- Combination Friction and Point Bearing Pile: A pile that derives its capacity from contribution of both friction resistance mobilized along the embedded pile and point bearing developed at the pile tip.

In Arizona, the following two types of piles are commonly used:

- Pipe Pile: 14 and 16 inch diameter steel pipes with 1/2 or 5/8 inch wall thickness are generally recommended for the shell. The pile is driven or vibrated down into the soil until the designed bearing capacity is reached. Then, the steel reinforcing cage is placed inside the shell. Finally, concrete is poured into the pipe. The bridge designer shall assume that the shell is not contributing to the structural capacity of the pile.

- Steel H-Pile: ASTM 709 grade 50 HP shape or as recommended by the geotechnical engineer shall be used. H-piles are generally classified as friction piles.

Bridge designers shall include the following information per abutment and pier foundation on the structure plan sheets:

- Total settlement which is used in the design of the driven pile based on the geotechnical report.
- Total unfactored axial load at the top of each driven pile before increasing the axial load to account for redundancy or group efficiency effects.
- Total unfactored axial load at the top of each driven pile which is used in the design of the pile after increasing the axial load for redundancy or group efficiency effects.

10.7.2 Service Limit State Design

10.7.2.2 Tolerable Movements

The requirements of AASHTO LRFD Article 10.5.2.1 and Article 10.5.2.2 of these guidelines shall apply.

10.8 DRILLED SHAFTS

10.8.1 General

10.8.1.1 Scope

The provisions of this Section shall not be taken as applicable to drilled piles, e.g., augercast piles, installed with continuous flight augers that are concreted as the auger is being extracted.

All drilled shafts shall be constructed vertically. Battered drilled shafts are not allowed. The geotechnical engineer is responsible for recommending the minimum diameter of the shaft and for providing the necessary information for determining the minimum required embedment below a specified elevation to develop the required resistance to the design axial and lateral load.

The geotechnical engineer is also responsible for determining the soil properties in each layer to be used in resisting lateral loads. In the Bridge Foundation Report, the geotechnical engineer shall specify a method of drilled shaft construction based on either dry or wet excavation. In the event of wet excavation, slurry, temporary casing, or permanent casing is usually recommended depending on the water table elevation and soil condition.

The axial and lateral capacity of the drilled shafts shall be reduced by ignoring the embedment within the specified scour depth as documented in the Bridge Hydraulics Report.

Drilled shafts installed under wet excavation conditions shall be inspected according to a method described in the ADOT Standard Specifications for Road and Bridge Construction or the project’s special provisions. Two commonly used methods are the gamma-gamma logging device and the cross-hole sonic logging survey.

The following types of drilled shafts are commonly used in Arizona:

- Prismatic Shaft: A shaft with constant diameter throughout its entire length.

- Rock-Socketed Shaft: A shaft where its lower portion or its entire length is embedded into the rock strata. This type of drilled shaft requires special heavy duty drilling equipment. Where rock-socketed shafts require casing through the overburden soils, the socket diameter shall be at least 6.0 inch less than the inside diameter of the casing. For rock-socketed shafts not requiring casing through the overburden soils, the socket diameter may be equal to the shaft diameter through the soil. Unless otherwise specified by the geotechnical engineer, the minimum embedment into the rock strata shall be 10 feet. A separate pay item shall be set up to account for the rock socket.

- Bell Shaped Shaft: A shaft with a flared bell shape at its tip to increase the bearing area. This type of drilled shaft is more advantageous when stiff foundation material is documented which results in higher bearing capacity enabling the designer to reduce the drilled shaft length. The entire base area may be taken as effective in transferring the load only if appropriate provisions are included in the contract documents so that the bottom of the bell shaped drilled hole is cleaned and inspected prior to concrete placement. Due to the difficulty of properly cleaning the bottom of the hole, this type of drilled shaft is not a preferred alternative.

- Telescoping Shaft: A shaft with two or more segments of consecutively smaller diameters. In order to avoid using excessive steel casing for shoring purpose during drilled shaft construction when very loose foundation material is present, telescoping augering technique can be beneficial to accommodate varying soil conditions. The bridge designer should avoid using this type of drilled shaft due to the inherent difficulty of constructing it.