

The QAM shall submit summary reports of all work corresponding to requests for payment. The QAM's summary reports shall include the Contractor's geotechnical engineer's certifications of completed work.

#### **IV. DRILLED SHAFTS**

##### **A. Demonstration Shafts (also known as "Test Shafts" or "Technique Shafts")**

Demonstration shafts shall be constructed to determine if the methods, equipment, and procedures proposed by the Contractor are adequate to produce drilled shafts that meet the requirements of the project. All demonstration shafts (and load tests performed on demonstration shafts, if required) shall be completed to the satisfaction of the Department prior to commencement of the construction of production shafts.

The location of the demonstration shaft(s) shall be shown on the plans and is subject to the approval of the Department. Demonstration shafts shall be considered non-production shafts and shall be located at least 25 ft. (horizontally) from all proposed foundation systems. The diameter of the demonstration shaft shall be the same as that of the production shafts used on the project. The depth of the demonstration shaft shall be extended a minimum of 10 feet below the lowest plan tip elevation of the production shafts estimated on the plans, except for shafts on which load testing will be performed. If a load test will be performed on a demonstration shaft, the tip elevation shall be the same as the estimated tip elevation of the closest production shaft. Steel reinforcement and concrete shall be placed within the test shaft in the same manner as that proposed for the production shafts.

##### Frequency:

For bridges having five (5) spans or less and if the entire bridge footprint will be constructed within the same geologic formation, at least one (1) demonstration shaft shall be installed per bridge for each drilled shaft size proposed for the structure. For bridges having greater than five (5) spans but less than fifteen (15) spans, at least two (2) demonstration shafts shall be installed per bridge for each drilled shaft size proposed for the structure. For bridges having fifteen (15) spans or more, at least three (3) demonstration shafts shall be installed per bridge for each drilled shaft size proposed for the structure. If multiple demonstration shafts will be constructed, they shall be well spaced across the site of the structure.

Regardless of the size of the bridge, if the footprint of the structure is known to span multiple geologic formations, at least one (1) demonstration shaft for each geologic formation shall be installed. If the Contractor intends to use more than one method of construction (i.e., slurry construction for some shafts and temporary casing for others), at least one (1) demonstration shaft shall be utilized for each method of construction.

Note that for dual structures (parallel bridges situated in close proximity to each other), while these bridges are considered to be two individual structures, for the purposes of the paragraphs above, they can be considered to be a "single" bridge. [For example, if two parallel, three-span structures will be supported on drilled shafts having a 60-inch diameter, and these bridges are founded within the same geologic formation, one (1) demonstration shaft, having a diameter of 60 inches, is required.]

##### Acceptance:

A demonstration shaft will be deemed acceptable if the results all of the test procedures performed on the shaft during, and subsequent to, construction are determined to be acceptable. The required testing procedures are described below.

If, based on the test results, a demonstration shaft is deemed unacceptable, the Contractor shall revise his methods and/or equipment, and a subsequent demonstration shaft shall be constructed in the same general area to determine if the corrective measures were adequate. The subsequent demonstration shaft shall be tested for acceptance in the same manner as the previous shaft.

## **B. Concreting Curves**

### Frequency:

During concrete placement of all demonstration shafts and production shafts, the Contractor shall plot the theoretical and actual concrete volume curves. This information shall be submitted to the Department no later than 48 hours after the concrete placement of each shaft has been completed. If unexpected occurrences are observed during concrete placement (such as the actual volume deviating from the theoretical volume by more than 10%, for example), the Department shall be contacted immediately.

### Acceptance:

No acceptance/rejection of the concreting curves will be made. This information will be used as an indicator as to the quality of the concrete in the shaft.

## **C. Crosshole Sonic Logging (CSL)**

CSL is a nondestructive testing method performed on completed drilled shafts. It provides a method for evaluating the integrity of the drilled shaft concrete. All shafts (demonstration shafts and production shafts) shall be equipped with CSL tubes as described the Special Provision for Drilled Shafts.

### Frequency:

All demonstration shafts shall be CSL tested. All non-redundant shafts shall be CSL tested. (A typical example of a non-redundant shaft is the case in which a single drilled shaft supports a single pier column. The failure of a non-redundant shaft, by definition, will likely result in the failure of the entire substructure unit and the structure itself.)

On projects that utilize redundant shafts (several shafts arranged in a group), the first two (2) production shafts (of each size) constructed for each bridge shall be CSL tested. Furthermore, a minimum of 20% of the total number of production shafts shall be CSL tested for each structure. The CSL testing shall be equally spaced (in time and location) across the structure. Copies of the CSL test results shall be submitted to the Department within five (5) working days of the completion of the fieldwork. The Contractor shall be prepared to perform additional CSL testing as deemed necessary by the Department. Additional CSL testing will be requested if field observations seem to indicate that concrete contamination has occurred.

### Acceptance:

Acceptable CSL tests will be defined as those for which there is essentially no signal distortion throughout the entire length of the shaft, and the signal velocity is reduced by no more than 10% of that of sound concrete. If the CSL test results indicate that the aforementioned criteria have not been met, the Contractor shall propose remedial procedures to the Department. If the Contractor feels that, in spite of marginal or poor CSL results, the drilled shaft is adequate, the Contractor shall propose alternative integrity testing to the Department in an attempt to demonstrate that the shaft is acceptable. Some of these alternatives may include the use of other appropriate methods of non-destructive testing, coring the entire length of the shaft, or some other method acceptable to the Department.