ITEM #0702770 OSTERBERG CELL LOAD TESTING OF DRILLED SHAFT

Description:

This work shall consist of furnishing all materials, equipment and labor necessary for conducting an Osterberg Cell (O-Cell) Load Test and reporting the results. The Contractor shall supply all material and labor as hereinafter specified and including prior to, during and after the load test. The test shaft shall be constructed at the location shown on the site plan and in accordance with the requirements of these special provisions and also as outlined elsewhere in project plans and/or contract documents.

The Contractor shall employ the services of

Loadtest, Inc.
2631-D NW 41st Street
Gainsville, FL 32606
Phone (800) 368-1138
(352) 378-3717
Fax: (352) 378-3934

to instrument and conduct the load test(s) on the drilled shaft(s) used for the load test. The Contractor shall provide auxiliary equipment and services as detailed herein. If a test shaft is constructed at a production shaft location (intended to carry structural service loads) it shall be left in a condition suitable for use as a production shaft in the finished structure.

Materials:

The Contractor shall furnish all materials required to install the O-Cell, conduct the load test, and remove the load test apparatus as required. The Contractor shall furnish one (1) or more O-Cells as required for each load test. The O-Cell(s) to be provided shall have a bi-directional capacity as called for in the project plans and/or contract documents and shall be equipped with all necessary hydraulic lines, fittings, pressure source, pressure gage and telltale devices.

Construction Method:

1. Submittals: The Contractor shall submit a testing plan with working drawings which outline the test setup, including details of all system elements, instrumentation, materials, data collection system and procedures. This testing submittal shall be developed in coordination with and submitted concurrently with the Drilled Shaft working drawing submittal as required in related specifications elsewhere in the contract documents.

All submittals shall comply with the working drawing submittal requirements as outlined in Article 1.05.02 of the Form 816.

2. Equipment: The Contractor shall supply equipment and labor required to install the O-Cell, conduct the load test, and remove the load test apparatus as required. Required equipment includes but is not limited to:

(a) Fresh, clean, potable water from an approved source to be used as hydraulic fluid to pressurize the O-Cell.

(b) Materials sufficient to construct a stable reference beam system for monitoring movements of the shaft during testing. The system shall be supported at a minimum distance of 3 shaft diameters from the center of the test shaft to minimize disturbance of the reference system. A good quality, self-leveling surveyor's level shall be provided to monitor the reference system.

(c) Materials sufficient to construct a protected work area (including provisions such as a tent or shed for protection from inclement weather for the load test equipment and personnel) of size and type required by Loadtest, Inc. In the case of cold weather, the protected work area shall be maintained at a temperature above 40° F in order to insure proper operation of the load testing equipment.

(d) Stable electric power source, as required for lights, welding, instruments, etc.

(e) Materials for carrier frame, steel bearing plates and/or other devices needed to attach O-cell to rebar cage, as required.

(f) Welding equipment, certified welding personnel and labor, as required, to assemble the test equipment under the supervision of Loadtest, Inc., attach instrumentation to the O-Cell(s), and prepare the work area.

(g) Equipment and labor to construct the steel reinforcing cage and/or placement frame including any steel bearing plates required for the test shaft.

(h) Equipment and operators for handling the O-Cell, instrumentation and placement frame or steel reinforcing cage during the installation of the O-Cell and during the conduct of the test, including but not limited to a crane or other lifting device, manual labor, and hand tools as required by Loadtest, Inc.

(i) Equipment and labor sufficient to erect the protected work area and reference beam system, to be constructed to the requirements of Loadtest, Inc.

(j) Air compressor (minimum 185cfm, 100psi) for pump operation during the load test.

3. Installation and Removal of Load Testing Apparatus: For the drilled shaft(s) selected for testing in the contract or by the Engineer, the Contractor shall construct the drilled shaft using the approved shaft installation techniques until the drilled shaft excavation has been completed.

The O-Cell, hydraulic supply lines and other instruments will be assembled and made ready for installation under the direction of Loadtest, Inc., in a suitable area, adjacent to the test shaft, to be provided by the Contractor. When a steel reinforcing cage is required for the shaft, the O-Cell assembly shall be welded to the bottom of the cage in conjunction with the construction of the cage. The plane of the bottom plate(s) of the O-

cell(s) shall be set at right angles to the long axis of the cage. The Contractor shall use the utmost care in handling the test assembly so as not to damage the instrumentation during installation. The contractor shall limit the deflection of the cage to two (2) feet between pick points while lifting the cage from the horizontal position to vertical. The maximum spacing between pick points shall be 25 feet. The contractor shall provide support bracing, strong backs, etc. to maintain the deflection within the specified tolerance. The O-cell assembly must remain perpendicular to the long axis of the reinforcing cage throughout the lifting and installation process.

When the test shaft excavation has been completed, inspected and accepted by the Engineer, the O-cell assembly and the reinforcing steel may be installed. A common method is to install the O-cell assembly using a pump line or tremie pipe extending through the O-cell assembly to the base of the shaft. Depending on the configuration of the test assembly, it may be necessary to deliver a seating layer of concrete prior to installing the O-cell. In this case, the O-cell assembly would be installed while the concrete or grout at the base is still fluid, under the direction of the Loadtest, Inc. The O-Cell should end up at least partially submerged and firmly seated into the base grout or concrete

After seating the O-Cell, the remainder of the drilled shaft will be concreted in a manner similar to that specified for production shafts. However, if approved by the Engineer, the Contractor may use high early strength cement (Type III) in the mix to reduce the time between concreting and testing. At least four (4) concrete test cylinders, in addition to those specified elsewhere, shall be made from the concrete used in the test shaft, to be tested at the direction of Loadtest, Inc. At least one of these test cylinders shall be tested prior to the load test and at least two cylinders shall be tested on the day of the load test.

Load testing shall not begin until cylinder break testing has confirmed that the drilled shaft concrete has obtained the compressive strength as call for in the plans or contract documents. Testing to confirm the concrete strength shall be in conformance with Article 6.01.03 of the Form 816.

During the load test, no casings may be vibrated into place in the foundation area near the load test. Drilling may not continue within a 100-foot radius of the test shaft. If test apparatus shows any interference due to construction activities outside of this perimeter, such activities shall cease immediately.

After the completion of the load test, the Contractor shall remove any equipment, material, waste, etc. which are not to be a part of the finished structure. If the load test shaft is constructed at a production location and intended to carry service loads, the Contractor shall grout the interior of the O-Cell and annular space around the outside of the O-Cell using grouting techniques approved by Loadtest, Inc.

4. Testing and Reporting: The load testing and reporting shall be performed by Loadtest, Inc. The report shall be signed by a Professional Engineer registered in the State of Connecticut. The load testing shall be performed in general compliance with *ASTM D 1143 Standard Test Method for Piles Under Static Axial Load* using the Quick Load Test Method for Individual Piles. Initially the loads shall be applied in increments equaling 5 to 8% of the anticipated ultimate capacity of the test shaft. The magnitude of the load increments may be increased or decreased depending on the project requirements but should not be changed during the test.

Direct movement indicator measurements should be made of the following: O-cell expansion either directly or with telltales (minimum. of 3 indicators required), upward top-of-shaft displacement (minimum of 2 indicators required) and shaft compression above O-cell (minimum. of 2 indicators required).

Loads shall be applied at the prescribed intervals until the ultimate capacity of the shaft is reached in either end bearing or side shear, until the maximum capacity or maximum stroke of the O-cell is reached, or unless otherwise directed by the Engineer. Multiple load cycles to the maximum stroke of the O-Cell will be required for test performed on non-production drilled shafts.

At each load increment, or decrement, movement indicators shall be read at 1, 2, 4 and 8-minute intervals while the load is held constant.

During unloading cycles the load decrement shall be such that at least 4 data points are acquired for the load versus movement curve. Additional cycles of loading and unloading using similar procedures may be required by the Engineer following the completion of the initial test cycle.

Digital dial gages, LVDTs, or LVWDTs used to measure O-cell expansion and top-of-shaft displacement should have a minimum travel of 4 inches and be capable of being read to the nearest 0.001 inch division. When O-cell expansion is measured directly, or when testing requires the maximum stroke of the O-Cell to be reached, LVWDTs capable of measuring the full stroke of the O-Cell will be used. Digital dial gages, LVDTs, or LVWDTs used to measure shaft compression should have a minimum travel of 1 inch and be capable of being read to the nearest 0.001 inch division.

Unless otherwise specified by the Engineer, the Contractor will supply six (6) copies of a report of each load test, as prepared by Loadtest, Inc. An initial data report containing the load-movement curves and data tables will be provided to the Engineer within 4 working days of the completion of load testing, to allow evaluation of the test results. A final report on the load testing shall be submitted to the Engineer within 7 working days after completion of the load testing. As a minimum, the report shall include the following:

(a) As-installed location of the test shaft.

(b) Logs of test borings conducted at the test shaft location.

(c) Installation records of test shaft showing locations of all instrumentation.

(d) Summary of the load test procedure and data collected during load testing.

(e) Analysis of unit side adhesion in the test socket and unit end-bearing pressure.

(f) Plots of axial load versus displacement at the base of the shaft, and axial load versus displacement and/or strain along the test socket.

5. Post-Test Grouting Procedures:

Commentary: This section should be only be used when the test is to be performed on a production drilled shaft. It should be deleted if the load test is to be performed on a non-production drilled shaft.

During the O-cell test, the shaft breaks on a horizontal plane separating the upper section above the O-cell (upper side shear) from the lower section below (combined end bearing and lower side shear). This creates an annular space, the size of which depends on the shaft/O-cell geometry and the expansion of the O-cell.

When a production shaft has been tested, the Engineer may want to include the end bearing component from the lower section in order to obtain sufficient capacity of the production shaft. In such cases the contractor will be required to grout the O-Cell and the annular space around the O-Cell in order to allow load transfer to the lower side shear and end bearing.

Grout used for filling Access Tubes shall conform to the requirements of Article M.03.01-12 of the Standard Specifications. The grout shall have strength properties equivalent to or better than those of the drilled shaft concrete.

(a) Grouting of O-Cells

i. The grout shall consist of Portland cement and water only, **NO SAND**. The grout shall be fluid and pumpable. An initial mix consisting of 6 to 7 gallons of water per 95-lb bag of cement is recommended. Adjust water to obtain desired consistency.

ii. The mixing shall be thorough to ensure that there are no lumps of dry cement. Pass the grout through a window screen mesh before pumping.

iii. Connect the grout pump outlet to one hydraulic line of the O-cell. Open the other line and establish a flow of **water** through the system.

iv. Pump the grout through the O-cell hydraulic line while collecting the effluent from the bleed line. Monitor characteristics of effluent material and when it becomes equivalent to the grout being pumped, stop pumping.

v. Take three samples of the grout for compression testing @ 28 days, if required.

Recommended pre-mixed amount of grout for grouting of O-cell:				
O-cell Diameter (Inches)	13	21	26	34
Grout Volume (Cubic Feet)	4	7	9	13

(b) Grouting of Annular Space Around O-Cells

i. Prepare a fluid grout mix consisting of Portland cement and water only, no sand. The mixing procedures should be as outlined for grouting the O-Cells. The quantity of grout

should be at least three (3) times the theoretical volume required to fill the annular space and grout pipes.

ii. Pump **water** and establish a flow through the grout pipes (two per shaft).

iii. Pump the fluid grout through one of the grout pipes until grout is observed flowing from the second grout pipe or until 1.5 times the theoretical volume has been pumped.

iv. If no return of grout is observed from the second grout pipe, transfer the pump to the second pipe and pump grout through it until 1.5 times the theoretical volume has been pumped.

v. If higher strength grout is deemed necessary, immediately proceed with pumping the higher strength grout (which may be a sand mix). The pumping procedures for this grout will be the same as described above for the initial cement-water grout. The entire grouting operation must be completed before the set time for the initial grout has elapsed.

vi. Take three (3) samples of each type of grout for compression testing @ 28 days.

Recommended pre-mix amount of grout for grouting of annular space:								
Shaft Diameter (Feet)	2	3	4	5	6	7	8	9
Grout Volume (Cubic Feet)	25	30	40	50	65	80	100	125

Method of Measurement:

The “Osterberg Cell Load Testing of Drilled Shaft” shall be measured by the actual number of test(s) completed and accepted, and shall include and material, labor and equipment necessary for the O-Cell load testing of the drilled shaft(s). This item should include everything necessary to assemble, install and remove the load test apparatus, conduct and report results of the load test, and grouting of the O-Cell and annular space around the O-Cell. All costs associated with the normal production of the drilled shafts are measured and paid for elsewhere in the contract documents.

Basis of Payment:

The O-Cell load tests shall be paid for at the contract unit price each for accepted "Osterberg Cell Load Testing of Drilled Shaft". The price and payment shall be considered full compensation for furnishing all materials, providing all tools, equipment, labor and incidentals to perform the Statnamic load test, subsequent removal of test apparatus and appurtenances, and preparation of the load test report.