



**Standard
Specifications
for Construction
and Maintenance of
Highways, Streets,
and Bridges**

**Adopted by the
Texas Department of Transportation**

November 1, 2014

Item 416

Drilled Shaft Foundations



1. DESCRIPTION

Construct foundations consisting of reinforced or non-reinforced concrete drilled shafts.

2. MATERIALS

Use materials that meet the requirements of the following items.

- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 448, "Structural Field Welding"

Use concrete for drilled shafts that meets the requirements of Table 1 unless otherwise shown on the plans.

Table 1
Concrete for Drilled Shafts

Drilled Shaft Type	Concrete
Non-reinforced	Class A
Reinforced	Class C
Slurry and underwater concrete placement	Class SS

Use coarse aggregate Grade 4, 5, or 6 for drilled shaft concrete in reinforced drilled shafts. Grade 2 or 3 may be used if the shaft is dry and reinforcing steel has a 5 in. minimum clear spacing.

Use a water-reducing, retarding admixture in accordance with DMS-4640, "Chemical Admixtures for Concrete," in all concrete when using casing that will be pulled or when placing shafts underwater or under slurry.

Use concrete with slump that meets the requirements of Table 2 as determined by Tex-415-A.

Table 2
Slump Requirements

Placement Type	Minimum Acceptable Placement Slump, in.	Recommended Design and Placement Slump, in.	Maximum Acceptable Placement Slump, in.
Dry	5-1/2	6-1/2	7-1/2
Underwater and under slurry	7	8	9

Perform a slump loss test in accordance with Tex-430-A before beginning work when casing is to be pulled or concrete is to be placed underwater or under slurry. Provide concrete that will maintain a slump of at least 4 in. throughout the entire anticipated time of concrete placement. Time of concrete placement is described in Section 416.3.6., "Concrete," and Section 416.3.7., "Additional Requirements for Slurry Displacement or Underwater Concrete Placement Methods." Note the temperature of the concrete mix at the beginning of the slump loss test. Place the concrete if its temperature at the time of placement into the drilled shaft is no more than 10°F higher than the slump loss test temperature. Use ice or other concrete cooling ingredients to lower concrete temperature, or run additional slump loss tests at the higher temperatures. Slump loss testing will be waived if anticipated time of concrete placement is less than 90 minutes.

Use mineral drilling slurry that meets the requirements of Table 3, as determined by Tex-130-E. Determine pH of slurry by Tex-128-E or pH paper strips.

Use an air lift or proper size cleanout bucket, just before placing reinforcing steel, to remove any material that may have fallen from the sides of the excavation or accumulated on the bottom after the completion of drilling. Use a cleanout bucket if material is too large to be picked up with an air lift.

Re-process the hole with the auger as directed if concrete placement is not started within 4 hr. of the completion of the shaft excavation. Then clean the bottom with an air lift or cleanout bucket, and check the slurry at the bottom of the hole for compliance with the slurry requirements of Article 416.2., "Materials."

Agitate the congealed slurry to liquefaction if the slurry forms a gel before concrete placement, and whenever directed.

Recover and dispose of all slurry as approved, and in accordance with all federal, state, and local laws. Do not discharge slurry into or in close proximity to streams or other bodies of water.

3.5.

Reinforcing Steel. Completely assemble the cage of reinforcing steel, and place it as a unit immediately before concrete placement. The cage consists of longitudinal bars and lateral reinforcement (spiral reinforcement, lateral ties, or horizontal bands). Connect individual segments with couplers or by lapping steel as approved if overhead obstacles prevent placement of the cage as a single unit.

Extend the reinforcing steel cage as follows if the shaft is lengthened beyond plan length unless directed otherwise.

- Extend the cage to the bottom for shafts supporting structures other than bridges.
- Extend the cage to 25 ft. or to the bottom, whichever is shorter, for bridge shafts with plan lengths less than 25 ft.
- Do not extend the cage for bridge shafts with plan lengths at least 25 ft. that are lengthened less than 33% of plan length.
- Extend the cage as directed for bridge shafts with plan lengths at least 25 ft. that are lengthened more than 33% of plan length.

If the cage does not reach the bottom of the shaft, it may be suspended, or a portion of the longitudinal steel may be extended to support the cage on the bottom of the shaft. Bars used to extend or support the cage may be lap spliced or welded by a qualified welder. Place the extension at the bottom of the shaft.

Tie spiral reinforcement to the longitudinal bars at a spacing no more than 24 in., or as required for a stable cage. Ensure lateral reinforcement is not welded to longitudinal bars unless otherwise shown on the plans.

Center the reinforcing steel cage in the excavation using approved "roller" type centering devices unless otherwise approved. Use concrete or plastic chairs to keep the reinforcing cage off of the bottom of the hole. Use centering devices starting at 1.5 ft. off from the bottom of the cage and spaced vertically at intervals not exceeding 10 ft. Use a minimum of 3 centering devices per level at a spacing not to exceed 30 in. Flat or crescent-shaped centralizers ("sleds") are not allowed.

Support or hold down the cage to control vertical displacement during concrete placement or extraction of the casing. Use support that is concentric with the cage to prevent racking and distortion of the steel.

Check the elevation of the top of the steel cage before and after concrete placement or after casing extraction when casing is used. Downward movement of the steel up to 6 in. per 20 feet of shaft length and upward movement of the steel up to 6 in. total are acceptable.

Maintain the minimum length of steel required for lap with column steel. Use dowel bars if the proper lap length is provided both into the shaft and into the column. Locate and tie all dowel bars into the cage before placing concrete or insert dowel bars into fresh, workable concrete.

Locate and tie anchor bolts when required before placement of concrete. Use templates or other devices to assure accurate placement of anchor bolts.