STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
CROSSHOLE SONIC LOGGING (CSL) TESTING FOR DRILLED SHAFTS

SUM-76/77/8-10.99/11.54/0.00 (PID 101402)
BRIDGE NO. SUM-76-1148Q – RAMP Q OVER IR-76 WB, LANE O, RAMP S, SR-8 NB/SB
BRIDGE NO. SUM-76-1152N – RAMP N OVER RAMP S, LANE O, IR-76 EB, SR-8 NB/SB, LANE M

01 Description. This work consists of evaluating the structural integrity of drilled shafts using the crosshole sonic logging (CSL) test method. The work also consists of furnishing and installing access tubes required to conduct the testing, and core drilling of concrete to confirm possible defects.

CSL testing measures the time it takes for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between parallel tubes will be relatively constant and correspond to a reasonable signal velocity from the bottom to the top of the drilled shaft. In uniform, good quality concrete, CSL testing will also measure strong signal amplitude and energy readings. Long travel times, low signal amplitude, or low energy readings indicate the presence of anomalies that may consist of poor quality concrete, voids, honeycombs or soil intrusions. The signal may be completely lost by the receiver and CSL recording system for severe defects such as voids and soil intrusions.

02 Materials. Furnish materials conforming to:

Portland cement.....701.02
Chemical admixture.....705.12

Cement grout consists of a mixture of cement and water that provides a minimum 28-day compressive strength equal to, or greater than, the drilled shaft concrete. Determine the compressive strength of the cement grout according to ASTM C 39 or ASTM C 942. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout if approved by the Engineer. For grout, use water free from sewage, oil, acid, strong alkalis, vegetable matter, clay, and loam. Potable water is satisfactory for use in grout.

Furnish access tubes consisting of Schedule 40 steel pipe with an inside diameter between 1.5 and 2.0 inches. Access tubes shall have round, regular inside surfaces free from defects and obstructions,

including all pipe joints, in order to permit the free, unobstructed passage of the probes. Access tubes shall be free from corrosion to ensure a good bond to the concrete.

Submit the grout mix and the selected pipe for the access tubes with the Drilled Shaft Installation Plan for the Engineer's acceptance. Also include for the Engineer's acceptance the proposed method for joining the pipe and for attaching the pipe to the reinforcing steel cage.

03 NDT Consultant. Retain an experienced Nondestructive Testing (NDT) consultant to perform or supervise the CSL testing. The NDT consultant shall have at least two years experience in CSL testing. Submit to the Engineer for approval a resume of the credentials of the proposed NDT consultant at least 14 Calendar Days before constructing the drilled shafts.

04 Installation of Access Tubes. Install access tubes in all drilled shafts to permit access for the CSL test equipment. Use Table No. 04-1 to determine the number of access tubes per shaft and the tube spacing. If the shaft diameter varies along the length of the shaft, use the largest diameter to determine the number of access tubes.

TABLE 04-1

Shaft Diameter (feet)	Number of Tubes	Tube Spacing (degrees)
4.0 to 5.0	4	90
5.5 to 7.5	6	60
8.0 to 9.5	8	45
10.0 to 12.0	10	36

Provide watertight joints, a watertight cap on the bottom, and a removable cap at the top of the access tubes. Use threaded joints or mechanical couplings. If mechanical couplings are used, record the location of each coupler. Do not weld joints. Do not cover joints with tape or other wrapping material. Attach the tubes to the interior of the reinforcing steel cage so that the tubes are parallel and evenly spaced around the perimeter of the reinforcing steel cage. Provide a minimum concrete cover of 3 inches. Install the access tubes so that the bottom of the tube is 6 inches or less from the bottom of the drilled shaft but does not touch the bottom of the shaft. Wire-tie or secure the access tubes to the reinforcing steel cage every 3 feet. Extend the top of the access tubes at least 3 feet above the top of the drilled shaft. If the top of the drilled shaft is below the surface, extend the top of the access tubes at least 2 feet above the ground surface. Ensure that the access tubes do not move during placement of the cage and concrete.

Within 4 hours of placing the reinforcing steel cage but before placing the concrete, fill the access tubes with clean water and recap the tubes. After placing the concrete, exercise care when removing the caps from the access tubes so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete. Label each access tube with a unique identifier at the top of the tube.

05 Test Procedure. Before CSL testing, supply the Engineer and NDT Consultant with a record of the length, top elevation, bottom elevation, and date of concrete placement for all drilled shafts. Perform CSL tests in accordance with ASTM D 6760 except as modified by this specification. Perform CSL tests on all drilled shafts. Perform the CSL test at least 72 hours after concrete placement in a shaft, but no more than 30 Calendar Days after concrete placement. The Engineer may direct a longer minimum time if the drilled shaft concrete contains a retarding admixture or uses a mix design that results in a longer setting time for the drilled shaft concrete.

For shafts with 4 or 6 access tubes, obtain readings between all pairs of tubes. For shafts with 8 or 10 access tubes, obtain readings between adjacent pairs of access tube around the perimeter, between pairs of access tubes across the diameter of the shaft, and between pairs of access tubes that are spaced at two times the spacing shown in Table 04-1 (See Figure 05-1 for a diagram). Obtain readings at depth intervals of 0.2 feet or less. If possible defects are detected, obtain additional readings to confirm the initial readings at no additional cost to the Department. Notify the Engineer of possible defects within 24 hours of testing.

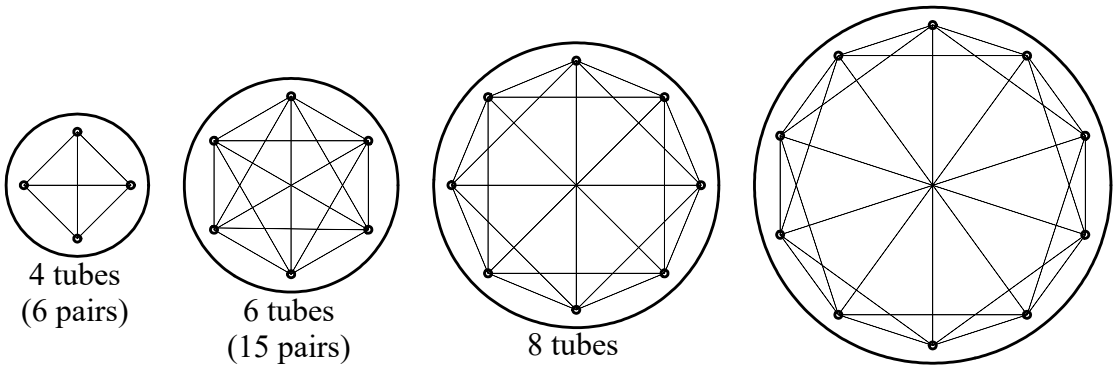

FIGURE 05-1

06 Test Report. Present the CSL test results in a written report. Supply the Engineer with two copies of the report within seven Calendar Days after completion of the CSL testing. The Engineer may require separate reports for each substructure depending on the number of drilled shafts or the length of the drilled shaft construction schedule. If separate reports for each substructure are required by the Engineer, supply the report within seven Calendar Days after completion of testing at that given substructure.

In addition to the report requirements in ASTM D 6760, indicate all possible defects on the CSL logs and include a summary of all possible defects detected during the CSL testing. The summary shall indicate for each possible defect:

A. the drilled shaft identification,

B. test date,

C. number of days between concrete placement and CSL testing,

D. access tube pairs tested,

E. depth below top of shaft,

F. percent wave speed reduction, and

G. an evaluation of the defect.

07 Evaluation of Test Results. The Engineer will evaluate the CSL test results and determine if the drilled shaft construction is acceptable. If the CSL test results indicate possible defects in the drilled shaft, the Engineer may require coring of the drilled shaft to obtain samples in the area of the possible defect, or excavation of the drilled shaft to examine the condition of the concrete. The Engineer may require testing of the core samples. The Engineer will consider the CSL test results, the condition of the concrete as shown by core samples, results of testing on the core samples, and other information when determining the acceptability of the drilled shaft. Do not proceed with construction of substructures or structures above a drilled shaft until the Engineer has accepted the drilled shaft.

If examination of the drilled shaft concrete confirms the presence of a defect in the drilled shaft, then the Department will not pay for coring, testing on the core samples, or excavation costs, even if the Engineer accepts the drilled shaft. If a defect cannot be confirmed by coring, then the Department will pay for coring, testing on the core samples, and excavation costs as Extra Work according to 109.05.

If the Engineer determines a drilled shaft is not acceptable, submit a plan for remedial action to the Engineer for approval. Have an Ohio Registered Professional Engineer prepare, sign, seal, and date calculations and working drawings for all foundation elements affected by the plan. Have a second Ohio Registered Professional Engineer check, sign, seal and date the calculations and working drawings. The preparer and checker are two different engineers.

08 Coring of Drilled Shaft Concrete. If the CSL test results indicate possible defects in the drilled shaft, the Engineer may require coring of the drilled shaft concrete to obtain samples in the area of the possible defect. If directed by the Engineer, obtain core samples in accordance with ASTM D 2113 for the full length of the possible defect plus 3 feet above and below the possible defect, or as directed by the Engineer. Obtain core samples with a minimum diameter of 3.0 inches.

Use either a conventional double-tube, swivel-type core barrel with split liners or a wireline core barrel with split inner liners. Use a new diamond coring bit. Replace the coring bit and core barrel as necessary to achieve a high percentage of core recovery.

Record an accurate log of the coring. Place the core samples in a partitioned core box with a cover and fasteners to prevent accidental opening during handling. Identify the boxes of cores by Project Name, shaft number, depths sampled, box number, and total number of boxes per shaft. Clearly and permanently mark the top and bottom depths below the top of the drilled shaft of each core sample. Securely block the samples in a partially filled compartment to prevent shifting and dislocation. Protect the samples during transport and storage until testing can be accomplished. Submit the core samples and two copies of the coring logs to the Engineer.

09 Grouting Tubes and Holes. After CSL testing and coring of the drilled shaft concrete is complete, remove all water from the access tubes and any cored holes. If the tubes extend above the top of the drilled shaft reinforcing, cut off the tubes below the top of the drilled shaft reinforcing. Fill the tubes and holes with grout.

10 Method of Measurement. The Department will measure CSL testing by the number of drilled shafts on which CSL testing is performed.

11 Basis of Payment. The Department will pay for Crosshole Sonic Logging (CSL) testing after being provided the written test report at the contract price as follows.

Item	Unit	Description
524	Each	Drilled Shafts, Misc.: CSL Testing, 96”/102” Dia. Shaft