OVERVIEW

If necessity is the mother of invention, then the invention of the Total Station robotic instrument truly fits the requirements of the necessity. This powerful engineering tool performs the work of a five-man survey crew, is twice as accurate, and reduces tedious errors in time-consuming data collection. Unlike Global Positioning Satellite (GPS), the equipment offers pinpoint precision in severe environmental conditions, where satellite radio crosstalk interference and overhead obstructions commonly renders a GPS useless.

The instrument is based on older theodolite technology that was eventually enhanced by laser or electronic distance measurement (EDM) and internal motor driven components that made remote operation possible through local radio control. That remote operation allows the instrument operator the luxury of hands on survey, where a physical presence at the point of stakeout had always been desired.

Figure 5-1: Trimble 5600 Robotic Total Station

The advances in distance measurement capabilities have led the surveyor to the world of “Prismless Survey”, where the instrument can now perform measurements from afar and out of the hazards of heavy traffic conditions. Prismless survey is a great tool for surface scans, where the extremities of an existing surface are input through the data collector software, and the instrument takes robotic observations in a grid pattern. Those collected observations can be used to create 3D surface models.

LIMITATIONS

The limitations of the Total Station are based on the manufacturer's model specifications and the geographical nature of the intended survey location.

Manufacturers build differing features into their equipment, where degree of accuracy, distance measuring, robotic controls, communication features, convenience features, telescopic options, durability, and battery life are options the user needs to consider prior to the final purchase. The daily needs, future needs, and equipment upgrade capabilities to meet those needs are all parameters the consumer should consider prior to committing to one piece of equipment.
Geographical limitations, such as physical obstructions, will limit the user's production. A construction survey conducted in rugged well-vegetated terrain will force tedious breakdowns and setups of the equipment to remain clear of obstructions. Telescopic limitations in this type of terrain and the effects of heat shimmer make long observations difficult.

The Total Station also has minor measurement limitations, where the distance between the prism target and instrument, prism configurations, temperature, common foliage, weather conditions, and prism characteristics all effect measurement characteristics. Long-range prisms have expanded the length of observation capabilities. The overall range is determined by the manufacturer's specifications, where the Trimble 5600 and a single long-range prism yields distances to 16,400 ft maximum.

Power options in relation to the locations of the planned instrument setup are another concern. In rural areas, where the user's vehicle is nearby, DC connections can power the equipment from a simple cigarette lighter or alligator clips to the vehicle battery. In remote areas, portable rechargeable power packs or gel batteries are transported to the setup site and the day's survey production is based on that collective stored power.

The time of day is typically not a problem for a Total Station. Many models come with illumination features that allow nighttime usage. The data collectors are backlit as well, so the surveyor can operate twenty-four hours a day if the power is available.

**ESTABLISH LOCALIZED CONSTRUCTION CONTROL**

In relation to geographical limitations, the establishment of localized construction control can aid greatly in the reduction of numerous equipment movements.

The Total Station has the edge over GPS in elevation precision, so the surveyor will want construction control in the areas of ditch work, culvert pipe, reinforced concrete boxes, traffic signals, curbs, valley-gutters, stockpiles, and any area of redundant surveys. The prudent surveyor performs a reconnaissance of these areas of construction and physically walks the contract to assess where the Total Station setups will yield the most productive shots.

To maintain accurate coordinates and elevations, the surveyor most likely will field-calculate and traverse in these points from project monuments. Their locations will be in areas of extreme activity, so protection is a priority and is enhanced through conspicuous delineation by means of bold colored ribbons and brightly painted lath. The preferred location for these points is near existing utility poles or in areas designated as "Not to be Disturbed".

Time saving efforts, made early in the contract, will help avoid the ever-wandering contractor's penchant to mysteriously find and destroy your construction control points.

All data collected can be uploaded and processed in the respective office software for further distribution to field personnel, the contractor, various engineering factions, or Engineer of Record.

**LOCALIZED DRAINAGE CONTROL**

As previously mentioned, the presence of control near drainage construction provides the surveyor a reference to quickly check initial offset stakeout points, flow line grade, drainage excavation quantities, elevations of existing connection sections for tie-in, potential utility conflicts, and as-built conditions. The Total Station is an invaluable tool for these areas of need. All data collected can be uploaded and processed in the respective office software for further distribution to field personnel, the contractor, various engineering factions, or Engineer of Record.
MISCELLANEOUS CONSTRUCTION CONTROL

This topic essentially reminds the surveyor that rare circumstances may dictate the need for control outside the normal lines of stationing and elevation references. Items like existing utility locations, where manhole covers, valve covers, and junction boxes may be in need of relocation after construction and paving operations. Control may be simple ties to undisturbed curb and gutter or extensive coordinate references topographically depicted in a 3D model.

Either process involves a preliminary or detailed walk of the roadway, with thorough identification or inventory of the facilities (utilities) in place. The Total Station can be setup in intersections, and with robotics, the remote operator can be physically at the utility and enter feature codes (description) data accordingly. Refer to file:\datsrv1\Public\FeatureCodeLibraries\SUE for more information.

MATERIAL PIT CROSS SECTIONS

Prior to the start of the contract, the survey crew typically accesses the material pit of intent and performs a cross section for a model of existing pit conditions. The pit model is based off construction control from the roadway monuments, section corner monuments, or a surveyor placed take-off point with an assumed elevation and coordinates. The problem with the latter control is the data lacks a true reference to existing topography.

Once a protected control point is established, the Total Station can be set to use either remote or scan shots. The surface scan feature is a valuable tool in pit assessment conditions. (Refer to “Surface Scan”, in Appendix B, for more information.) The surveyor cross sections the pit for a 3D model and after material production is ceased, the surveyor can re-cross section the identical grid patterns and compare the original surface to the excavated surface. The office software can create an instantaneous report that represents a comprehensive volumetric account of quantities used.

The scanning feature is also a great tool for stockpile assessment. Accuracy is dependent on the shape of the material piles, and the contractor should be made aware that uniformity in his stockpile would aid in any payment resolution.