
Supplemental Technical Specification for

Vibrating Wire Rod Extensometer

SCDOT Designation: SC-M-203-8 (7/17)

1.0 DESCRIPTION

1.1. Furnish all necessary supervision, labor, material, equipment, and related services necessary to furnish, and to install and maintain Vibrating Wire Rod Extensometers (VWREs) in accordance with the lines, grades, dimensions, and designs shown on the plans, this Supplemental Technical Specification (STS), the project Specifications or Special Provisions, or as directed by the Resident Construction Engineer (RCE) or Geotechnical Engineer-of-Record (GEOR). This item includes the furnishing of "As-Built" drawings of actual locations where instrumentation was installed, survey data recorded during instrumentation installation, and installation field reports. Also included in this item of work is the initial and periodic/continuous recording of VWRE readings and reporting the readings to the RCE and GEOR in accordance with the Department's Geotechnical Instrumentation Monitoring Plan for the entire duration of the project, unless otherwise directed. Measure, record and provide to the RCE and GEOR the elevations of the VWREs as required in this STS. Install VWREs in the presence of the RCE and/or the GEOR. Accommodate the RCE and GEOR in the monitoring of VWREs, as required.

1.2. The project geotechnical conditions and data including geotechnical boring logs, laboratory testing results, and other pertinent information are available upon request from the RCE. All interpretation of geotechnical conditions and data relevant to the VWREs is the responsibility of the GEOR.

2.0 MATERIALS

2.1. The VWRE is an automated device for monitoring settlement and typically has a capacity to contain 6 rod extensometers that will measure settlement at different depths below the ground surface (see Figure 1). The depths of data collection are indicated in the project plans. The rod extensometers will be housed in a casing of sufficient diameter to allow for 6 rods in each casing. The VWRE shall be capable of measuring the total settlement indicated in the Geotechnical Instrumentation Monitoring Plan. The VWRE shall have an accuracy ± 0.1 percent with a thermal effect of < 0.05 percent for a temperature range of -4°F to 176°F . In addition, the VWRE shall have a long-term stability of < 0.2 percent per year. The location of each rod extensometer cluster is indicated in the project plans. In addition, supply an Excel[®] spreadsheet prepared by the VWRE manufacturer that converts field readings to elevation data.

2.2. The VWRE shall be installed in accordance with the manufacturer's recommendations. Each VWRE shall be connected to the Vibrating Wire Data Collection Center (VW-DCC) either via cable or cellular communications. The VWRE and the VW-DCC shall be capable of communicating with the other device regardless of how the connection is made. If cable is used, enough cable shall be provided to run from the VWRE to the location of the VW-DCC plus 10 feet for each instrument. The cable used to connect the VWRE to the VW-DCC shall meet the requirements of the instrument

manufacturer/supplier. The Contractor shall supply non-conductive conduit to encase the cable between the VWRE and VW-DCC. The conduit shall have a minimal nominal diameter of 1 inch and meet the requirements of Schedule 80 materials. Provide enough conduit to enclose all lengths of buried cable from the VWRE to the VW-DCC. All connections in the conduit and in the cable between the VWRE and VW-DCC shall be water proof.

2.3. If the connection is made via cellular communications, provide power to each device (VWRE and VW-DCC) via either hard wiring to a public utility or by rechargeable batteries with adequate means to recharge the batteries. The cellular communications shall not interfere with or be interfered with by other means of communications. Only cellular communications devices approved by the appropriate Federal or State agencies will be used.

3.0 SUBMITTALS

3.1. Vibrating Wire Rod Extensometer Plan: Within 30 calendar days before installing the VWRE, submit to the RCE and GEOR for review the personnel qualification, installation plan, and monitoring plan. Include in the installation plan as a minimum the following information:

1. The manufacturer's Specification sheet for the proposed VWRE system for review and acceptance by the GEOR.
2. Submit locations where VWRE will be installed if different from the location shown on the plans. Prior approval of new locations by the GEOR is required.
3. Proposed installation method.
4. Proposed method to protect VWRE during construction from construction equipment, vandalism, and weather.

3.2. Identify the licensed surveyor who will be responsible for providing survey services during the installation of the VWRE. Select a Geotechnical Engineering Consultant (GEC) to install the VWREs. The GEC shall be selected from those firms who are currently on the SCDOT Geotechnical On-Call Contract. Contact the RCE for the list of GEC firms or see the SCDOT website for the current list of Geotechnical On-Call Contracts. The same GEC that is responsible for the VWREs will also be responsible for the VW-DCC. Document the GEC's experience in installing VWRE in accordance with the plans and Contract Documents. The documentation shall include a project summary, of at least 3 projects, that includes for each project the project name, role in providing instrumentation services, type of VWRE, equipment used, duration of the project (i.e. dates), magnitude of settlements, client name and address, name and phone number of representative of the consultant and owner for whom the work was performed and can attest to the successful completion of the work, and any other information relevant to demonstrating the geotechnical engineer's qualifications. In addition, the manufacturer/supplier shall also be on-site during the initial installation of the VWRE to ascertain that all instruments have been connected correctly. The manufacturer/supplier shall also be available for questions from either the geotechnical engineer responsible for maintaining the VWRE or from the GEOR concerning the data being collected.

3.3. Submittal Reviews: Acceptance of the personnel qualification and installation plan by the GEOR shall not relieve the Contractor of its responsibility to successfully install the VWREs in accordance with the plans and specifications. Approval by the GEOR of the VWRE installation plan shall be contingent upon satisfactory demonstration that the VWRE is meeting the objectives of the Department's Geotechnical

Instrumentation Monitoring Plan. If, at any time, the GEOR in consultation with the RCE considers that the VWRE does not produce satisfactory results, alter the method and/or equipment as necessary to comply with this STS and Department's Geotechnical Instrumentation Monitoring Plan. The RCE and the GEOR will be the sole judge in determining the adequacy of the Contractor's VWRE.

3.4. Within 1 week following installation, submit an installation record for each VWRE, which includes the VWRE designation, station, offset, and elevation of the VWRE. The VWRE shall be located to an accuracy of 0.01 feet (both vertically and horizontally). In addition, indicate on the installation plan the benchmark(s) that will be used to measure settlement from. Establish the benchmark on stable ground that is not subject to settlement and is typically located away from any earthwork/construction activities.

4.0 DELIVERY, STORAGE, AND HANDLING

4.1. Check all materials and equipment upon delivery to ensure that the proper items are received and are not damaged. Store and maintain all materials in a clean, uncontaminated condition throughout the course of the project. Upon receipt of the VWRE, submit copies of the manufacturer's installation and instruction manual for review and acceptance by the GEOR, and make available the data logging system for inspection by the GEOR.

5.0 CONSTRUCTION REQUIREMENTS

5.1. Notify the GEOR at least 14 days prior to the installation of VWRE. The VWREs shall be furnished and installed by the Contractor in accordance with the plans and this STS and in the presence of the GEOR or the RCE.

5.2. Locate all VWREs in the field and ensure that no conflicts exist between VWREs and foundations, structures, utilities or other construction proposed or present at the site.

5.3. Provide a licensed surveyor to stake out and provide as-built locations and elevations of all VWREs locations.

5.4. Install VWREs prior to construction of the embankment. Install VWREs in accordance with the manufacturer's recommendations as presented in their instruction and installation manual. The VWRE will be connected to the VW-DCC in accordance with the plans, contract documents, and manufacturer's recommendations.

5.5. Accurately locate all VWREs in accordance with the plans. VWREs may be adjusted by the Contractor, with the prior written approval of the GEOR, to avoid utilities, foundations, and all other underground construction.

5.6. Within 1 week following installation, submit an installation record for each VWRE, which includes the instrumentation identification as provided in the plans, station/alignment, offset, and elevation. The VWRE shall be located to an accuracy of 0.01 ft (both vertically and horizontally). Establish the benchmark on stable ground that is not subject to settlement and is typically located away from any earthwork/construction activities.

5.7. Protect VWRE locations from damage and vandalism for the duration of the Contract and repair or replace damaged or inoperative VWREs at no cost to the Department.

6.0 ABANDONMENT OF VWRE

6.1. Once the GEOR has determined that the VWRE systems have served their purpose and are no longer needed, the VWRE systems shall be abandoned in-place. Remove recoverable portions of the VWRE. All recoverable instrumentation shall remain property of the Contractor. Remove no more than 2 feet of the conduit that extends into the embankment and seal the conduit left in place within the embankment using a lean grout mix.

7.0 METHOD OF MEASUREMENT

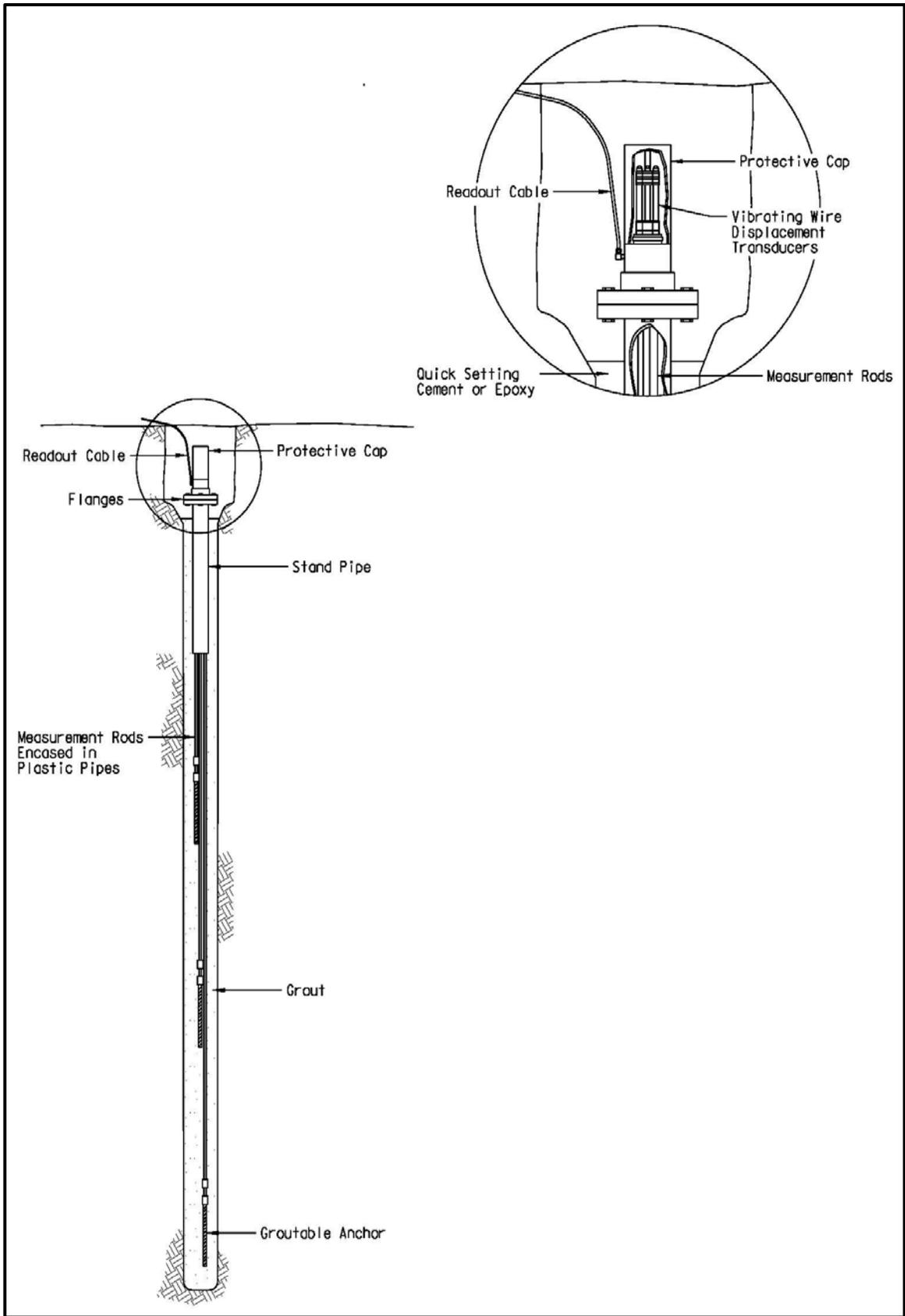
7.1. The number of VWRE provided in the plans, will be paid for at the contract unit price bid for "Vibrating Wire Rod Extensometer" which shall include all equipment, including but not limited to the VWRE including Excel® spreadsheet, water proof casing; mobilization; labor; surveys; materials; incidentals and abandonment required by these Specifications along with VWRE data as outlined in the Geotechnical Instrumentation and Monitoring Plan. Payment will not be made for VWREs that malfunction or are rejected for their inability to perform, or do not meet the requirements in the plans and these specifications.

8.0 BASIS OF PAYMENT

8.1. The price and payment for this work shall be full compensation for furnishing the necessary data logging system, enclosure, protection from vandalism and construction equipment, data as outlined in the Geotechnical Instrumentation and Monitoring Plan, and incidental items based on the successful implementation of the VWRE system.

8.2. Payments shall be made under:

| Item No. | Pay Item | Pay Unit |
|-----------------|--|-----------------|
| 2038140 | Mon. Device - Vibrating Wire Rod Extensometers | EA |



Note: Only 3 rods are shown for clarity

Figure 1