16.4 DRILLED SHAFTS

A drilled shaft (also called drilled caisson or caisson) is a deep foundation element that is constructed by excavating a hole with power auger equipment. Reinforcing steel and concrete are then placed within the excavation. In unstable soils, casing or drilling slurry is used to maintain the stability of the hole. Drilling slurry typically consists of natural materials (i.e. bentonite); the use of polymer materials is not allowed. For certain geologic conditions (i.e. sound rock) the use of plain water (potable) as a drilling fluid is allowed; however, permission to use plain water must be obtained from SCDOT. Drilled shafts should be considered when large loads are anticipated (compressive, uplift or lateral) and where the amount of allowable deformation is small. Additionally, drilled shafts should be considered in locations where the losses due to scour are large, seismically induced downdrag loads are large or where the instability of slope cannot be maintained using conventional methods. Further drilled shafts should be considered when there is a limitation on water crossing work.

Drilled shaft sizes (diameters) can typically range from 30 inches (2-1/2 feet) to 144 inches (12 feet). Drilled shaft diameters are normally 6 inches larger than the column above the shaft or 6 inches larger than the rock socket below the shaft. Drilled shaft sizes typically used by SCDOT range from 42 inches (3-1/2 feet) to 84 inches (7 feet) in diameter. According to the BDM drilled shafts are typically used when the span length of a bridge is greater than 50 feet.

As required by AASHTO, the drilled shaft analyses and design should address the following:

- Nominal axial resistance of a single shaft and of a group of shafts.
- The resistance of the underlying strata to support the load of the shaft group.
- The effects of constructing the shaft(s) on adjacent structures.
- Minimum shaft penetration necessary to satisfy the requirements caused by uplift, scour, downdrag, settlement, liquefaction, lateral loads, and seismic conditions.
- Drilled Shaft nominal structural resistance
- Satisfactory behavior under service loads
- Long-term durability of the shaft in service (i.e. corrosion and deterioration)

A thorough reference on shaft foundations is presented in the FHWA publication *Drilled Shafts: Construction Procedures and Design Methods* (O'Neil and Reese, 1999).

16.4.1 Axial Compressive Capacity

There are numerous static analysis methods available for calculating the bearing capacity of a single drilled shaft. The axial compressive capacity for drilled shafts shall follow the procedures provide in the AASHTO LRFD Bridge Design Specifications (latest edition), Article 10.8 – Drilled Shafts. The methods found in the AASHTO LRFD Bridge Design Specifications are used to satisfy the Strength and Extreme Event limit states.