

## SECTION 710 Construction Surveying - General

*CMM provisions mobilized by the contract:*

CMM 710.3.....**construction data packet**

*Revise the CMM provisions mobilized by the contract text box to change wording from contractor to construction data packet.*

### 710.1 Responsibility for Surveys

Generally, construction survey work will consist of setting the construction stakes necessary for field control and layout. It will include setting stakes or marks to establish alignment, grade, and slopes for grading the roadway, ditches, and channels; to designate limits of right-of-way; to establish alignment and grade for base and surface courses; and to establish location, grade, and alignment of structures. Construction survey work will also consist of taking measurements, such as cross sections or a digital terrain model (DTM), for determining quantities of work.

The engineer is directly responsible for the construction survey work. Regardless of how the survey crew is organized administratively, the engineer must have full knowledge of methods used and results accomplished.

The engineer, by means of the survey crew, will furnish and set the initial stakes for establishment; however, standard spec 105.6 provides that the contractor will furnish such other facilities and labor the engineer may deem necessary for setting stakes or points after work has begun. The contractor is required to furnish all stakes and other material necessary to preserve and protect stakes or points. The contractor must furnish and set all additional stakes or markings necessary to transfer alignment or grades from the controlling stakes or points established by the engineer.

If any survey monuments stakes set by the department are carelessly or willfully destroyed or disturbed by the contractor, the cost of replacement by the department may be charged against the contractor and deducted from the next payment.

Attention should be directed to safety of the survey crew when performing survey work, especially where work is subject to public traffic or construction machinery movements. The crew chief is responsible for implementing and maintaining safe procedures on survey work and for ensuring proper use of safety measures such as hard hats, safety vests, warning signs, flags, paddles, etc.

Construction survey work done by the contractor, or by a consultant engineering firm retained by the State or by the contractor, must adhere to and meet the same standards under which department personnel operate. It will be the responsibility of the engineer or designated inspector to randomly check the survey work of the contractor or consultant to ensure that qualified personnel have been retained and are performing competently.

### 710.2 Coordination with Contractor's Operations

*Revise 710.2 to change wording from contractor to construction data packet.*

The survey work must be planned and accomplished with due regard for the expediency and accuracy of the work under the contract. To avoid delaying the contractor's operations due to lack of staking, complete as much of the survey work and staking as is practicable before actual start of construction activities. Where staking is delayed or is required subsequent to start of contract operations, setting of stakes should be in accordance with the sequence of the contractor's plan of operations.

The engineer and members of the engineer's staff responsible for staking should confer with the contractor's superintendent concerning the method of staking to be used, how stakes will be marked and guarded, offsets, spacing, etc. Information to be placed on stakes, abbreviations to be used, location of message on stakes, etc., should be carefully established so no misunderstanding or misinterpretation will result.

Staking may be one of the items discussed at the preconstruction conference. A **construction data packet** will be made available at the preconstruction conference to facilitate staking operations.

*Requirements for documentation of supplemental control as prescribed in 710.3, table 710-1 are called into the contract by standard spec 650.3.12.*

### 710.3 Construction Data Packet

*Revise 710.3 to change title wording and wording within subsection from contractor to construction data packet.*

The **construction data packet** consists of digital files prepared by the project designer. The packet contains survey information and existing and proposed design files based on the project type. The data in the **construction data packet** is only provided for the contractor's general knowledge and is not a part of the construction project contract. The department assumes no responsibility for discrepancies between

the data provided and the contract documents. Table 710-1 provides a list of data types, submittal requirements, data formats, the person responsible for survey data and links to FDM procedures and WisDOT forms to used.

**TABLE 710-1 Existing and Proposed Design Data Files**

Item	Format	Responsible party	Comments
Provide a copy of all digital data to contractor	Digital	Design engineer	Refer to <a href="#">FDM 19-10-43</a> attachment 43.1 for the list of files to be provided and acceptable formats.
Complete <a href="#">DT1291</a> U.S. Public Land Survey Monument Record	Digital & paper	Contractor (RLS required)	The form must be completed by a registered land surveyor (RLS) under contract to perpetuate landmarks on the project.
Complete <a href="#">DT2262</a> Control Survey Station Record	Digital & paper	Contractor	The form must be completed by surveying contractor to graphically document new horizontal control set in the field.
Complete Contractor Staking Data Record	Digital & paper	Contractor	
AMG Construction model	Digital	Contractor	Refer to <a href="#">standard specification 650.3.1.2</a> Automated Machine Guidance for delivery guidelines

Survey information on paper will be placed in a folder labeled with "Project name, Project ID, "Survey Information - Keep in Field Office when not in use of - DO NOT LOSE!".

Not all projects will require all categories of data. Refer to [FDM 19-10-43](#) for details regarding the categories of data and the recommended electronic project data by project type.

#### **710.4 Accuracy and Tolerance**

It is essential that work procedures in staking a project be conducted in a manner to avoid making mistakes and errors. Errors in staking may lead to additional expense for the project. It is necessary when staking structures, right-of-way, or other work requiring high precision, that the work be carefully done and rechecked before being released as final. It is assumed the crew chief is familiar with methods and procedures in staking; however, concurrence as to method and procedure must be obtained from the engineer before the start of staking operations. To promote efficiency and accuracy in the work, each member of the survey crew and especially new members should be explicitly instructed in the proper manner and method of taking measurements and setting stakes. The engineer must make periodic observations and checks on the work to ensure the survey work proceeds properly and conforms to the accuracy required.

Basic horizontal and vertical controls are to conform to recognized accuracy. Refer to [FDM 9-35-5](#), and [FDM 9-40-5](#) for orders of accuracy. Other construction stakes should be set to an accuracy corresponding with their use.

It is generally accepted the error of closure in establishing or checking an intermediate benchmark be not more than 0.02 ft (6 mm), while for other level work such as taking cross sections or setting grade and slope stakes and similar work, an error of closure on a bench mark of 0.05 ft (15 mm) is allowable. Under circumstances where it is not considered to be critical to the work, a greater error of closure may be allowed.

Generally, level rod readings should be taken to the nearest 0.01 ft (3 mm) in setting grade for forms, structures, and pavements; to at least the nearest 0.05 ft (15 mm) in setting sub-grade and base stakes; and to the nearest 0.1 ft (30 mm) when reading ground elevations for cross sections and setting slope stakes.

#### **710.5 Care of Equipment**

The global positioning system (GPS) equipment, total stations, theodolites, transits, and levels used on construction survey are precise instruments and are expensive. The retention of their value and the results of the work depend to a large degree upon proper care and functioning of these instruments. Proper care must be exercised when handling and transporting surveying instruments to protect from

possible damage. Survey equipment should never be left unattended when in use. When not in use, equipment should be stored in a secure and locked location.

Instruments should be cleaned, checked and adjusted for accuracy frequently to ensure proper working order. Procedures for checking instruments and making the necessary adjustments may be found in most surveying manuals. Pamphlets containing methods and procedures for proper adjustment of instruments may be obtained from manufacturers of surveying equipment through the region office.

## **710.6 Survey Notes and Records**

### **710.6.1 Data Records**

*Revise 710.6.1 to change wording from contractor data package to contractor staking data packet.*

In general, all measurements and calculations of contract quantities must be accurate. Both hard copy and electronic records of contract quantities must be complete and detailed enough to sustain an audit, and records of all activities pertaining to the contract must contain sufficient detail and must be clear enough to be read and understood by any one unfamiliar with the contract. Refer to the section of this chapter, which includes a list of forms and digital data to be completed by the contractor.

All construction survey notes covering alignment, bench levels, cross sections, grade stakes, slope stakes, stakes set for structures of all types, and any other survey work related to the construction of the project should be recorded in standard notebooks (as well as electronically, when possible in the AASHTO Survey Data Management System (SDMS) or CAiCE archive format) at the time of performing such survey work and should become part of the **Contractor Staking Data Packet**. Cross section notes to be processed electronically may be recorded, as the sections are taken, on forms provided for that purpose and slope stake notes may be entered on appropriate computer tabulation sheets, but preferably this will be recorded electronically as the data is collected.

Survey notes should be accurate and legible and should be recorded in a neat, orderly manner. Information should be provided to show a complete record of the survey work. Each notebook should bear the identification of the project, the date, and the survey crew personnel. Large projects will require separate books for alignment, level work, slope staking, grade staking, staking of structures, etc.; while for small projects, two or more phases of the survey work may be recorded in separate sections of a book, depending on the space required.

The alignment book should show complete information for the construction centerline or other lines run, including any errors found in angles or distances and corrections made and reference ties to control points. The level book should show level checks run on existing benchmarks and should include any errors found and corrections made. It should also show descriptions of new benchmarks established at structures, or to replace those that will be disturbed during construction. A record should be made of all grade stakes set, showing the level runs, established grade, and rod readings on the stakes.

### **710.6.2 Data Submittal**

Upon completion of the project, all survey notebooks and disks of project information/data should be assembled in an orderly manner and sent to the engineer at the region office with the other project records. Raw data should be archived before making any changes or edits and should be included in the package.

Information and instructions for recording and submitting notes for electronic data processing are contained [CMM 165](#). Requirements for submittal of survey data may also be found in the contract special provisions.

Refer questions concerning data recording and submittal to the region survey coordinator.