SPECIAL PROVISION

SPECIFICATION 916 – OSTERBERG CELL LOAD TESTING

916-1 DESCRIPTION

916-1.01 Scope

a. This work shall consist of furnishing all materials and labor necessary for conducting Osterberg Cell (O-Cell) load tests and reporting the results on drilled shafts or pre-tensioned cylinder concrete piles designated on the plans, as directed by this specification or indicated by the Engineer. The Contractor shall coordinate with the Osterberg Cell supplier for all its requirements for the proper performance of the test.

b. The Puerto Rico Highway and Transportation Authority (PRHTA) has established that the supplier for the testing shall be:

LOADTEST, Inc.
5420 S. Klee Mill Road, Suite 4
Sykesville, MD 21784
Phone: (800) 436-2355
(410) 552-1979
Fax: (410) 552-1843

c. Also included under this specification is the presentation of a technology transfer seminar to personnel of the PRHTA by experienced engineers on O-cell Testing. Sessions shall be one before testing, a second one during testing and a third one after results are obtained and data has been interpreted.

916-2 MATERIALS

916-2.01 The Osterberg Cell supplier shall supply all materials, personnel, and equipment for performing a test with a capacity of at least 400 tons in each direction and provide all necessary hydraulic lines, fittings, pressure source, pressure gage and telltale devices. The materials required include, but are not limited to the following:

a. Fresh water forms an approved source to mix with water-soluble oil provided by the Supplier to form the hydraulic fluid used to pressurize the Osterberg Cell.

b. Materials sufficient to construct a stable reference beam system for monitoring movements of the shaft or pile during testing supported at a minimum distance of 3 diameters from the center of the shaft or pile to prevent 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 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 the Engineer and the Supplier.

d. Electric power, 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 reinforcing steel cage, as required.

916-2.02 Materials supplied, which do not become a part of the finished structure become the responsibility of the Contractor at the conclusion of the load test and shall be removed from the job site.

916-2.03 The Contractor shall supply equipment required to install the O-cell, conduct the load test, and remove the load test apparatus as required. Equipment required includes, but is not limited to:

a. Welding equipment and certified welding personnel, as required, to assemble the test equipment under the supervision of the Supplier personnel, attach hydraulic fittings and telltales to the Osterberg cell(s), and prepare the work area.

b. Equipment and labor to construct the reinforcing steel cage and/or carrier frame required for the test shaft or pile, including any steel bearing plates required for the test shaft.

c. Equipment and operators for handling the Osterberg cell and instrumentation and carrier frame or reinforcing steel cage during the installation of the Osterberg cell and during the conduct of the test, including but not limited to a crane or other lifting device for Osterberg cell and instrumentation, manual labor, and hand tools as required by the Supplier and the Engineer.

d. Equipment and labor sufficient to erect the protected work area and reference beam system, to be constructed to the requirements of the Engineer and the Supplier.

e. Air compressor (minimum 150 cfm) for pump operation during load testing.

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916-3 CONSTRUCTION REQUIREMENTS

916-3.01 The Osterberg Cell, hydraulic supply and other attachments will be assembled and made ready for installation under the direction of the Supplier and the Engineer, in a suitable area, adjacent to the test shaft or pile, to be provided by the Contractor. When a reinforcing steel cage is required for the shaft or pile, the Osterberg Cell assembly shall be welded to the bottom of the cage in conjunction with the construction of the cage.

916-3.02 When the test shaft excavation has been constructed, inspected and accepted by the Engineer, a seating layer of concrete or grout shall be placed by an approved method, in the base of the shaft. The Contractor shall then install the Osterberg Cell and the carrier frame or reinforcing steel cage assembly in the test shaft (while the concrete or grout is still fluid) under the direction of the Supplier and the Engineer so that the Osterberg Cell is resting firmly in the concrete. The Contractor shall use the utmost care in handling the placement/test equipment 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.

916-3.03 After seating the Osterberg cell assembly, the drilled shaft or pile may be concreted in the manner specified for similar to production shafts or piles. However, if approved by the Engineer, the Contractor may use high early strength cement (Type ILL) in the mix to reduce the time between concreting and testing. At least six (6) concrete compression test cylinders shall be molded from the concrete used in the test shafts or piles. At least one of these cylinders shall be tested prior to the load test and at least two cylinders shall be tested on the day of the load test.

916-3.04 During the period required to perform the load test, no casings may be vibrated into place in the foundation area near the load test. However, drilling may continue, provided that it is on shafts approximately 50 ft clear from the work area. If test apparatus shows any signs of negative effects due to construction activities, such activities shall cease immediately.

916-3.05 After the completion of the load test, and at the direction of the Engineer, 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, the Contractor shall grout the interior of the Osterberg cell and annular space around the outside of the Osterberg cell using the grouting techniques approved by the Engineer and the Supplier.

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916-3.06 Post-test Grouting Procedures for Production Drilled Shafts Tested with an Osterberg Cell

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

b. 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 reconnect the end bearing section.

916-3.07 Post-test Grouting of Osterberg Cells (O-Cells)

a. The grout should consist of Portland cement and water only; sand shall not be included in the mix.

b. The grout should be fluid and pumpable. It is recommended to batch up a mix consisting of 4 to 6 gallons of water per 95-lb bag of cement. Adjust water to obtain the desired consistency

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

d. Connect grout pump outlet to one hydraulic line of the O-cell. Open the other line to allow hydraulic fluid to bleed.

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

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

Recommended Pre-mixed Amount of Grout for Grouting of O-Cell			
O-cell Size (Inches)	13	21	34
Grout Volume (Cubic feet)	4	7	13

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916-3.08 Post-Test Grouting of Annular Space Around Osterberg Cells (O-Cells)

a. Prepare a fluid grout mix consisting of Portland cement and water only, sand shall not be included in the mix. The mixing procedures should be as outlined for grouting the O-cells. The quantity of grout should be at least 3 times the theoretical volume required to fill the annular space and the grout pipes.

b. Pump water to "blow out" the bottom caps of the plastic grout lines (two on each shaft).

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

d. 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.

e. If higher strength grout is deemed to be 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 complete before the set time for the initial grout has elapsed.

f. Take 3 samples of each type of grout for compression testing @ 28 days.

Recommended Pre-mixed Amount of Grout for Grouting Annular Space:							
Shaft Diameter (Feet)	2	3	4	5	6	7	8
Grout Volume (Cubic Feet)	25	30	40	50	65	80	100

916-3.09 Load Testing and Reporting

a. The load testing shall be performed in general compliance with ASTM D-1 143 (Quick Test Method). Initially, the loads shall be applied in increments equaling *5%* of the anticipated ultimate capacity of the test shaft. The magnitude of the load increments may be increased or decreased depending on the actual test shaft capacity.

b. Direct movement indicator measurements should be made of the following: downward shaft end-bearing movement (minimum of two indicators required), upward top-of-shaft movement (minimum of two indicators required), shaft compression

(minimum of two indicators required). Strain gage instrumentation should be utilized to assist in determining the side shear load transfer in the shaft above the O-cell.

c. Loads shall be applied at the prescribed intervals until the ultimate capacity of the shaft is reached in either end bearing or side shear, or until the maximum capacity or maximum stroke of the O-cell is reached, unless otherwise directed by the Engineer.

d. At each load increment, or decrement, movement indicators shall be read at 1.0, 2.0 and 4.0-minute intervals while the load is held constant.

e. During unloading cycles, the load decrement shall be such that at least four data points are acquired for the load versus movement curve. The Engineer following the completion of the initial test cycle may require additional cycles of loading and unloading using similar procedures.

f. Dial gages, digital gages, or LVWDT's used to measure end bearing and side shear movements should have a minimum travel of 4 inches and be capable of being read to the nearest 0.0001-inch division. End bearing movement may be alternately monitored using LVWDT's capable of measuring the expansion of the O-cell (6 inches). Dial gages, digital gages, or LVWDT's used to measure the shaft compression should have a minimum travel of 1-inch and be capable of being read to the nearest 0.0001-inch division.

g. The reference beam selected should have a minimum length equal to six times the shaft diameter and should be monitored for movement during load testing using a surveyor's level.

h. Unless otherwise specified by the Engineer, the Contractor will supply five (5) copies of a report of each load test, as prepared by the Supplier or others approved by the Engineer. A preliminary report containing the load-movement curves and test data shall be provided to the Engineer within 7 calendar days of the completion of load testing. A final report of load testing, signed and sealed by a Professional Engineer licensed by the Commonwealth of Puerto Rico, shall be submitted to the Engineer within 21 calendar days of the completion of all load testing on site.

i. At a minimum, the report shall include the following:

1. As-installed location of the test shaft.

2. Schematic indicating location of all instrumentation.

3. Summary of load test procedures and data collected during testing.

4. Summary of all applicable shaft dimensions, areas, elevations and properties used for analysis purposes.

5. Plots of load vs. movement, creep, equivalent top load and (where appropriate) side shear load transfer from strain gage results.

916-4 METHOD OF MEASUREMENT

916-4.01 Osterberg cell load tests called for on the plans or ordered by the Engineer will be measured by the number of tests made, completed and accepted on an individual test pile or shaft in accordance with the plans, these specifications or directed by the Engineer.

916-4.02 The Technology Transfer Seminar as described under this specification will be measured as a single lump item. This shall include all costs necessary for the seminar presentation, resources, lodging, transportation and all other miscellaneous required by the Supplier who shall make the presentation.

916-5 BASIS OF PAYMENT

916-5.01 The accepted quantities, determined as provided above, for the pay item listed below which is included in the contract, will be paid for at the contract unit price per unit of measurement. Such price and payment shall constitute full compensation for furnishing, placing and finishing all required materials, and for all equipment, tools, labor, Contractor-Supplier coordination and incidentals necessary to complete each item as required by the plans, specifications and directed by the Engineer.

916-5.02 Payment will be made under:

Pay Item	Pay Unit
Osterberg Cell Load Test	Each
Technology Transfer Seminar	Lump Sum