuttings.

3. If voids, soil seams, or solution channels are detected, the Engineer shall be contacted for potential deeper probing depth.

4. If the test probe hole has a diameter of 8 inch or greater, the test probe hole can be filled with drilled-in pile concrete in lieu of grout. Otherwise, fill drilled probe holes with neat cement grout.

5. Drilled-in pile installation shall not proceed until all the probes have been drilled, and the resulting data submitted to the Engineer. The Engineer will determine the final tip elevation based on the results of the probing.

6. Develop the schedule such that all the probes can be performed as early as possible and the record of the air-track probes shall be submitted to the Engineer for evaluations and issuance

of the final tip elevations. Allow the Engineer 15 working days to evaluate and issue the final tip elevations

F. Control and Disposal of Materials.

Dispose of excavated material, as well as water removed from the excavation. Collect and properly dispose at an off-site all water displaced during final cleaning and concrete placement. Open pits for collection of materials will not be allowed. Control all excavated material, water, and other matter so that at no time it enters or encroaches upon the adjacent travel lanes, railroad, water ways, and so forth.

G. Drilled-in Pile Excavation.

1. General.

a. Construct drilled-in pile excavation by either the dry or casing method as necessary to produce sound, durable concrete foundation free of defects. These methods are described below.

b. Remove surface and subsurface obstructions. Special tools and/or procedures may be required. No separate payment will be made for removing obstructions.

c. 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-in pile, extend the drilled-in pile tip elevations.

d. Maintain a drilling log during soil and rock socket excavation. In the log, place information such as elevation, depth of penetration, drilling time in each of the strata, material description, and remarks. Furnish two copies of the log (signed by the Contractor) to the Engineer within 1 week after completion of the excavation.

e. After the excavation has been completed, immediately proceed with drilled-in pile construction.

f. Due to the potential presence of karst features, the use of slurry is not permitted.

2. Dry Method.

a. The dry method consists of:

- Drilling the excavation,
- Removing accumulated water and loose material from the excavation,
- Placing the steel H-pile core, and
- Concreting the drilled-in pile in a relatively dry excavation.

b. Use the dry method only at sites where:

- The ground water level and soil and rock conditions are suitable to permit construction of the drilled-in pile in a relatively dry excavation, and
- The Engineer can visually inspect the sides and bottom of the excavation prior to placing the concrete.

c. The Engineer will approve the dry method only if the drilled-in pile excavation demonstrates:

- Less than 12 inches 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
- All loose material and water can be satisfactorily removed prior to inspection and concrete placement (less than 3 inches of water will be permitted in the bottom of the excavation at the time of concrete placement).

d. Use the casing method for excavations that do not meet the dry method requirements.

3. Casing Method.

a. The casing method is used to advance the excavation 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 must be a minimum of 5 feet above the bottom of the casing so that fluid trapped behind the casing is displaced upward. As the casing is

withdrawn, maintain the concrete level so that fluid trapped behind the casing is displaced upward without contamination or displacing drilled-in pile concrete.

b. Determine the appropriate depth to terminate the temporary casing to ensure the stability of the excavation. The purpose of the temporary casing is to stabilize the excavation walls during drilling to prevent cave-ins as the result of potential vibrations. The purpose of the casing is also to prevent drilled-in pile installation procedures from having an impact on adjacent structures, railroads, and so forth.

c. Permanent casing is not allowed.

H. Final Cleaning.

1. Clean the base of each excavation so that a minimum of 50% of the base will have less than 1/2 inch of sediment at the time of concrete placement. Ensure the maximum sediment or debris depth at the base of the excavation does not exceed 1 inch.

2. The Engineer will visually inspect dry excavations.

I. Excavation Inspection.

Provide equipment for checking the dimensions and alignment of each excavation. Under the direction of the Engineer, verify the dimensions and alignment of the drilled-in pile under construction. After final cleaning, use a suitable weighted tape or other approved methods to measure final excavation depths.

J. Placement of Steel H-Pile Cores.

1. Pile template shall be constructed first that is capable of maintaining alignment and position of the H-pile core during installing within tolerances specified herein.

2. The steel H-pile cores shall be placed as soon as possible after the excavation is completed and cleaned.

3. The steel H-piles core shall be placed in the excavation to the length shown on the plans.

4. The steel H-piles core shall be placed and maintained in the center of the excavation.

5. The steel H-piles core shall be furnished and installed full length. Maximum one splice shall be used; the splice shall be performed in accordance with Article 2501.03, P of the Standard Specifications.

6. Steel sections damaged during transportation, handling or installation shall be removed.

7. Steel sections spacing shall be ± 3 inch from plan location and shall not be more than 2% off from vertical.

8. All cuts of steel H-pile sections shall be perpendicular to the axis of the pile.

K. Concrete Placement.

1. General.

a. Place drilled-in pile concrete within 24 hours of the start of excavation of the rock socket. Place concrete as soon as possible after placing the steel H-pile.

b. Coordinate concrete batching and delivery with the batch plant so the time limits, as stated in the contract documents, between batching and delivery are not exceeded.

c. Place concrete in a continuous manner. Continue concrete placement after the excavation is full until good quality concrete is evident at the plan top elevation.

d. Calculate volume of concrete needed to fill rock socket in competent rock and submit to Engineer for approval.
e. Record top elevation of concrete and volume of placed concrete at the top of competent rock. Volume of concrete place must be within 10% of approved value. If volume of concrete required to fill the rock socket exceeds the allowable differential, determine cause of differential. Contact Engineer with proposed remediation action for approval.
f. Remove a sufficient volume of concrete from the top of freshly placed wet concrete to ensure elimination of all contaminated concrete at the top surface of concrete -- a pump or air lift will be needed.
g. Place concrete through a tremie.
h. Complete placement of the concrete in the drilled-in pile within 3 hours. Adjust admixtures, when approved for use, for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 3 hour placement limit.
i. Remove all temporary casing.

2. Concrete Placement by Tremie.
a. For the tremie, comply with the following:
- Constructed so that it is watertight and will readily discharge concrete.
- No more than 12 inches in diameter.
- No aluminum parts in contact with concrete.
- Discharge end of the tremie constructed to prevent water intrusion and permit the free flow of concrete during placement operations.
- Sufficient mass so that it will rest on the excavation bottom before start of concrete placement.
- Sufficient length to extend to the bottom of the excavation.

b. Maintain the discharge orifice between 5 feet and 10 feet below the surface of the fluid concrete.
c. Support the tremie so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete.
d. Maintain a continuous flow of concrete. Ensure the concrete in the tremie maintains a positive pressure differential at all times to prevent introduction of air pockets or contaminants into the concrete.

3. Concrete Placement by Pump line.
Concrete placement by pump is not permitted without the use of gravity tremie pipe.

L. Demonstration Drilled-in Pile.

1. Demonstrate equipment and methods, prior to construction of the first production drilled-in pile, by installing a non-production drilled-in pile. Install on site at a location the Engineer determines.

2. Construct the demonstration drilled-in pile in soil as shown in the contract documents.

3. Construct the demonstration drilled-in pile according to the requirements of this specification with special emphasis on method of scouring, air lift pump usage, concrete delivery and coordination with the batch plant, concrete slump at the point of delivery, and concrete placement.

4. If the demonstration drilled-in pile installation demonstrates the equipment and methods used to construct drilled-in piles to the requirements of this specification are inadequate, the Engineer will require appropriate alterations in equipment or methods, or both, to eliminate the unsatisfactory results. The Contractor may be required to perform additional demonstration drilled-in piles until an adequate procedure is demonstrated and approved by the Engineer.

5. Do not begin constructing production drilled-in plies until the Engineer approves the methodology.

120172.05 METHOD OF MEASUREMENT.
Measurement will be as follows:

A. Air-track Probe.
Feet, to the nearest 6 inches, drilled in soil and rock.

B. Drilled-in Pile.
Feet, to the nearest 6 inches, constructed in soil. CMP above drilling elevation is considered ancillary.

C. Rock Socket.
Feet, to the nearest 6 inches, constructed in rock.

D. Steel H-Pile.
Feet, to the nearest 6 inches constructed.

E. Demonstration Drilled-in Pile.
Feet, to the nearest 6 inches, constructed and approved.

120172.06 BASIS OF PAYMENT.
Payment will be the contract unit prices as follows:

A. Air-track probe.

1. Per foot.

2. Payment is full compensation for all equipment, labor, and materials necessary to satisfactorily complete the air-track probe including:
- Drilling and excavation air-track probe,
- Furnishing and placing of grout backfill,
- Disposal of excavated materials, water, and all other materials.

B. Drilled-In Pile.

1. Per foot.

2. Payment is full compensation for all equipment, labor, and materials (except steel H- Pile Core) necessary to satisfactorily construct the drilled-in pile including:
- Drilling and excavation in soil,
- Installation and removal of temporary casing,
- Furnishing and placing concrete, sand, bentonite, and any CMP required to support the installation of the sand and bentonite.
- Drilled-in pile inspection, and
- Disposal of excavated materials, water, and all other materials.

C. Rock Socket.

1. Per foot.

2. Payment is full compensation for all equipment, labor, and materials (except steel H- Pile Core) necessary to satisfactorily construct the drilled-in pile including:
- Drilling and excavation of rock socket,
- Installation and removal of temporary casing,

- Drilled-in pile inspection, and
- Disposal of excavated materials, water, and all other materials.

D. Steel H-Pile.
Per foot, including centralizers and placement within the excavated hole.

E. Demonstration Drilled-in Pile.

1. Per foot.

2. Payment is full compensation for all equipment, labor, and materials necessary to satisfactorily construct the approved drilled-in pile including:
- Drilling and excavation of drilled shaft and rock socket,
- Installation and removal of temporary casing,
- Furnishing and placing H-pile core and centralizers
- Furnishing and placing concrete, sand, bentonite, and any CMP required to support the ground to facilitate the installation of the sand and bentonite
- Drilled-in pile inspection, and
- Disposal of excavated materials, water, and all other materials.