Construction Advisory

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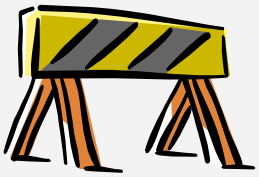

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Construction of Drilled Shafts for Sign Structures – Concrete and Reinforcing Steel

This construction advisory provides information in regards to concrete requirements and reinforcing steel placement for drilled shaft sign structure foundations, and drilled shaft construction in general. Concrete mix and placement, and the bundling of reinforcement bars are important construction parameters that help ensure free passage of concrete through the cage and into the space between the cage and borehole wall. These issues are discussed in more detail below:

Concrete Mix

The *Special Provision for Drilled Shaft Sign Structures Foundations*, 03T810(343), has been included in proposals that contain the use of drilled shaft foundations for sign structures. Section b.2 of the *Special Provision for Drilled Shaft Sign Structure Foundation* states:

"Use concrete according to subsection 919.11.A.4 of the Standard Specifications for Construction."

The above reference section of the *Standard Specifications for Construction* outlines the mix and slump requirement for concrete used in drilled shaft construction. To summarize the section, only grade S2 and grade T concrete should be used. Grade S2 concrete should be used in dry pours, and grade T concrete should be used in wet/tremie pours.

Slump requirements are as follows per 919.11.A.4 of the Standard Specification for Construction:

Slump Table (Refer to 919.11.A.4)

Slump Range	Condition
4-6 inches	Dry, uncased bore hole
6-8 inches	Temporary cased bore hole
8-10 inches	Concrete placed under water or under drilling slurry

Please be aware that Slump Table in subsection 919.11.A.4 (above) supersedes the slump requirements of Standard Specification 701-Portland Cement Concrete For Structures.

A high percentage of the drilled shafts use a permanent steel casing, which the above Slump Table does not specifically address. Slump requirements for a shaft with a permanent casing are the same as the condition with temporary cased bore hole, 6-8 inches.

Concrete Placement

Concrete shall be placed either by free-fall, through a tremie tube, or a concrete pump, the same day the shaft is excavated. Free-fall placement shall only be permitted in dry excavations where free water accumulation of 3 inches or less can be maintained immediately prior to concrete placement. Concrete placed by free-fall methods shall be directed in the center of the shaft to avoid contact with the reinforcing steel cage, shaft sidewalls and casing. Drop chutes may be used to direct concrete in a vertical stream down the shaft.

Vibrating of the concrete should be limited to the top five feet of the shaft and care should be taken not to over vibrate the high slump concrete, which may cause aggregate segregation.

Reinforcement Steel

For drilled shaft sign structure foundations, the reinforcement cage should be installed in accordance with the Traffic Signing standard plan set *SIGN-340-A* "*Drilled Shaft Foundation for Cantilevers and Truss Type E*" or standard plan set *SIGN-350-A* "*Drilled Shaft Foundation for Cantilever Type J*". On sheet 4 of the above mentioned standards plan sets, there is a plan note as follows:

"Bars shall bundled, 3 bars per bundle"

Project staff should verify proper bundling of reinforcement steel, quantity, size of bars, and dimensions of the cage, prior to placement of reinforcement cage.

In summary, both the above concrete slump requirements and the bundling of reinforcement bars, are important construction parameters that help ensure free passage of concrete through the cage and into the space between the cage and borehole wall without resorting to vibrating the concrete. This will help to eliminate the honey-combing effect that could take place in tightly spaced reinforcement cages.

The concerns expressed in this construction advisory are not specific to just drilled shafts for sign structure foundations, rather they are present in all projects using drilled shaft foundations. In general, section 919.11.A.4 of the *Standard Specification for Construction* applies to most drilled shaft foundations. The majority of the special provisions written for drilled shaft foundations reference section 919.11.A.4 for concrete requirements. Please pay special attention to the concrete mix and reinforcing steel placement outlined in the plans, specifications, and special provisions for drilled shaft foundations.

Prior to the start of drilled shaft construction, the following Drilled Shaft Inspection Tutorial from FHWA is recommended for review: http://www.fhwa.dot.gov/infrastructure/tccc/tutorial/shafts/index.htm.