

GEOTECHNICAL INSTRUMENTATION

**\*\*From Cabot BRO 1446(27)**

- xx. DESCRIPTION. This work shall consist of furnishing and installing Earth Pressure Cells (EPC) and Vibrating Wire Settlement Systems (VWS) at specified locations in accordance with the Contract Documents and as directed by the Engineer.
- xx. MATERIALS.
- (a) Earth Pressure Cells. The earth pressure cells shall be Model 4810, as manufactured by Geokon Inc. of Lebanon, New Hampshire, or approved equal. The vibrating wire transducers shall measure over a range of 0 to 68.9 kPa (0 to 10 psi), an over-range rating of twice the rated pressure,  $\pm 0.2$  percent full scale accuracy, 0.025 percent full scale resolution, and shall have the capability to measure temperature. Gas tube discharge electrical surge protection units shall be incorporated inside the body of each sensor. The manufacturer shall have a minimum of five years proven long-term stability data.
  - (b) Vibrating Wire Transducers. The vibrating wire transducers shall have factory-attached cables of sufficient length to route to the terminal box without splicing. Cable shall be of the same commercial source as the earth pressure cells, and shall be 4-conductor, 22 gauge, with two (2) shielded twisted pairs, and a common drain wire. Cable shall be attached to the cells through an integral bulkhead seal, consisting of an interior waterstop seal and cable entry seal. Seals shall be either O-rings or hermetic seals and must be tested and certified for water-tightness over the specified pressure range of the transducer.
  - (c) Vibrating Wire Settlement Systems. The vibrating wire settlement systems shall be Model 4650, as manufactured by Geokon Inc. of Lebanon, New Hampshire, or approved equal. A vibrating wire pressure sensor attached to a settlement plate shall be located behind each abutment as shown on the Plans. The sensor shall be connected to a reservoir via two liquid-filled tubes. The reservoir and readout terminal shall be located in a lockable rainproof enclosure attached to the front face of each abutment. The minimum sensor range shall be 2 meters (6.6 feet) with a 2 mm (1/16 inch) resolution and system accuracy of  $\pm 4$  mm (3/16 inch). Temperature range shall be  $-40^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $122^{\circ}\text{F}$ ).
  - (d) Terminal Box. Provide one Model 4999-16VT Terminal Box as manufactured by Geokon Inc. of Lebanon, New Hampshire, or approved equal, at each abutment.
  - (e) Surge Protection. Provide three-phase surge protection circuit boards. The surge protection circuit boards shall contain a combination of gas tube discharge rectifiers, solid state diode circuits, and coils to suppress electrical transients. Surge protection circuit boards

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shall be installed on every lead wire connected into the terminal box to protect the instruments.

- (f) Grounding Rods. Grounding rods shall be 19 mm (¾ inch) diameter by 3 m (10 feet) long, copper clad steel as manufactured by Copperweld, Blackburn, or approved equal.
- (g) Ground cable. Ground cable shall meet the requirements of ASTM B8 copper, #4 AWG bare wire.
- (h) Sand Borrow. Sand borrow shall meet the requirements of Subsection 703.03.

xx. SUBMITTALS. The Contractor shall submit the following to the Engineer two (2) weeks prior to purchasing for approval:

- (a) A list of all pressure cells with the cable lengths. Identify method for marking and identifying cables from individual pressure cells.
- (b) Manufacturer calibration sheets for all pressure cells. Calibration sheets shall include the gauge factor, and temperature correction factor, and calibration data at the time of manufacture.
- (c) A list of vibrating wire settlement systems with tube lengths and signal cable lengths. The manufacturer's calibration sheets shall be provided for each sensor.

xx. INSTALLATION.

- (a) General. All geotechnical instrumentation shall be surveyed, in both location and elevation, prior to and after installation. Earth Pressure Cells shall be provided to VTrans 4 weeks prior to installation for independent calibration verification.

The Contractor shall provide access during construction to allow technicians from VTRANS or its designee to install instrumentation as necessary. Contractor will assist technicians in the installation as required.

- (b) Earth Pressure Cells. Earth Pressure Cells shall be installed at two locations along the centerline of the abutment on the back side of each abutment at locations specified in the Plans. The EPCs are required to be installed flush mounted so that the active face of the EPC is in the same plane as the back face of the abutment. The Contractor shall provide a plywood "cutout" on the face of concrete forms in the proper location for installation of the EPCs as shown in the Plans. The Contractor shall provide a recess in the back face of the abutment to accept the EPC transducer and wire as shown in the Plans. The Contractor shall notify VTrans or its designee at least 48 hours prior to the time that EPCs will be installed so that technicians from either VTrans or its designee can be onsite to install the EPCs. The Contractor shall allow

sufficient access for technicians from VTrans or its designee to install EPCs. The Contractor shall assist in the installation. It is estimated that it will take approximately three (3) hours to complete the installation of each EPC.

The EPCs shall be fully seated in non-cement grout in the recess in the abutment face. No voids shall be present behind or around the pressure cell. The grout will be supplied by VTrans. EPCs on the abutment are to be flush with concrete after installation. Non-cement grout is to be used to finish the edge contact between the EPC and concrete. The EPCs shall be equipped with sufficient length of wire so that all wires from all EPCs may be terminated at a common junction block for each abutment/backfill.

Where sand borrow is placed against the EPC or in the trench surrounding liquid filled tubes and signal cable, the materials shall not have particles greater than 10 mm (3/8 inch) in contact with the face of the EPC or the liquid filled tubes and signal cable.

- (c) Vibrating Wire Settlement Systems. Vibrating Wire Settlement Systems are to be installed as shown on the Plans at the top of the shredded tire fill. Liquid-filled tubes and signal cables shall be placed in sand-filled trenches behind the abutments and in PVC conduits on the face of the abutments. It is estimated that it will take approximately three (3) hours to complete the installation of each VWS.
- (d) Terminal Boxes. Terminal boxes shall be mounted on the river side of the concrete abutments. The Contractor shall supply appropriate hardware and connectors for attaching the boxes to the concrete face of the abutments.

- xx. MAINTENANCE. The Contractor shall maintain the geotechnical instrumentation equipment for the duration of the project and shall repair or replace any such equipment which fails to function properly.

Any instrumentation that becomes damaged or inoperable through no fault of the Contractor shall be repaired or replaced and paid for at the Contract unit price bid for the respective instrumentation.

Any instrumentation that becomes damaged or inoperable and requires replacement as a result of the Contractor's operation shall be replaced by the Contractor at no cost to the State. If replacement or repair is not feasible, no payment will be made for the damaged cell.

- xx. METHOD OF MEASUREMENT. The quantities of Special Provision (Earth Pressure Cell) and Special Provision (Vibrating Wire Settlement System) to be measured for payment will be the number of each installed and maintained complete in place in the accepted work.

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xx. BASIS OF PAYMENT. The accepted quantities of Special Provision (Earth Pressure Cell) and Special Provision (Vibrating Wire Settlement System) will be paid for at the Contract unit price for each. Payment shall be full compensation for furnishing the specified materials and equipment, assisting with the installation, protecting and maintaining the equipment as specified, and for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

A partial payment of seventy-five (75) percent of the Contract unit price will be made when instrumentation has been installed and is functioning correctly to the satisfaction of the Engineer. The remaining twenty-five (25) percent of the Contract unit price will be paid upon completion of the project.

Final payment will be made only if the earth pressure cells and vibrating wire settlement systems remain fully functional until the completion of the project.

At the completion of the project, all Geotechnical Instrumentation and appurtenances, including all readout devices, will remain the property of the State of Vermont.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.620 Special Provision (Earth Pressure Cell)	Each
900.620 Special Provision (Vibrating Wire Settlement System)	Each