

204-R-727 GEOTECHNICAL INSTRUMENTATION

(Adopted 05-20-21)

The Standard Specifications are revised as follows:

SECTION 204, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

**SECTION 204 – GEOTECHNICAL INSTRUMENTATION**

**204.01 Description**

This work shall consist of providing, installing and maintaining ~~of~~ geotechnical instrumentation including settlement plates, settlement stakes, lateral stakes, *vibrating wire settlement systems*, and standpipe piezometers as directed and in accordance with 105.03.

**MATERIALS**

**204.02 Materials**

Materials shall be in accordance with the following:

B Borrow .....	<del>211.02</del> 904.06
Coarse Aggregate, Class D or Higher, Size No. 53. ....	904.03
Ottawa Sand* .....	AASHTO T 252
<i>Portland Cement, Type I</i> .....	901.01(b)
Structure Backfill, Size No. 30 .....	904.05
<i>Water</i> .....	913.01

\* Ottawa Sand shall have a minimum permeability of 25 ft/day.

Bentonite chips shall consist of commercially processed angular fragments of pure bentonite, without additives.

Bentonite-cement grout shall consist of a mixture with the ratio of 25 lb of bentonite with 94 lb of portland cement, Type I ~~in accordance with 901.01(b)~~ and a 30 gal. of water.

SECTION 204, BEGIN LINE 97, DELETE AND INSERT AS FOLLOWS:

**204.04 Vibrating Wire Settlement Systems**

*A vibrating wire settlement system from the Department’s QPL for Vibrating Wire Settlement Systems shall be provided. A vibrating wire settlement system will be considered for inclusion on the QPL by following ITM 806, Procedure U. The settlement system shall consist of sensor, tubing, and reservoir system. The system shall also have the capability of being attached to a datalogger and be remotely monitored via a cell phone modem.*

*Structure backfill shall be No. 30 sand in accordance with 904.05.*

*The Contractor shall submit a type D certification in accordance with 916 and the manufacturer’s calibration report for the settlement system to the Engineer and to the Department’s Geotechnical Engineering Division two weeks prior to beginning construction. The Contractor shall supply the hardware, software, power supply, and monitoring system.*

*A qualified geotechnical consultant, from the Department's list of Qualified Geotechnical Consultants, shall install these devices as specified by the manufacturer.*

***(a) Installation Requirements***

*Prior to installation, the settlement system materials shall be assembled and inspected for defects in accordance with manufacturer's instructions and recommendations. The Contractor shall verify that all cable and tube lengths are of sufficient length to facilitate proper installation and layout. Cables and tubes shall be labeled with a unique instrument number using a permanent marking system at the terminal end, at the sensor end, and at 50 ft intervals in between.*

*The settlement cells shall be mounted onto rigid plates. The Contractor shall also install at least two survey pins on the plates and provide easy access to the markers for a survey crew to measure elevations using standard tools.*

*The Contractor shall provide details for protecting the signal cables and tubing at the connection from the reservoir to the settlement plate.*

*Sharp bends where the signal cable and tubing exit the embankment shall be avoided. All signal cable and tubing shall be run in a 1 ft deep by 1 ft, minimum, wide trench using structure backfill for 3 in. under the cable and 3 in. over the cable, or other approved method, to protect the signal cable and tubing from damage. The Contractor shall run cabling and tubing leaving enough slack to provide necessary strain relief for the anticipated movements in accordance with the manufacturer's recommendations.*

*Only hand tools shall be used to place and compact fill material for a height of 1 1/2 ft above signal cable, tubing, and the settlement plate. The Contractor shall avoid driving heavy equipment that causes rutting deeper than 2 in. over or near the signal cable, tubing, and settlement plate until the height of the fill over the signal cable, tubing, and settlement plate reaches at least 5 ft.*

*The signal cable and tubing shall terminate at a datalogger inside a lockable readout enclosure. The enclosure shall be mounted on a post driven into stable ground as close as possible to the right of way line. The Contractor shall keep the fluid reservoir vertical at all times. The sensor and tubing shall be at a lower elevation than the instrument reservoir at all times. The enclosure and instrument tubing from the ground into the reservoir enclosure shall be protected from thermal influence.*

*After the completion of the installation, a detailed installation log shall be completed. The as built location in a horizontal position shall be determined for both the sensor and the reservoir to an accuracy of  $\pm 1$  ft and the elevation for both the sensor and the reservoir determined to an accuracy of  $\pm 0.01$  ft.*

*After the completion of the installation, a post-installation acceptance test shall be performed by obtaining three independent readings from the sensor in accordance with the manufacturer's recommendations. The acceptance test shall be performed prior to backfilling of the trench. This shall be accomplished using a vibrating wire readout compatible with the installed settlement system. Elevations obtained from all three*

*readings shall be within a range of 0.02 ft from each other. The Engineer will review the data from these readings to determine whether the instrument is acceptable.*

*The Contractor shall be responsible for any damage to the vibratory wire settlement systems.*

**(b) Instrument Reading and Documentation**

*Monitoring will be performed by the Department’s Geotechnical Engineering Division. Measurements at each instrument will include the raw readings from the settlement cell, the temperature at the settlement cell, and the temperature at the reservoir. Instruments will be read in accordance with 101.36, or as recommended by the Engineer.*

*The Geotechnical Engineering Division will keep a weekly record which lists for each settlement system, sensor elevation, reservoir elevation, and list of pay items. A copy of each weekly report shall be provided to the Engineer.*

**204.045 Standpipe Piezometers**

SECTION 204, BEGIN LINE 199, DELETE AND INSERT AS FOLLOWS:

**204.056 Method of Measurement**

*Settlement plates, settlement stakes, lateral stakes, vibrating wire settlement systems, standpipe piezometers, and water monitoring boreholes will be measured by the number of units installed and accepted.*

**204.067 Basis of Payment**

*Settlement plates, settlement stakes, lateral stakes, vibrating wire settlement systems, standpipe piezometers, and water monitoring boreholes will be paid for at the contract unit price per each.*

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
Settlement Plate.....	EACH
Stake, Lateral .....	EACH
Stake, Settlement.....	EACH
Standpipe Piezometer.....	EACH
<i>Vibrating Wire Settlement System.....</i>	<i>EACH</i>
Water Monitoring Borehole.....	EACH

*The cost of furnishing, installing, and maintaining settlement plates, extension pipes, cover pipes, B borrow, structure backfill, coarse aggregate and all necessary incidentals shall be included in the cost of settlement plates.*

*The cost of furnishing all tools, labor, and materials necessary to complete the installation, maintenance, and baseline reading of vibratory wire settlement systems as specified by the manufacturer shall be included in the cost of the vibratory wire settlement system pay item.*

The cost of backfilling water monitoring boreholes will be included in *the* cost of water monitoring boreholes.

The cost of handholes, protective covers, bentonite chips, bentonite-cement grout, Ottawa sand, tips, casing, drilling, tubing or PVC pipe, backfilling and measurements will be included in the cost of standpipe piezometers.

No additional compensation will be made for any costs incurred related to the repair of settlement plates, pipes, settlement stakes, lateral stakes, *vibratory wire settlement systems*, or standpipe piezometers as the result of damage by the Contractor.

*No payment will be made for unacceptable settlement plates, pipes, settlement stakes, lateral stakes, vibratory wire settlement systems, or standpipe piezometers. No payment will be made for delays and expenses incurred by the Contractor, through changes necessitated by improper or unacceptable installation, material or equipment.*

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