WHITE PAPER

TRIMBLE ENGINEERING SOLUTION – TUNNELS AND MONITORING

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INTRODUCTION

The Trimble offering of solutions for engineering applications allows you to broaden the horizon of your surveying business. With a full range of new tools, Trimble enables you to bid on and perform jobs previously inaccessible to you with minimal investment and a very short learning curve. The following engineering applications highlight tunneling and monitoring solutions.

TUNNELS

As a part of the Engineering Option for Trimble Survey Controller™ (PN 90100-02 or 90100-03), you'll have access to a workflow for automatic profile measurements and review of tunnels. To be able to use this functionality, you'll need to order the engineering option for Trimble Survey Controller and have version 12.20 or later installed on your controller.

You can bring a tunnel model into the software in one of two ways; either key it in through an intuitive workflow or import a LandXML file, e.g. from AutoCAD or Microstation, with a tunnel definition.

The tunnel file format created in Trimble Survey Controller is similar to the .rxl file format for roads but is instead called .txl. It can be used within the software in a similar fashion to the road format and can be shared between multiple jobs and controllers.

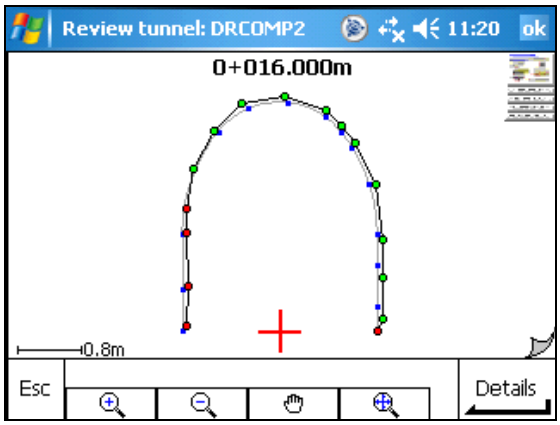


FIG 1. SCREEN SNAP OF THE TUNNEL REVIEW SHOWING POINTS OF OVER- AND UNCERCUT ON THE SCREEN OF THE CONTROLLER.

Once the tunnel is on the controller, you can set up your instrument and automatically scan cross-sections of your tunnel at given stations or intervals. This procedure is fully automated and requires no input from the user after the measurements have been initiated. In the tunnel shown in the picture below outside of Christchurch in New Zealand, the Trimble S8 Total Station needed about one minute per cross section with 17 points.

The software will graphically highlight what has been scanned – together with over- and undercut and the measurement points – compared with the model.

Once the measurement is done you can easily review the tunnel directly on the controller. Areas of over- and undercut can easily be re-measured using the graphical representation on the screen.

MONITORING

The second component of the Engineering Option in Trimble Survey Controller is the monitoring extension to the Rounds program. This works with any supported total station, but for optimal performance, it's highly recommended to use together with the Trimble S8, which features FineLock. You can read more about the FineLock feature of the Trimble S8 below.

DATA COLLECTION FOR MONITORING APPLICATIONS WITH TRIMBLE SURVEY CONTROLLER

The monitoring extension to Trimble Survey Controller is located in the software's well-known Rounds Program.

On your first visit to a site with targets that need to be monitored over time, your crew can use the Trimble Survey Controller Rounds Program as normal, manually aiming to each target with the Total Station. If you have a Trimble S8 Total Station you can use the FineLock feature in rounds.

Once this first round is observed, the targets can be exported to a .csv file.

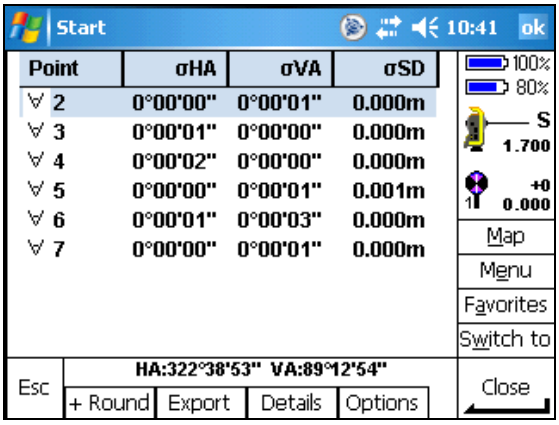


FIG 2. ONCE THE FIRST ROUND IS COMPLETED, YOU HAVE THE OPTION TO EXPORT THE TARGETS TO A TARGET FILE USING THE "EXPORT" SOFT BUTTON AT THE BOTTOM OF THE SCREEN

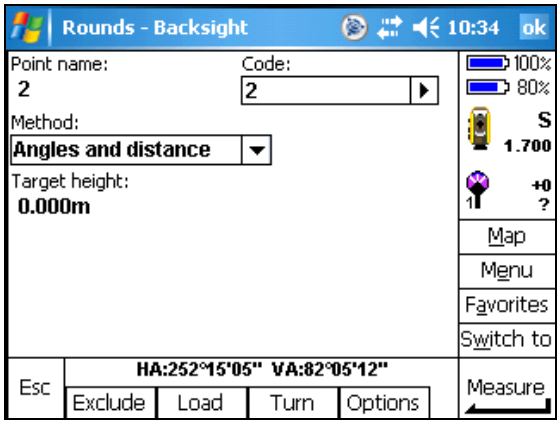


FIG 3. WHEN YOU HAVE A TARGET FILE AVAILABLE YOU CAN EASILY LOAD IT FOR A SECOND ROUND ON THE SAME SITE USING THE "LOAD" BUTTON WHEN YOU START A NEW ROUND.

This file, which stores information about target locations, types, prism constants, and heights, can be used in a different job or exported to another controller for later use.

When you come back to the same site the next time you no longer need to manually aim to each individual target. You need to set up the instrument in the same coordinate system as the first time but then, the only step is to load the previously created target file. On a site with several setups and hundreds of targets, you can save a lot of time using this new workflow. Thanks to the Trimble S8 and FineLock, which finds the target even if you can't see it, you can even visit the site in the dark and still get the measurements you need.

ANALYSIS AND REPORTING FOR MONITORING APPLICATIONS FROM TRIMBLE SURVEY CONTROLLER

Once a Monitoring round is complete and the data has been collected, it's possible to export basic reports directly from Trimble Survey Controller software using style sheets for basic analysis of the data. These are available on Trimble.com and on the Survey Controller CD. Copy the appropriate .xls file into the Trimble Data directory on your controller. Now, from the main menu go *Files->Import/Export->Export custom format files*. The style sheet you have copied is now available as a File format to choose in the form that appears.

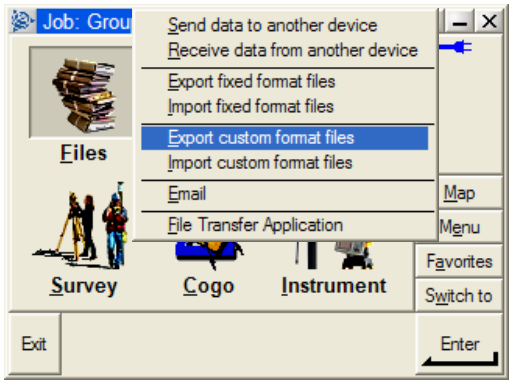


FIG 4. THE FUNCTION TO EXPORT A MONITORING REPORT FROM SURVEY CONTROLLER IS AVAILABLE DIRECTLY FROM THE MAIN MENU.

The specific style sheet for monitoring applications is called *Monitoring Report* and is available for download here: http://www.trimble.com/tsc_ts.asp?Nav=Collection-32914. Figure 5 shows what the export custom file format form in Trimble Survey Controller looks like with the monitoring report file format selected. Figure 6 is an example of what the report in html format looks like when viewed in the web browser.

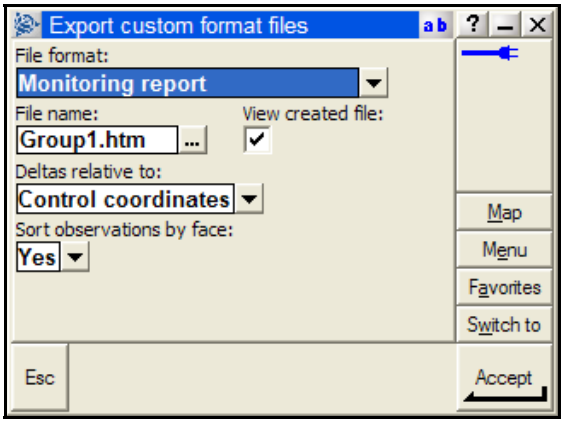
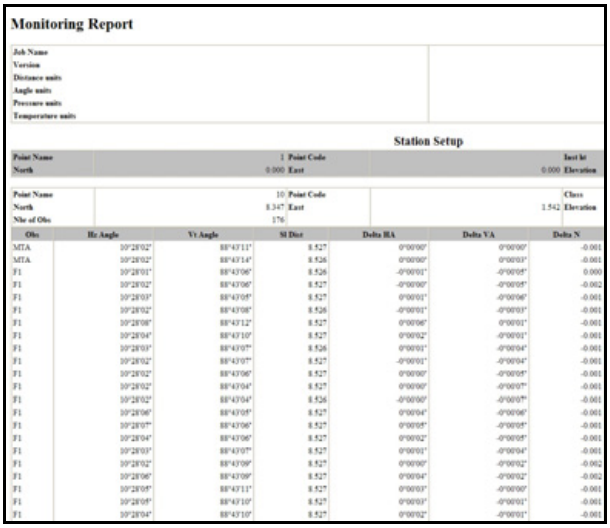


FIG 5. THE EXPORT CUSTOM FORMAT FORM IN TRIMBLE SURVEY CONTROLLER WITH THE MONITORING REPORT SELECTED AS FILE FORMAT.


Monitoring Report

Station Setup

FIG 6. AN EXAMPLE OF A MONITORING REPORT IN A WEB BROWSER.

New style sheets may be uploaded to Trimble.com at any time so make sure to check in on a regular basis.

However, for more advanced analysis, reporting and alarming, Trimble® 4D Control™ Software is the ideal solution. It offers much more monitoring-specific functionality than the simple reporting available through Survey Controller.

TRIMBLE 4D CONTROL

Trimble 4D Control is a crucial component in Trimble's new solution for engineering applications. It works in harmony with the Trimble S8 Total Station and Trimble Survey Controller field software to create a seamlessly connected system for applications such as tunneling and monitoring. Now your business can

expand beyond traditional surveying tasks into more specialized opportunities.

The Trimble 4D Control Standard package is office software that post-processes the data collected by total stations on monitoring or similar applications. It reads rounds imported from Trimble Survey Controller field software as individual sessions and reveals any movement of targets over time.

The terrestrial engine in Trimble 4D Control processes each session and validates the data. It then stores the point information together with the raw data. Other modules of the software use this data to create warnings and alarms, as well as graphs and reports, as seen in figures 7 &8. Multiple options for delivery of the information ensure that whatever you and your client need, Trimble 4D Control can deliver.

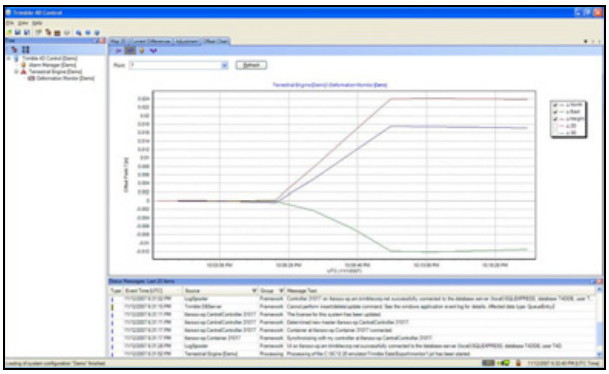


FIG 8. GRAPHICAL REPORT SHOWING DEFORMATION OVER TIME.

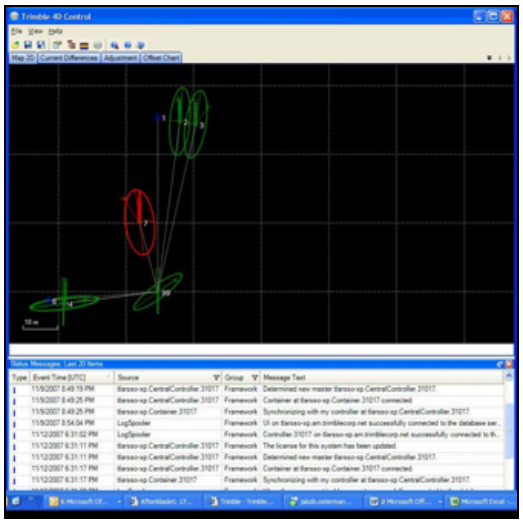


FIG 7. GRAPHICAL DISPLAY SHOWING NETWORK WITH ERROR ELLIPSES.

Trimble S8 Total Station€

The Trimble S8 Total Station features FineLock, which is an automatic aiming functionality ideal for monitoring applications. It is available as a measurement method when the rounds software in Trimble Survey Controller is run together with a Trimble S8 Total Station.

Similar to Autolock, FineLock technology is used to automatically aim the instrument towards a target, however in FineLock mode, the instrument uses a much narrower field of view when aiming at a target. This is especially useful in engineering applications such as monitoring and tunneling where passive targets with very tight spacing are used.