design except that tensioned wire strands replace the reinforcing bars. Conventionally reinforced piles are more susceptible to damage from mishandling or over-driving, but prestressed concrete piles are more difficult to splice together.

3.2.3.2.5 Drilled Shafts.

Drilled shafts have been used for bridge structures around the world, but only recently have they gained widespread acceptance in the United States. Drilled shafts for bridge structures have historically been used only where the depth to rock was relatively shallow. Shallow depth to rock allowed the bottom of a drilled shaft to be anchored in a bedrock socket. Shallow drilled shafts in soil are commonly used by NDOR as foundation elements for traffic control structures (see Section 3.5). Drilled shafts can be advantageous when used in situations where deep excavations and/or large number of piles can delay the construction progress (i.e. railroad viaducts, large structures). Drilled shafts should also be considered when the noise or vibration commonly associated with pile driving operations must be minimized.

3.3 Culverts.

Culverts consist of two basic types, pipe culverts used for hydraulic openings with smaller discharges, and box culverts composed of one or more cells capable of handling much larger discharges. At both ends of a box culvert, wingwalls are constructed to retain earth adjacent to the culvert, preventing soil from sliding into the channel. Horizontal cantilevered walls can be constructed so that they are structurally continuous with the headwall and thus do not require a foundation. T-type and L-type vertical cantilevered wings are usually structurally independent of the headwall and require separate foundations.

Geotechnical analysis and evaluation for culverts should at minimum address the following concerns:

3.3.1 Slope Stability.

The overall slope height and width from the roadway embankment to the flow line or toe of the side slope must be evaluated for slope stability. If the material comprising the slope has insufficient stability to stand at the proposed slope angle, other materials can be substituted, a shallower slope can be created, or the slope can be reinforced using geotextiles or other methods.