

## **GLOBAL POSITIONING SYSTEM MACHINE CONTROL GRADING**

### **Description:**

This specification contains the requirements for grading operations utilizing Global Positioning Systems (GPS).

The Contractor may utilize grading equipment equipped with GPS machine control systems to perform the excavation and embankment for this project as indicated on the plans. Use of this procedure and equipment is intended for grading the subgrade surface; it is not intended for the use in constructing final surface grades.

The Plans indicate the areas of the project where roadway construction may be accomplished with GPS machine control techniques. All other areas shall be constructed with conventional survey techniques unless the contractor chooses to build the required surface model to facilitate GPS machine control grading for those areas at no additional cost to the Department.

The Contractor may use any type of GPS machine control equipment and system that results in achieving the grading requirements outlined in section 202 of the standard specifications. The Contractor shall convert the electronic data provided by the Department into the format required by their system. The Department will only provide the information outlined in this document and no additional electronic data will be provided.

### **Materials:**

All equipment required to perform GPS machine control grading, including equipment needed to verify the work, shall be provided by the Contractor and shall be able to generate end results that are in accordance with the requirements of Division 200 – EARTHWORK of the Standard Specifications.

### **Construction Methods:**

#### **a. DelDOT Responsibilities:**

1. The Department will set initial vertical and horizontal control points in the field for the project as indicated in the contract documents, (plans set). If the contractor needs to establish new control points they shall be traversed from existing control points and verified to be accurate by conventional surveying techniques.
2. The Department will provide the project specific localized coordinate system.

3. The Department will provide the data listed below in an electronic format to the Contractor.
  - a. The information provided shall not be considered a representation of actual conditions to be encountered during construction. Furnishing this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered including, but not limited to site visits, and basing the bid on information obtained from these investigations, and the professional interpretations and judgments of the Contractor. The Contractor shall assume the risk of error if the information is used for any purpose for which the information is not intended.
  - b. Any assumption the Contractor makes from this electronic information shall be at their risk. If the contractor chooses to develop their own digital terrain model the Contractor shall be fully responsible for all cost, liability, accuracy and delays.
  - c. The Department will develop and provide electronic data to the Contractor for their use as part of the contract documents. The Contractor shall independently ensure that the electronic data will function in their machine control grading system.
  
4. The Files that are provided were originally created with the computer software applications MicroStation (CADD software) and INROADS (civil engineering software). The data files will be provided in the native formats and other software formats described below. The contractor shall perform necessary conversion of the files for their selected grade control equipment. The Department will furnish the Contractor with the following electronic files:
  - a. CAD files
    - i. Inroads- Existing digital terrain model (.DTM)
    - ii. Inroads- Proposed digital terrain model (.DTM)
    - iii. Microstation Existing and proposed surface elements – triangles
  
  - b. Alignment Data Files:
    - i. ASCII Format
  
5. The Engineer may perform spot checks of the Contractor's machine control grading results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines that the work is not being performed in a manner that will assure accurate results, the Engineer may

order the contractor to redo such work to the requirements of the contract documents, at no additional cost to the Department.

## **B. Contractor's Responsibilities**

1. The Contractor shall provide the Engineer with a GPS rover and Automatic Level, for use during the duration of the contract. At the end of the contract, the GPS rover and Automatic Level will be returned to the Contractor. The Contractor shall provide a total of 8 hours of formal training on the Contractor's GPS machine control system to the Engineer and up to three additional Department appointees.
2. The Contractor shall review and apply the data provided by the Department to perform GPS machine control grading.
3. The Contractor shall bear all costs, including but not limited to the cost of actual reconstruction of work, that may be incurred due to application of GPS machine control grading techniques. Grade elevation errors and associated corrections including quantity adjustments resulting from the contractor's use of GPS machine control shall be at no cost to the Department.
4. The Contractor shall convert the electronic data provided by the Department into a format compatible with their system.
5. The Contractor understands that manipulation of the electronic data provided by the Department shall be performed at their own risk.
6. The Contractor shall check and if necessary, recalibrate their GPS machine control system at the beginning of each workday in accordance with the manufactures recommendations, or more frequently as needed to meet the requirements of the project.
7. The Contractor shall meet the accuracy requirements for the subbase placement as detailed in the Standard Specifications.
8. The Contractor shall establish secondary control points at appropriate intervals and at locations along the length of the project. These points shall be outside the project limits and/or where work is performed. These points shall be at intervals not to exceed 1000 feet (300m). The horizontal position of these points shall be determined by conventional survey traverse from the original baseline control points. The elevation of these control points shall be established using differential leveling from the project benchmarks, forming a closed loop. A copy of all new control point information including closure report shall be provided and approved by the Engineer prior to construction activities. The contractor shall be responsible for all errors resulting from their efforts and shall correct deficiencies to the satisfaction of the Engineer and at no additional cost to the Department.

9. The Contractor shall preserve all reference points and monuments that are identified and established by the Engineer for the project. If the Contractor fails to preserve these items the Contractor shall reestablish them at no additional cost to the Department.
10. The Contractor shall at a minimum set hubs at the top of finished grade at all hinge points on the cross section at 500 foot (300 m) intervals on the main line and at least 4 cross sections on side roads and ramps as directed by the engineer or as shown on the plans. Placement of a minimum of 4 control points outside the limits of disturbance for the excavation of borrow pits, Stormwater Management Ponds, wetland mitigation sites etc. These control points shall be established using conventional survey methods for use by the Engineer to check the accuracy of the construction.
11. The Contractor shall provide control points and conventional grades stakes at critical points such as, but not limited to, PC's, PT's, superelevation points, and other critical points required for the construction of drainage and roadway structures.
12. If the Contractor makes any changes to the final surface during construction then he/she shall provide the Engineer with electronic as-built construction data for the final roadway surface in DTM format compatible with the latest version of Inroads Survey Select CADD.
13. At least 2 weeks before the preconstruction meeting, the Contractor shall submit to the Engineer for review a written machine control grading work plan which shall include the equipment type, control software manufacture and version, and proposed location of the local GPS base station used for broadcasting differential correction data to rover units.
14. The Contractor shall follow the guidelines set forth in the "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques" and follow a minimum of Second Order Class 1, (2-I) classification standards.

**Method of Measurement:**

No measurement.

**Basis of Payment:**

No payment.