DATA SETUP

OVERVIEW

NOTE: Refer to "Conventions Used in this Manual", in Chapter 1, for terminology used in this chapter and/or the order of precedence of contract documentation.

The modern Total Station, in advance of theodolites, chain measurements and the sizable labor required to make use of both tools, offers a new standard with servo-driven laser-measuring robotic tools that automate data collection and reduce the labor requirements to a single operator. Combined with Global Positioning Satellite (GPS), the Robotic Total Station completes a dynamic approach to construction survey. That twofold approach allows the surveyor some flexibility and convenient transitions between two methods of survey, all the while maintaining dependable accuracy.

The Total Station lacks the sophistication of GPS, in consideration of the complex computations for terrestrial solutions from orbiting satellites, but delivers efficient results with accuracy that is solely dependent on the equipment condition and user input. Simply put, the equipment will yield varying results based on the preparatory effort of the operator.

In this chapter, the user will find reference to essential quick-start routines that hasten the startup time of the Total Station and reduce prospective operational errors. The limited routines in this manual do not represent the entire arsenal of techniques offered by the Total Station. Therefore, the user is encouraged to explore their manufacturer's operating manuals and collector help screens to realize the full potential of these instruments.

DATA SETUP

For Desktop Software-Project Design Input: The central computer (office or notebook) is the hub for importing and exporting design data, or project data built from contract plans, into the data collector, which the surveyor then uses to stake or measure information in the field.

Monuments are typically taken from the contract plans under referenced datum, then researched in the NDOT Location Information System (LoIS) LPN files, and verified in the field.

997117 S Geodetic = 36-10-54.38842 -115-8-34.85322 UTM - 11 = 4005708.09 666989.67 State Plane = 26768083.37 786106.02 kf = 0.99991931 hf = 0.99990854 Ground = 26772821.32 786245.16	Ortho Elev = 2004.26 Ellp Elev = 1912.4 Geoid Ht = -91.86 Conv = 0-15-35.8 Sf = 0.99982786 Area CF = 0.9998230313	Display on Map V Datum = NAVD 88 H Datum = NAD 83/94 Zone = East(2701) Units = Feet Date = 6/26/2006	LPN 997 H-Acc = 0.05 H-Rel = GA V-Acc = 0.1 V-Rel = GP
FOUND 2" ALUM CAP REFERENCE MONUMENT, STAMPED: "RM, 11.64', 265.23' PLS 2002". LOCATED IN THE TOP OF CURB ON THE EAST SIDE OF "A" ST. AT THE NORTH SIDE OF THE DRIVEWAY AT 950 "A" ST.			

NOTE: The typical LoIS monument description contains the information above. The essential data is the Geodetic coordinates, Ground coordinates, and Ortho and "Elip" (Ellipsoidal) elevations. The V&H Datum references obviously need to fit the project datum. The user is encouraged to explore these LPN folders and seek the "help" sections for further explanations.

The Survey software typically has a "Points Management" function that allows the user to insert northing, easting, and elevation data. Those points, when entered as such, usually display on the software's main screen, where "view" functions render point labeling for easier screen identification. To reduce entry errors, the use of the "cut and paste" entry method is highly suggested in comparison to the tedious keypad entry.

In concern of GPS points for calibrations, LoIS Longitude and Latitude (Geodetic) data can be copied and pasted with minor alterations to the Longitude and Latitude, where in LoIS they display as: Latitude; 36-10-54.38842, but enter as 36.105438842 and Longitude; -115-8-34.85322 but enter as 115.083485322 (note the 8 in the longitude minutes are entered "08" when less than 10).

- Road Alignment and Vertical Profile: The software typically allows for horizontal and vertical alignment.
- Information input, where either electronic design files are imported into the routine or the user manually inputs alignment data from the contract plans.
- Typical Section Template Data: The vertical profile information adds the dimensional aspect of a surface relative to the planned or existing roadway. Using the contract plans, cross sectional templates are built using subgrade depth, cross slope, shoulder cuts or fills, shoulder width, ditch elevation, and back slope data. With this information in the data collector, the surveyor will have instantaneous cut or fill information and the preparatory slope staking effort is minimal.
- Surface Datum: Surface data for the contract is obtained by two main methods. First, the contract may have design information derived from aerial mapping which contains accuracy to within .3 to .4 ft. The second method is by cross section, where the survey crew performs a preliminary grid collection of elevations within the roadway limits.
- Stakeout Data Input: Once all roadway alignment information and design surface data has been input into the desktop software, the data then must be downloaded to the data collector for field staking and compilation.
- Drainage Stakeout Data: Alignment, culvert dimensions, and flow line elevation data in the contract plans can build a drainage model that, when staked, yields accurate quantities of drainage excavation.
- Special Survey Data: Geographical Information Systems (GIS) data can be merged into survey data, where satellite imagery can be overlaid to show a road alignment in its actual environment.

NOTE: Refer to your equipment manufacturer's owner's manual for actual input methods. Software compatibility issues may require additional research and updates for accurate data management.

DATA COLLECTOR SETUP

The specifics of the data collector setup vary by manufacturer and model. Refer to Appendix A – Data File Management for the file/folder structure for survey data.

- Connectivity: The typical method of connecting the data collector and the central system includes USB/ USB mini-B, Bluetooth, and Wi-Fi. The user will need to ascertain the most effective way to transfer files within the environment provided.
- Memory and File Considerations:
  - Memory of late is readily available, but the user should consider collector capacity in heavy staking and collection conditions.
  - Roadway sections, as in the plans, need different file associations. Slope staking, drainage items, aggregate base section staking (redheads and blue-tops), curb-and-gutter, asphalt, PCCP, electrical items, and even permanent striping all need file names that isolate daily stakeouts and collection.
- On-board data collector operating systems typically allow for temporary contract information storage. Your collector file system centers on the limits of the operating software, the survey standards for data storage, and ultimate compatibility for differing users.
- Download Daily Stakeout: The central computer being the hub for contract data manipulation is the starting point for the surveyor's workload. To prevent recovery issues, the tasks for the day should be downloaded and uploaded accordingly for minimal memory usage.

- Collection of Data: Feature codes and terrain strategies lend to the methodology the user employs into data collection (e.g., a cross-section of a road may involve original ground, curb and gutter, utility accesses, and asphalt. The user may want to survey one component at a time, and thus reduce constant and error-prone toggling of feature code selections). Refer to file:\\datsrv1\017Public\FeatureCodeLibraries\SUE for more information.
- Backup, Protection, and Uploading Data to Desktop: The user is cautioned that all electronic devices are prone to catastrophic failure and that a backup system should be in place for daily protection of data files.

TOTAL STATION CONFIGURATION

The electronic manipulation of any survey equipment starts with the data collector. The Total Station is configured by the data collector through specific setup routines that reside in the collector's software. Permanent survey style settings such as model type, communication frequencies, laser specifications, prism specifications, and instrument properties are typical data collector inputs. Setup information regarding atmospheric conditions, setup point coordinates, backsight coordinates, instrument height, and prism height are data collector settings made upon the onsite initialization of the instrument.

A significant instrument setting is the Direct Reflex (prismless) configuration that involves reflected laser measurements to any surface that has sufficient characteristics of reflection. The resulting rectangular coordinates can be used to model the surface irregularities. In this situation, the operator is controlling the survey solely through the data collector and without a need to leave the instrument. (Refer to "Surface Scan", in Appendix B for the Data Collector and instrument Direct Reflex settings.)

The operating manuals and help screens will always be the definitive source for the information regarding the configuration of the Total Station.

TOTAL STATION SETUP

The Total Station will be used in a variety of setup situations. In order to ensure efficient results, some key elements such as the tripod used, the power sources, and cable connections need to be addressed.

Tripod - Out of the case, the immediate requirements for the Total Station center on the platform that the instrument will be mounted. A sturdy tripod is an essential piece for the operation of the equipment, where fluctuations in the leveling of the instrument will be problematic. Most instruments will cease operation, shutdown the instrument, and require a re-initialization if the leveling is out of balance.

Power. A typical Total Station lists a multitude of battery requirements for their equipment, such as the instrument, the prism pole, the radio, and for any long-range transistorized prisms. Most manufacturers offer a variety of ways to power the instrument by means of close proximity connections to a vehicle or by batteries in remote areas away from road access. Recharging of remote power sources can be completed either in the vehicle or in the field office. Strict adherence to the manufacturer's requirements will yield the most usage out of these expensive batteries. It is recommended that backup batteries be on hand for all equipment and for any unforeseen remote operations.

Connections. Manufacturers are compelled to realize profit through accessories. The cables required to connect a Total Station to various components represents a myriad of specificity. Seldom do the data cables of one manufacturer fit the data ports of another. With that added uniqueness, having connection problems in remote terrain is not a pleasant experience for anyone. The protection of these specialized cables is paramount, as replacement cables, due to their specialty, carry robust pricing.

Beyond the elements mentioned above, Total Stations are delicate optical equipment that will always need periodic recalibration. These recalibrations are best handled through a local manufacturer's repair center. Internal batteries often need changing as well. The repair center is the best source for the restoration needs of your individual equipment, as warranties can be voided if the user attempts an unauthorized repair.

The following list is a basic approach to general instrument setup in the field:

- Set and rough-level the tripod
- Mount and bubble-level the instrument (or tri-bracket)
- Rough center the instrument over the control point (plumb bob)
- Connect power to the instrument
- Connect the data collector and initialize the instrument
- While in sync with the collector, fine-level and then re-center the instrument
- Set the local atmospheric conditions (temperature, barometric pressure, etc.)
- Initialize the station setup
- Initialize a robotic survey
- Disconnect the data collector
- Reconnect the data collector to the prism pole mounted radio
- Establish remote radio communications with the instrument radio
- Begin the survey under robotic conditions
- Open a project file in the collector and stake points or accumulate data as needed

TOTAL STATION ROBOTIC SURVEYS

During stakeout, the robotic operation of the Total Station is controlled remotely via radio communications to the instrument from the prism pole-mounted data collector. Line of sight obstructions and long distant operations will affect the distance measuring and reception abilities of the communication equipment. The surveyor needs to assess his operating environment and plan for obstructions accordingly. The plan of attack may include the setting of additional construction control to avoid obstructions and reduce extensive distances between the prism and instrument.

The operator is reminded that Total Stations are not fool proof and when operating at great distances in robotic mode, the instrument can lose track of the prism target. Electronic “long-range” prisms help in target relocks by signaling their location when the telescope is within a few degrees of the target. Another search feature allows the operator to engage the instrument into a predefined scan to relocate a lost target. If all else fails, the operator can have the instrument return to the previously staked point for relock or have the instrument turn a certain angle to relock.

During robotic operations, the data collector provides basic audible and symbolic instructions that readily indicate direction and walking distance to reach the intended stakeout point. The typical data collector has several icons of significance during a remote operation. The operating manuals and help screens will always be the definitive source for the information on these collector screens.