

THE

# The American Surveyor

A FOOT IN THE PAST... AN EYE TO THE FUTURE

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# CHECKING INDUSTRIAL EQUIPMENT TOLERANCES



A 3DIM Observer handheld computer is often used to control Sokkia motorized NET05AX or NET1AX total stations as they take reflectorless roundness and straightness measurements on cylindrical sections of wind energy equipment in Europe.



The wireless 3-DIM Observer handheld computer controls an automated total station by Bluetooth up to a distance of more than 100 meters. A common industrial application in Europe is viewing actual positions of parts on the screen while aligning them.



Fixed total station installations are used in bending machines to control the bending process using reflectorless scans of desired cross sections. Wireless control of instruments is performed by a remote computer.

In several European countries, citywide monitoring of infrastructure is commonplace and typically focuses on existing structures that are adjacent to new ones that are being constructed, e.g., tunnels. By locating the positions of various sections of existing structures every half-second—often through the use of high-precision automated total stations—surveyors can determine whether or not the existing structures are being displaced during the construction process. The result is potentially savings of not only money but, also, lives.

This extreme level of accuracy is also suitable for ultra-precise industrial measurement applications. Potential gains in safety are possible in this arena, as are improved operating performance, longer equipment life and a quicker return on investment. Three applications in particular have recently benefited greatly from monitoring.

### Wind energy industry

Since many offshore wind energy farms have to be commissioned on very tight schedules, equipment manufacturers need to minimize the time it takes to produce towers, monopiles and rotor blades, yet maintain the highest quality standards. Specific monitoring applications include concentricity measurements of flanges, geometry measurements of tower sections, linearity or straightness of towers or masts, assembly of towers or masts, automatic locating of hole patterns on blades or rotors, checks during production and dimensioning during the building phase.

GLM Lasermesstechnik GmbH, a provider of software and hardware and service for industrial surveying and measuring applications in Witten, Germany, reports that Sokkia motorized NET05AX and NET1AX total stations are in use in the production of many different wind energy

>> By Don Talend

power plants in Germany for years and in the United Kingdom and the United Arab Emirates since the beginning of 2011. The NET05AX denotes half-second angle accuracy and NET1AX denotes one-second angle accuracy.

These instruments feature auto-pointing that sights the prism closest to the telescope center, even if multiple prisms or reflectors are in the field of view, allowing the operator to measure on prisms and reflective tags automatically. The operator points the instrument in the general direction of the target and it automatically finds the target point and displays the result directly on the LCD screen. The auto pointing accuracy range is up to 3,500 meters (11,480 feet) with a prism and up to 400 meters (1,310 feet) reflectorless. Nominal coordinates can be saved in a template and the instrument searches for the first point from the list of coordinates, automatically monitors the center of the target and saves the results. The system either completes the measuring tasks or measures in continuous loops.

A 3-DIM Observer Motorized field logger and data collector depicts deviations from the nominal value and points exceeding the tolerance. GLM Lasermeßtechnik GmbH recently developed a new monitoring module for the unit. The 3-DIM Observer Motorized

features several menu items that suit monitoring of this application, such as automatic tracking of measuring points; automatic scanning of components with automatic target-actual analysis; automatic 3-D marking of nominal positions on curved surfaces; monitoring of structures or components; and positioning and position tracking of components.

For this type of monitoring application, fixed installations in bending machines are used to control the bending process according to reflectorless scans of the desired cross sections. The points are measured without the need for an operator to sight them. Wireless control of instruments is performed by a remote computer and ovality data are generated automatically.

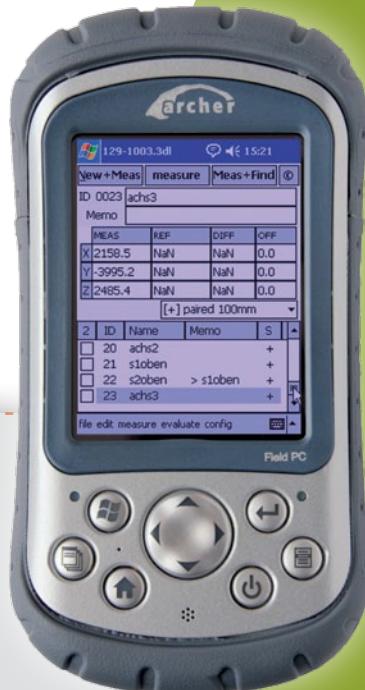
The 3-DIM Observer controls the instrument by Bluetooth up to a distance of more than 100 meters. Viewing actual positions of parts on the screen when the system is in tracking mode to ensure the alignment of parts can be very useful. Even if there is no direct line of site to the instrument, the operator can monitor the state of his work. The completely remote operation of the Sokkia NET05AX also allows touch-free operation, leading to accuracies typically in the range of 1/10 mm. One recent example of this industrial application was the successful setup and alignment

of high-accuracy portal drilling machines at Airbus industries near Bristol, UK.

In addition to 3D monitoring, the Sokkia NET-AX series has a 2D monitoring function specifically developed to reduce measurement time for real-time, 2D monitoring applications. The instruments can be operated by the external control system to quickly obtain vertical and horizontal angles to allow faster recognition of vertical and horizontal 2D movements.

Different onsite geometrical evaluations of installed equipment can be made on an Archer rugged handheld computer equipped with 3DIM Observer software. These include 3D stakeout, scanning and tracking.

Various geometrical evaluations can be made on site using an Archer rugged handheld computer equipped with 3DIM Observer software.



## ULTRA-PRECISE MEASUREMENT USING AUTOMATED TOTAL STATIONS, COMMON IN EUROPE, YIELDS A HIGHER RETURN ON INVESTMENT IN INDUSTRIAL EQUIPMENT.

## Aircraft construction

These total stations and the 3-DIM Observer Motorized suit aircraft construction. This combination of equipment has been used to assemble accessories and sections aligned in the direction of the axis.

When using a special target sheet (RT1A), alignment of the instrument is only possible with one known measuring point. Extended data flow capability is designed to simplify documentation. The data flows from the total station to the 3-DIM Observer-equipped field logger to the 3-DIM PC-Basic desktop software and, ultimately, to other commonly used software such as Excel.

This system represents a cost-effective alternative to the use of laser trackers, which are about four times as expensive.

## Shipbuilding

On such a large-scale, yet detailed manufacturing process, it makes sense to ensure precision of subassemblies

in order to ensure quicker lead times and lower assembly costs during final assembly. Monitoring can benefit unique aspects of shipbuilding:

- The geometry of components is often affected by the heat generated during welding. High-precision checks and comparisons after each production process can reveal the effects of welding. Reproducing components exactly is easier if the ramifications of welding shrinkage are known and corresponding countermeasures are put in place as early as the component design phase.
- The geometry of sections manufactured during prefabrication can be checked before final assembly as the linking of subassembled sections can be simulated by the 3D software before they are actually joined. This process can reduce expensive and time-consuming rework.

This application suits the Sokkia NET1200 or NET1 total stations equipped with 3-DIM PC-Basic.

The motorized automatic 3D Station NET1AX has an angle accuracy of 1 second (0.0003 gon) and is equipped with auto-pointing, auto-tracking, reflectorless measurements and wireless connection to the field data collector. An intelligent auto-pointing algorithm precisely determines the correct targets and prisms among many within range of the instrument. The new algorithm is capable of making automatic deformation measurements requiring the measuring of fixed targets at specific intervals around the clock.

A highly developed phase-comparison method is used for an extremely high degree of linear distance accuracy. RED-tech EX signal processing technology uses phase comparison and a process that allows for the analysis of four frequencies simultaneously. The integrated processor continuously compares thousands of measurements with the periodically processed data. Signal interferences due to atmospheric fluctuations or drop-outs due to obstructions are localized and eliminated. Only true data flows into the phase deviation calculation, the correcting quantity used to achieve optimal linear distance measuring values. Long ranges (e.g., reflectorless up to 200 m) make it possible to measure very large objects such as ship hulls. Typical linear distance accuracies to reflective targets and prisms are 0.3 mm and reflectorless measurements have typical accuracies of 0.5 mm.

The NET1200 can measure large structures such as ships, tunnels, buildings, bridges and domes in 0.1-mm resolution. The instrument incorporates an ultra-high performance EDM and reliable absolute encoders. The NET1200 has reflectorless measurement capability and 1 arc-second (0.3 mgon) angle accuracy.

The 3-DIM software is equipped with advanced test and inspection planning tools that suit this application, including comparison of measured to target values, data archiving in a database, and statistical analyses.

Don Talend of Write Results Inc., West Dundee, Ill., is a print and e-content developer specializing in covering technology and innovation.

The advertisement features a grid background with various survey markers and caps in different colors (yellow, orange, purple, silver) scattered across it. In the center is a circular badge with the text "The Landmark Name SURV-KAP® in Survey Products". Below the badge, the text "EASY ORDERING ONLINE!" is displayed in red, followed by the website "SURV-KAP.com" in large blue letters. At the bottom, the text "SURVEY MARKERS, CAPS AND ACCESSORIES • 800-445-5320" is shown. A gold seal with "SATISFACTION GUARANTEED" and "100%" is located at the bottom right.