KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS, EDITION 2015

Add a new SECTION to DIVISION 700:

DRILLED SHAFT (SPECIAL)

1.0 DESCRIPTION

For noise walls, high mast light towers, overhead sign structures and other specified items, construct drilled shafts by the uncased, temporary cased, or slurry method, depending upon site conditions and Contract Document requirements. Do not construct using permanent casing.

BID ITEMS	UNITS
Drilled Shaft (*) (Special) *Size	Linear Foot

2.0 MATERIALS

a. Concrete. Unless otherwise shown in the Contract Documents, provide Grade 4.0 concrete that complies with **SECTIONS 401, 402 and 1102**. Provide a mix design with a target slump of 9 inches ± 1 inch. Do not withhold mix water at the plant and do not add water at the site.

b. Reinforcing Steel. Provide steel bars for concrete reinforcement that comply with **DIVISION 1600**.

c. Temporary Casing. Provide casing of sufficient thickness to carry the working stresses and loads imposed on the casing during construction.

The Engineer will accept the casing based on compliance with the specified requirements, and visual inspection for condition.

3.0 CONSTRUCTION REQUIREMENTS

a. General. Drilled shaft lengths are shown in the Contract Documents If the Engineer changes the drilled shaft lengths, the Contractor will be advised (in writing) of the revised bottom of the tip elevation.

A minimum of 28 days before constructing the drilled shafts, submit an installation plan to the Engineer for review. Include the following:

- Name and experience record of the drilled shaft superintendent in charge of drilled shaft operations;
- List of proposed equipment, such as cranes, drills, augers, bailing buckets, final cleaning equipment, de-sanding equipment, slurry pumps, tremies or concrete pumps and casing; and
- Details of concrete placement, including proposed operational procedures for tremie and pumping methods and method of achieving a sealed tremie or pump.

b. Excavating the Drilled Shaft. Prior to constructing drilled shafts, complete the excavation for the entire element.

Locate the top of the shaft within 2 inches of the location shown in the Contract Documents. Unless otherwise shown in the Contract Documents, bore all shafts plumb to within a tolerance of 1 inch per 10 feet of length of shaft, not to exceed 6 inches over the full length of the shaft. The bottom of the shaft shall be nearly flat. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of ±⅜ inch per foot of diameter.

Depending upon site conditions and requirements in the Contract Documents, construct the drilled shaft by either the uncased, temporary cased or slurry method:

(1) Uncased Method. Use this method at locations anticipated to be free of caving soil or excess water inflow into the excavated shaft. Do not use the uncased method if the actual conditions show the shaft is prone to caving soil, or has water inflow that exceeds the dry pour method requirements in **subsection 3.0e**.

Excavate the shaft without the use of added water or drilling fluid. Completely excavate the shaft in a continuous operation, unless encountering rock or obstructions. Place the concrete without delay.

(2) Temporary Cased Method. Use this method at locations with caving soil or excess water inflow into the excavated shaft.

(3) Slurry Method. Advance the shaft excavation by stabilizing the hole with drilling fluid.

Do not excavate closely spaced drilled shafts (3 drilled shaft diameters or less, center to center) until adjacent shafts are completed and cured according to the following criteria:

- Completed shafts have been allowed to set for a minimum of 24 hours after the concrete placement; and
- Developed a compressive strength of 1800 psi; or
- Without testing, the Engineer may allow excavation to proceed when the shaft has cured 72 hours after completion of the concrete placement.

Once the concrete is placed, it must be cured according to the criteria above before excavating additional closely spaced drilled shafts.

c. Placing Reinforcing Steel. Tie reinforcing steel at all intersections of reinforcement, and place reinforcing steel as a unit for the full length of the shaft, prior to placing any concrete by either pour method. Use a minimum of 1 non-corrosive circular spacer per 30 inches of circumference of the reinforcing steel cage, within 2 to 4 feet of the bottom and top, and at intervals not to exceed 10 feet vertically. If the shaft is deepened and additional reinforcing steel cage is required, make the splice at the bottom of the steel cage.

d. Final Inspection and Access. At the time of placing the concrete, a minimum of 75% of the base of the shaft must have less than ½ inch of sediment. The Engineer will determine the shaft cleanliness before concrete placement by:

- Visual inspection; or
- Underwater inspection using probes; or
- Down hole television camera and video recordings

Provide access to 100% of the hole from probing purposes. Probing will be done by a tape with a minimum weight of 1 pound.

Review and inspection by the Engineer prior to concrete placement does not relieve the Contractor of the responsibility for producing a defect-free shaft per specifications.

When directed by the Engineer, operate the camera and recorder such that the optimum clarity of the details can be obtained and all surface areas of the shaft, including the bottom of the drilled shaft can be observed. Record video, label the recorded media, and deliver to KDOT.

e. Placing Drilled Shaft Concrete. Depending upon site conditions, place concrete by either the dry pour or wet pour method:

- Use the dry pour method if water inflow does not fill the shaft more than 4 inches in depth in a 5 minute period, and the shaft can be dewatered so a maximum of 2 inches of water is standing in the shaft when concrete placement begins.
- When the above 2 conditions cannot be met, use the wet pour method.

For both the dry and wet pour methods, the following common requirements for concrete placed in an uncased shaft shall apply:

- Target slump is 9 inches ± 1 inch;
- Place concrete in the shaft with a continuous operation, without construction joints;
- Do not vibrate concrete;
- Determine the top elevation of the fresh concrete and inform the Engineer; and
- Do not use aluminum concrete pump discharge tubes or tremie tubes.

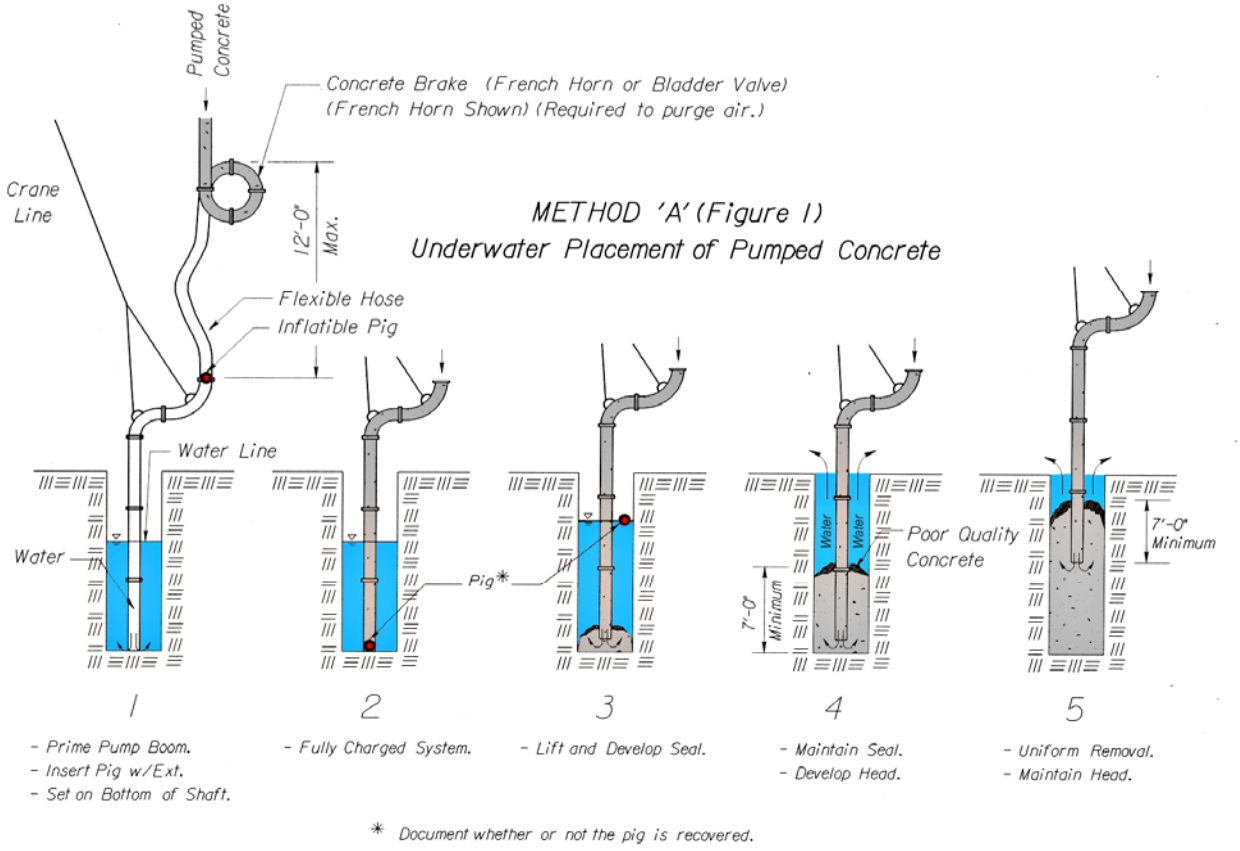
(1) Dry Pour Method. Use a centering device to deposit concrete so the falling concrete shall not come into contact with vertical and horizontal reinforcing steel and wire supports. To control the fall, extend the centering device a minimum of 8 feet into the shaft. For a temporary cased shaft, concrete may free fall to the bottom. For an uncased shaft, the maximum fall for concrete is 5 feet.

(2) Wet Pour Method. Prior to starting concrete placement, allow the water level in the shaft to reach its static level. Place concrete with either a sealed (watertight) tremie tube or pump with a rigid and watertight extension tube. In either case, use a device (i.e. commercially available pig or flap gate) that prevents water from entering the tube while charging with concrete. The commercially available pig shall be a minimum of 110% the diameter of the tube. Clearly label the outside of the tremie and pump tubes in 12-inch increments (starting at the bottom).

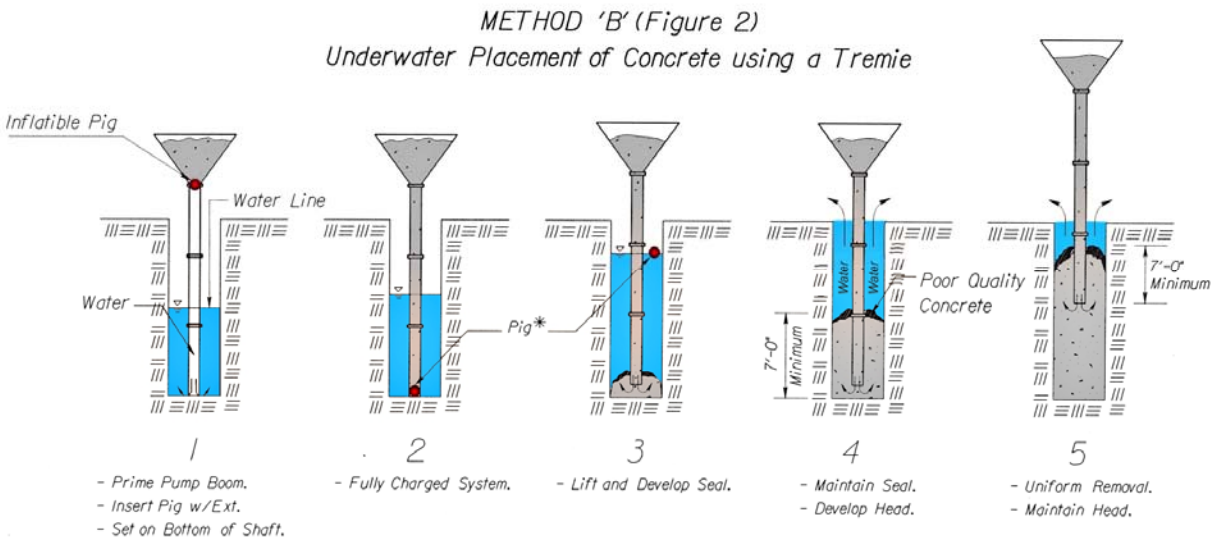
Lower the rigid tube into the shaft with the bottom of the tube resting on the bottom of the drilled shaft, and fully charge the system (tube and hopper or pumping system) with concrete. Once the system is fully charged, raise the tube off the bottom of the drilled shaft by 1 tube diameter, and allow the concrete to seal the discharge end of the tube. Maintain the tube at this elevation until a minimum of 7-foot head of concrete is developed. Maintain a minimum 7-foot head of concrete during the concrete placement. Prior to raising the tube, determine the top elevation of the fresh concrete and inform the Engineer.

For temporary cased shafts, withdraw the temporary casing during concrete placement. If caving soil is encountered withdraw the temporary casing after concrete placement. Do not withdraw the casing until a sufficient head of concrete is established above the zone of caving soil to prevent contamination of the concrete when the casing is withdrawn.

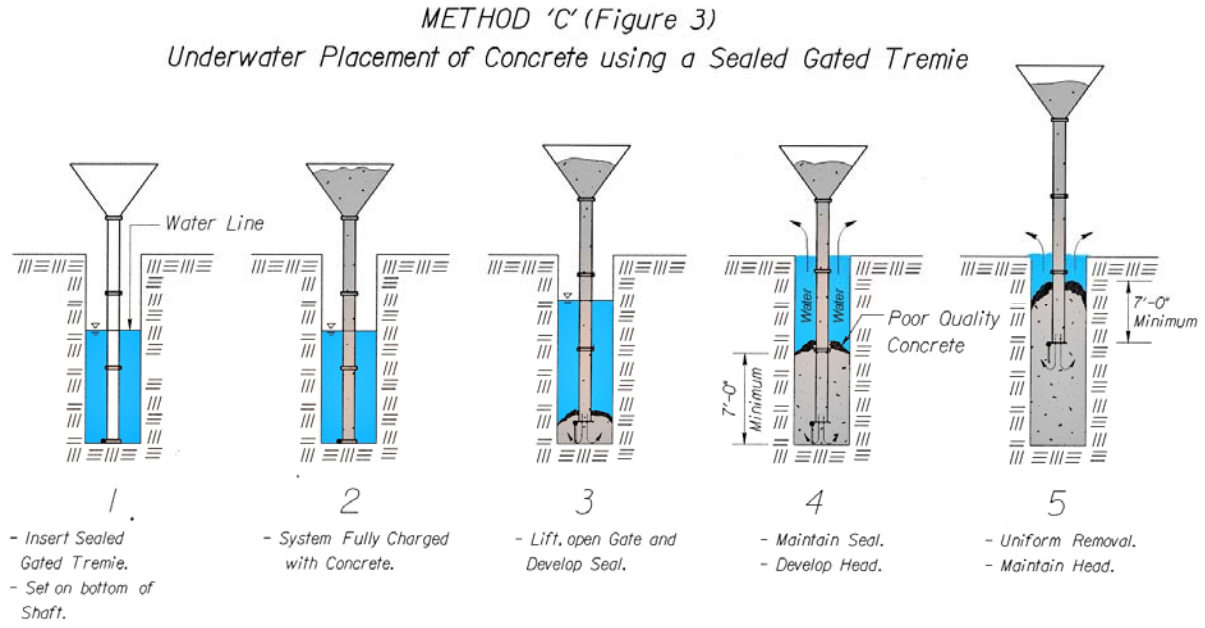
For wet pours, follow the steps listed in the previous paragraph, regardless of the Method (A, B or C) used to place concrete in the shaft:



Method A (Figure 1): Use a pump and extension tube, with a pig separating the ground water and concrete, to place concrete into the shaft. Install a concrete brake (e.g. bladder valve or French horn) at the end of the pump boom to purge the air from the pump line. Fully charge the boom with concrete (no air gaps) then install the pig in the top of the extension tube.



Method B (Figure 2): Use a tremie tube, with a pig separating the ground water and concrete, to place concrete into the shaft. Once the tremie tube is resting on the bottom of the shaft, install the pig just below the hopper in the top of the tremie tube. Fully charge the tremie tube and hopper (forcing the pig to the bottom of the tremie tube), then raise the tremie tube by 1 tremie diameter and seal the discharge end of the tremie tube with the fresh concrete.



Method C (Figure 3): Use a tremie tube, with a sealed gate separating ground water and concrete, to place concrete in the shaft. Fully charge the tremie tube and hopper, then raise the tremie tube by 1 tremie diameter and seal the discharge end of the tremie tube with the fresh concrete.

(3) For both Dry and Wet Pours. When the concrete reaches the top of the shaft, continue placing concrete (over-pump) to expel any excess water, debris or unsound concrete. Do not bail the excess material out of the shaft. On all wet pours, regardless of the method used, the Engineer will make a set of cylinders (in addition to normal

concrete cylinder sampling requirements) from the top of the shaft after completing over-pumping. This set of cylinders will be used to verify a compressive strength of 1800 psi before proceeding with subsequent substructure (i.e. columns, abutments, etc.) construction.

Prior to constructing the portion of the substructure that attaches to the drilled shaft, thoroughly clean the top of the drilled shaft to facilitate the bond at the cold joint.

f. Miscellaneous Hardware. Install any conduit, anchor bolts, etc. specified in the Contract Documents, and securely hold in proper position until concrete has set.

g. Curing. Cure the exposed surfaces of the shafts with wet burlap a minimum of 2 days. Do not use liquid membrane curing.

Cure all cylinders in the field, alongside and under the same conditions as the concrete they represent.

4.0 MEASUREMENT AND PAYMENT

The Engineer will measure drilled shafts by the linear foot measured from the bottom of the tip elevation to the top of the completed drilled shaft. The Engineer will not consider a request for additional compensation, unless the overall length of a drilled shaft changes by more than 20%.

Payment for "Drilled Shaft (Special)" at the contract unit prices is full compensation for the specified work.

If the Engineer lengthens the drilled shaft during construction, the Engineer will measure and pay for additional reinforcing steel as Extra Work according to **SECTION 104**.

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Dec-16 Letting