100-Meter Underground Baseline for EDM Calibration

Calibration Facility for Electronic Distance Meters

The underground 100m rail baseline is located at the Matsuda plant in Japan, one of the major factories of SOKKIA TOPCON CO., LTD. This unique facility plays a significant role in precise calibration of electronic distance meters (EDM).
In addition to applications for R&D, manufacturing, quality assurance, servicing and maintenance, this facility is used to provide calibration services for the user EDMs in compliance with ISO/IEC17025:2005. EDMs calibrated in this baseline have legal traceability to Japanese and overseas standards, including NIST*1, through the ILAC-MRA*2.

Distance Meter Calibration Facility

*1 National Institute of Standards and Technology, USA
*2 International Laboratory Accreditation Cooperation's Mutual Recognition Arrangement

Traceability System

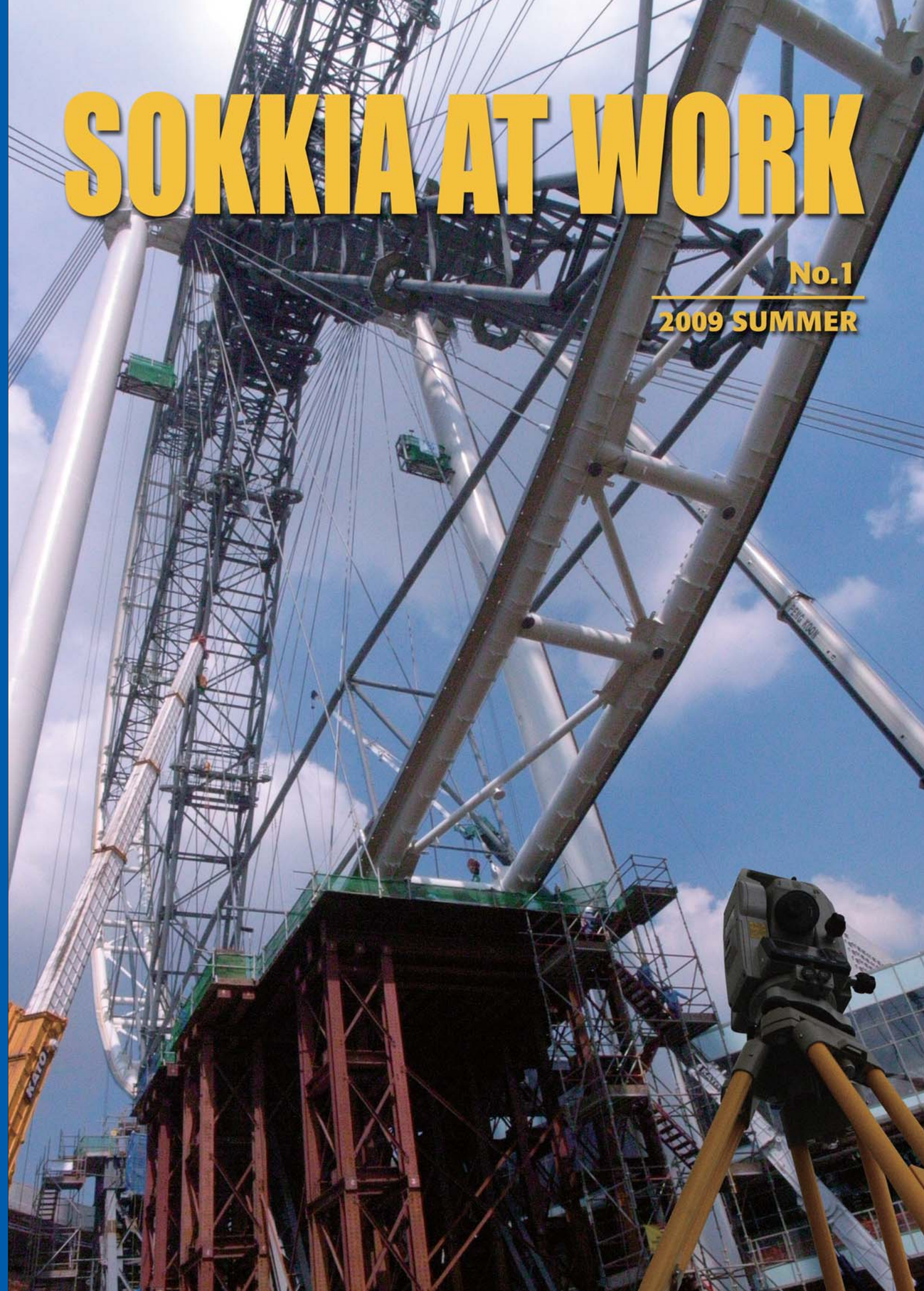
Traceability system is shown in the below diagram. The SL-2000L laser interferometer, designed and manufactured in-house, is employed as a reference for the baseline and measurement values thereof are used directly in EDM calibration. The wavelength of this laser interferometer is calibrated using the "specified secondary standard," an iodine-stabilized He-Ne laser accredited by the JCSS*3, at the Atsugi plant in Japan, thereby providing the baseline facility with traceability to the Japanese national standard.

*3 Japan Calibration Service System

National Standard	Specified Standard Instrument	**Iodine-stabilized He-Ne laser**	National Institute of Advanced Industrial Science and Technology
Secondary Standard	JCSS Specified Standard Instrument	**Iodine-stabilized He-Ne laser**	JCSS Accredited Calibration Laboratory SOKKIA TOPCON CO., LTD. Atsugi Factory (JCSS0045)
Reference Standard	JCSS	**Distance Meter Calibration Facility** (Laser Interferometer)	JCSS Accredited Calibration Laboratory SOKKIA TOPCON CO., LTD. Matsuda Factory (JCSS0162)
Customer Standard	Standard or Length Measurement Instrument	**Distance Meter** (EDM – Total Station)	Customer

SOKKIA http://www.sokkia.co.jp/

SOKKIA AT WORK No.1
TOPCON CORPORATION
75-1, Hasunuma-cho, Itabashi-ku, TOKYO, 174-8580 JAPAN



The Singapore Flyer-Surveying Technology Helps Make a Record-Setting Attraction Possible

The Republic of Singapore is an island nation with a rich history. First settled in the second century A.D., it has grown to become a booming center of technological, mechanical, petrochemical and biomedical development. Singapore continues this tradition of cutting-edge development by being home to the Singapore Flyer, the world's tallest Ferris wheel. UTOC Engineering Pte Ltd used a SOKKIA NET1200 to overcome the various challenges associated with the construction of a world record-setting structure.

The Singapore Flyer is the world's tallest Ferris wheel set to make its maiden flight on Valentine's Day, 14 February 2008. The Singapore Flyer occupies a land area of 33,700 square meters along the Marina Promenade and promises breathtaking views of downtown Singapore and extending 45 kilometers out to sea.

Standing at a spectacular height of 165 meters, the Singapore Flyer will feature 28 air-conditioned capsules capable of holding 27 passengers each. The wheel has a diameter of 150 meters and one full rotation will take 37 minutes.

SOKKIA user UTOC Engineering Pte Ltd was responsible for undertaking the enormous task of erecting the giant Ferris wheel.

Challenges in construction and the decision to use NET1200

The task of constructing the massive support columns and rim structure (wheel) was in the hands of the project managers and engineers from UTOC Engineering Pte Ltd.

Many challenges surfaced during the construction, the most pressing of which were the construction of the upright support columns within strict tolerances and the constant monitoring of the effects of the strong ocean winds on the rim structure.

Building the first section of the support columns

UTOC Survey Engineer using the NET1200 with diagonal eyepiece

Another challenge was presented by the conditions of the site itself. The Marina Promenade is a narrow peninsula of reclaimed land adjacent to the downtown business district of Singapore. Limited working space and the presence of the giant crank station was a challenge during construction. The tip of the support structure stands 85 meters high and the cramped work space required a steep zenith angle to perform a nearly impossible vertical measurement.


Limited working space

The solution to this problem started with a reference to a base line running across the base of the two support columns which required both good surveying technique and a high-precision total station.

The next set of challenges was presented by the spindle which forms the axis of the giant Ferris wheel. The spindle is fitted to both sides of the support structure and has morethan two thousand bolts, which required each hole to be measured in relation to the others before the actual fitting process began. This required an extreme amount of patience and a highly accurate, easy to use instrument to minimize operator fatigue.

The spindle itself weighs 180 tons and holds 112 radialcables that support the rim structure and the lifting operation to attach the spindle was the most critical part of the entire construction process. While the engineers were busy fitting the spindle, the support structure had tobe constantly monitored to ensure that both ends of thespindle were level despite differences in lifting speeds ofthe four lifting jacks used. This required an instrument thatwas both fast and accurate.


The spindle

To overcome the challenges in this high-precision three-dimensional structural project, the construction of the Singapore Flyer required special attention to be paid to surveying techniques and a high performance instrument. The decision was made to use a SOKKIA NET1200 3D station.

The NET1200 is an ultra-high performance 3D station. When utilized with SDR4000 3D measurement software installed on a data collector, NET1200 can measure and compare points in three dimensions to ensure the highest precision. This system does not require a known control point as it can establish a coordinate system by measuring two or three convenient points on site. This allows freedom of mobility so engineers can set up the instrument at any location to monitor the structure.

Using the NET1200, engineers were able to confidently measure the tip of the 165 meter tall support rim within the space constraints of the site. Using these measurements, the relation to any point along the support rim or wheel structure could be easily computed, greatly reducing working hours and operator fatigue when monitoring the entire structure.

Successful construction starts with successful planning

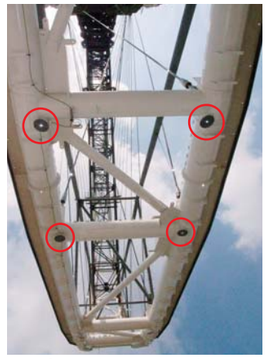
Construction began with the assembly of the two support structures section by section. Once the supports were completed, the spindle was installed. Installing the spindle was the most important part of the entire process and was accomplished after an exhausting 12-hour operation.


Installing the steel columns

Once the spindle was in place, the segments of the rim structure were installed one at a time. The final stage of the operation was lifting the capsules to be fitted to the perimeter of the rim structure.


Installing one of the capsules to the outer rim


Raising a capsule to the top


200 reflective sheets were carefully applied prior to construction

Throughout the entire operation, SOKKIA reflective sheets wer used at 200 points. Working closely with structural and design engineers, UTOC surveying engineers preplanned and attached reflective sheets to the support and rim structure components on the ground before actual construction began.

SOKKIA worked with UTOC Engineering Pte Ltd at every step of the way

UTOC Engineering Pte Ltd has been using SOKKIA total stations for 6 years. The Singapore Flyer project was their first purchase of NET1200 and SDR4000.


NET1200

The decision as to which instrument to use did not come easily as they had no previous experience using such a high-precision total station. However, given the tight tolerance requirements of 5mm at 85 meters measured from the ground, the decision to purchase NET1200 proved to be correct. Mr. Hiroaki Ohtomo, manager of UTOC Engineering Pte Ltd commented on the accuracy and ease of use in measuring 3D coordinates.

Prior to construction, SOKKIA conducted on-site training for the project team to simulate the actual working conditions and made regular visits to the site and project team. This was done to ensure that each member was fully competent in using the system. During this process, NET1200 was only sent back once for general maintenance and cleaning as required every six months according to the service contract.

Surveyors used advanced technology to make one of the most scenic tourist attractions in the world possible


The Singapore Flyer fitted with temporary support struts

Construction progressed smoothly and the Singapore Flyer was completed days ahead of schedule. The decision to purchase the NET1200 was a contributing factor to this success. NET1200 successfully accomplished the task of surveying one of the most scenic tourist attractions in the world – The Singapore Flyer. SOKKIA is proud to have been a part of this monumental project.

Automatic Multi-Purpose Dam Deformation Monitoring System Using SOKKIA's State-of-the-art NET1 Automated 3D Station Implemented at 13 dams with the aim of realizing a "ubiquitous Korea"

The Republic of Korea is creating an infrastructure maintenance information network with the aim of creating a ubiquitoussociety known as "u-Korea". The Korea Water Resources Corporation (KOWACO) has implemented a SOKKIA-made automatic multi-purpose dam deformation monitoring system in a plan to fully automate dam deformation monitoring. In this report we talk with those involved in the testing and operation of this equipment in Korea.

New system employing "NET1" effectively manages dam safety control and operation

SOKKIA KOREA CO.,LTD. provided the Korea Water Resources Corporation with an automatic multi-purpose dam deformation monitoring system using the NET1 as the core sensor. Installed at 13 of Korea's multi-purpose dams, this highly-anticipated system will effectively manage safety and dam operations in addition to fulfilling other vital roles.

The company that is implementing the system, the Korea Water Resources Corporation (KOWACO), is a public organization based in Daejeon with approximately 4,000 employees. It manages and operates 14 multi-purpose dams throughout the country and, in addition to water control operations to prevent flooding, it performs tasks such as providing water and sewage utilities and managing service water.

Incidentally, Daejeon is a major Korean city with a surrounding population of 1.5 million people. Nearby are the Yuseong hot springs which have been known as a getaway since the Baekje period (18 BC – 660 AD). Daejeon is also widely known as a scientific city as it is host to the Daedeok Science Town which is known as Korea's "Silicon Valley".

High accuracy and unprecedented environmental protection surpassed KOWACO demands

SOKKIA employed the state-of-the-art MONMOS Automated 3D Station "NET1" as the core sensor for the newly developed automatic multi-purpose dam deformation monitoring system. NET1 features a functionality to automatically sight the reflective prisms, that is crucial to automatic deformation monitoring. The auto-pointing function uses a dedicated algorithm which has the ability to recognize and accurately sight the intended target even if multiple prisms and other reflective objects are in the telescope's field of view. This target selection algorithm is extremely important in monitoring applications as predetermined points are automatically sighted and measured repeatedly to monitor the changes over time. In addition, the NET1's high IP64 environmental protection rating means that it is extremely reliable.

The environmental protection rating is maintained even with cables attached, which is a first in the industry. It also goes without saying that the distance meter and angle measurement performance have also met the high accuracy demands of KOWACO.

Automatic measurement using reflective prisms for real-time 3D deformation monitoring

Using the NET1 as the sensor, the system has the ability to automatically measure prisms placed on the dam body and surrounding slope to monitor dam deformation in real-time. A completely automatic system, the NET1 is situated in an unmanned observation room in full view of the multiple prisms placed in specific locations mainly on the dam body.

Monitoring control and data processing are automatically performed at the remotely located dam control office using monitoring control software according to a predetermined schedule. The acquired data are compared with reference data on a specific date and the results are graphically displayed on a monitor immediately for a visual representation of the processed data.

Planning and installation under extreme conditions

SOKKIA Korea handled everything from installation to testing, overcoming the many challenges to setting up the unmanned observation room designed for the NET1. The following were the conditions for the unmanned observation room:

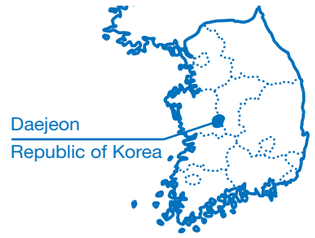
1. Assured visibility of approx. 40 measurement points on the dam and surrounding embankments
2. Solid footing allowing the NET1 to be securely fastened
3. A position that is out of the reach of the general public while providing easy access to maintenance personnel
4. A location that doesn't disturb the scenery of the public tourism resource

Prism placement was also a challenge. Dams are roughly broken into two categories: concrete dams, and fill dams made with compacted earth and stone, and this system was employed mainly on fill dams. One of the dams this system was installed on has a dam crest over 1 kilometer in length causing workers to descend the steep rocky slope countless times in order to place the prisms.

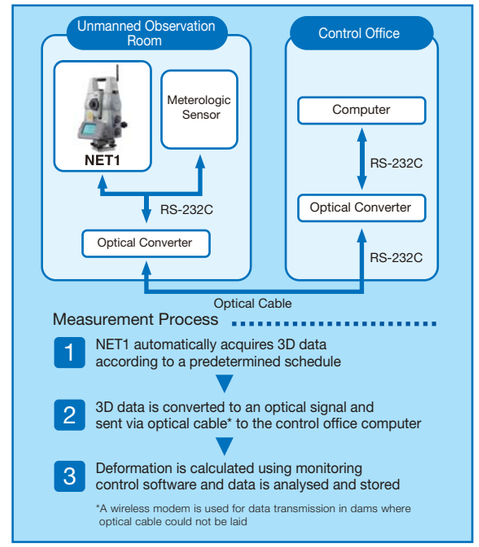
Even more concerning was the fact that the construction of the unmanned observation room was scheduled to take place in the winter. Looking at the latitude of South Korea, Busan is roughly the same as Tokyo, and Seoul is roughly the same as Washington DC, but due to geographic factors and ocean currents, Seoul drops to -10°C in the winter and temperatures drop even further in the mountains. However, worries about the cold were quickly put to rest as Korea experienced the warmest winter on record and construction was completed without incident.

Increased data reliability fuels future demand

By implementing a multi-purpose dam automatic deformation monitoring system, operations that were previously done by hand are now automated. Fully automatic prism sighting, data collection and storage ensure data reliability by eliminating human error. Another major benefit of this system is the instantaneous graphing of the acquired data allowing effective use of the recorded data.



Currently, the government of Korea is advocating a national strategy called "u-Korea" (Ubiquitous Korea). The goal of u-Korea is a society that joins the physical space in which we live with the knowledge information space introduced by the digital revolution. All levels of government are computerizing and networking with the aim of a ubiquitous society focused on construction of infrastructure and technological advancement. The automatization of multi-purpose dam deformation monitoring by KOWACO is a major step toward this goal.



MEASURING-UP IN KIEL

REFLECTORLESS MEASUREMENT AND INDUSTRIAL SURVEYING SKILLS HELP MAKE AN AGEING HULL AS GOOD AS NEW FOR ANOTHER GENERATION OF GERMAN SEAFARERS. REPORT BY PETER FITZGIBBON

Built in 1930 to carry freight on the South Atlantic and Caribbean trade routes, the motorised topsail schooner "Thor Heyerdahl" has in recent years provided seamanship and adventure training for thousands of German youngsters including many from disadvantaged backgrounds. Today operated by a not-for-profit organisation based in Kiel, this jewel of the sea acts as an ambassador for the nation on its regular voyages around the North Sea and further afield.

Yet time takes its toll,and despite refurbishment at the HDW shipyard in Kiel two decades ago, the 50mvessel found itselfin dry dock at the end of last year with its riveted iron hull platesweakened to the point where regulatory authorities considered replacement essential.

With finances under pressure, a rapid but ultra-accurate survey was the first step in assessing exactly which plates should be replaced. The survey became even more critical when set against the fact that none of the original shipyard drawings of the "Thor Heyerdahl" existed and no nominal data was available.

Fabricating replacement plates – few of which have the same dimensions - normally relies on following the complex shell plating diagram that is individual to every vessel. Here, the survey would re-create vital missing information.

Rare commodities

Instruments that can accurately scan large structures in 3D and 'in situ' are rare commodities, and the skills needed to utilise them rarerstill, for it is still a relatively new process. However, HDW (a ThyssenKrupp Marine Systems subsidiary) needed to look no further than GLM Lasermeßtechnik GmbH to find both.

Originally a commercial spin-off from the University of Bochum,Witten-based GLM has established itself over the past 17 years as the European market leader in providing optical 3D measurement surveys for shipbuilders (including HDW), railroad engineers,bridge builders, paper plant operators and many other customers. A second but no less important aspect of its thriving business is 3-DIM, a range of measuring and data logging software solutions developed over many years inpartnership with Sokkia.

The company's credentials were put to the test on a chilly day in December 2007 when surveying engineer Jennifer Neuhoff headed north and arrivedatHDW's yard in Kielwith two motorised Sokkia Total Stations – a NET1 and SET230RM - and a pair of the latest Archer ultra-rugged Field PCs from Juniper Systems running GLM's 3-DIM Observer Motorised data logging software.

Getting shipshape

Neuhoff set up the Total Stations at each end of the "Thor Heyerdahl",defined a local co-ordinate system, and controlled them wirelessly via the data loggers. Some 3,000 points identified from an earlier acoustic survey (and identified on the hull as chalk marks, fig.2) were incrementally scanned in reflectorless target mode and the 3D coordinates downloaded into point grids on the data loggers via Class 1 Bluetooth links. The side of the hull that needed most remedial work was scanned in detail and the results mirrored back at the office in the 3-DIM PC-Basic desktop package to build a complete picture.

GLM's marketing manager Martin Hartmann elaborates on the procedure. "Finding a position by staking out a 3D point is very difficult to do manually. 3-DIM Observer automates this process by taking a first order co-ordinate reading and applying an intelligent iterative algorithm to establish whether subsequent readings fall within defined tolerances."

The entire on-site survey was completed in a surprisingly quick 12 hours and with no compromise on accuracy. "Obtaining accurate reflectorless measurements can be problematic in heavy rain so we were perhaps a little lucky that the weather held," notes Neuhoff. Another potential drawback was that the upper part of the hull was painted black. "As such, I wondered whether it would be sufficiently reflective. In the event and much to my surprise it posed no problem at all," she adds.

While the shipwrights needed results accurate to within +/- 3mm,the scans achieved three times this level, with the NET1 able to deliver a typical accuracy of 0.5mm at ranges of up to 200m in reflectorless mode. As such, it is an ideal instrument for those working alone and who need to complete their surveys quickly and efficiently. Consistency is assured, for every instrument undergoes rigorous testing at a laboratory of the German Calibration Service (DKD) before being put to work.

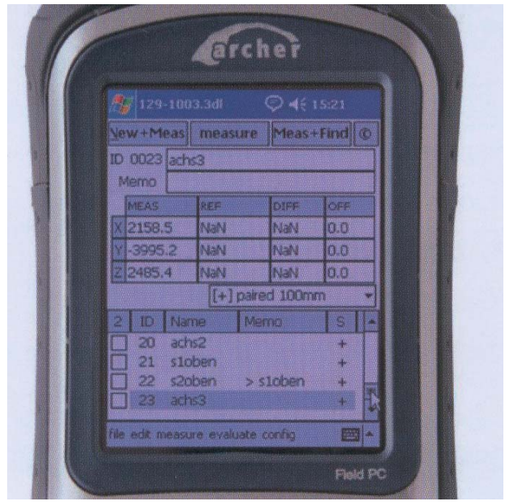


FIG.1: The GLM 3-DIM Observer is fully integrated with Sokkia's MONMOS range of industrial Total Stations.

FIG.2: Some 3,000 points and defined lines were scanned during the hull survey

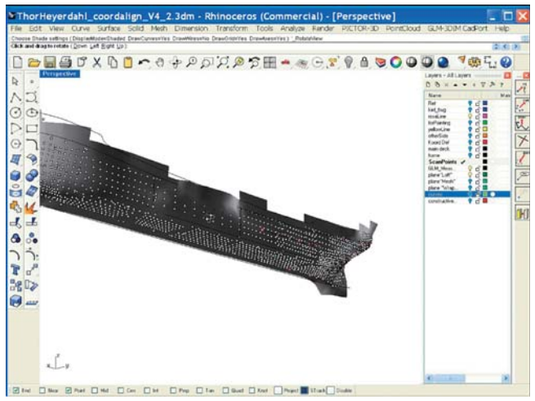


FIG.3: 3-D model generated from point cloud provides an input for HDW's CAD system

FIG.4: With a hull as good as new and a complete overhaul, the future of the Thor Heyerdahl looks assured.

On the line

The NET1 had another much-valued feature, as Jennifer Neuhoff explains: "A particular requirement of the exercise was to faithfully capture some lines that had been painted on the hull for replating purposes. These lines would not normally be picked up by a 3D laser scanner and the alternative of short-range photogrammetric data capture is a time-consuming process. However, scanning defined lines as well as shapes and areas – all to the same high level of accuracy – iseasy work for the NET1."

From the point cloud,a 3D model of the hull with the lines mentioned above and indicating where the thickness of the hull was less than 6mm was subsequently generated in Pictor 3D, a desktop analysis and visualisation package, for export to HDW's CAD system. Armed with this essential information, the task of re-plating the hull and refurbishing much of the rest of the vessel will proceed over the next two years at a cost of 1.4 million euros. The project is being backed by the generosity of sponsors such as HDW, Nord Metall (an industry organisation representing some 300 enterprises in northern Germany), the State of Schleswig-Holstein and countless individual donors and supportersi ncluding Thor Heyerdahl junior. It bodes well for the ship that bears his father's name and which looks set to sail long into the future.

'This article was written by Peter Fizgibbonn for Geo : connexion Magazine.
The original article can be viewed at: www.geoconnexion.com'

WEB LINKS

Thor Heyerdahl association: www.th-sailing.de
GLM Lasermeßtechnik GmbH: www.glm-laser.com
Howaldtswerke-Deutsche Werft GmbH (HDW): www.hdw.de
Sokkia Europe: www.sokkia.net

NEW PRODUCT NEWS

DIGITAL LEVEL
SDL1X

Advanced Digital Level with the Industry's Highest 0.2mm Precision

The SDL1X is exclusively designed to achieve the highest precision in leveling and height measurement applications. From Intelligent Auto Focus to wireless operation, a number of innovative technologies are implemented for unmatched productivity while eliminating error factors during measurement.

- The SDL1X achieves 0.2mm precision when used with the SOKKIA original New Super-Invar RAB-Code Staff with the industry's lowest linear expansion coefficient of ±0.1ppm/°C.
- "Intelligent Auto Focus" and quick sighting "View Finder" reduce measurement time by up to 40 percent compared to our manual focus digital levels.
- SDL1X automatically focuses exclusively on the RAB-Code Staffs, increasing productivity by eliminating false focusing on undesirable objects.
- Onboard software supports height difference measurement and data recording in the following procedures: BF, BFFB, BBFF, BFBF, aBF, aBFFB, aFBBF

Eight industry's first features*

1. 0.2mm precision (ISO 17123-2)
2. Auto Focus for high-end digital level
3. View Finder for quick sighting
4. Remote Trigger for wireless operation
5. Dual-axis tilt sensor that ensures precision
6. SD card slot for data storage
7. 100m (320ft.) *Bluetooth*® wireless communication
8. BIS30A staff with ±0.1ppm/°C linear expansion coefficient

*As of June 1, 2009

3D STATION
NET05X

0.5" and Sub-millimeter Precison

The NET05X universal 3D Station provides unparalleled precision in broad range of applications such as surveying, engineering, construction and industrial three-dimensional measurement.

- NET05X achieves the industry's highest 0.5" angle accuracy.
- With reflective sheet targets, it provides sub-millimeter "0.5mm+1ppm" accuracy within the range of 200m (650ft.).
- NET05X measures standard prisms with "0.8mm+1ppm" precision up to 3,500m (11,480ft.), providing the industry's highest accuracy at over 1,000m (3,200ft.). Measurement time is as fast as 2.4 seconds in fine mode.
- Reflectorless measurement can be performed with "1mm+1ppm" precision to 100m (320ft.) range.

Advanced Features for Maximam Productivity

- Using the high-intensity white LED built into the telescope, prisms or sheet targets can be easily located in dim lighting conditions.
- Windows CE operating system with highly visible touch screen display panels.
- IP65 dust- and water-resistant body, the highest rate among the Windows incorporated total stations, stands up under dusty or wet conditions.
- Built-in Class 1 *Bluetooth* modem allows wireless communication with an external controller or PC to a range of 200m (650ft.).
- SOKKIA's full line of unique and convenient reflectors maximizes the measurement accuracy and efficiency.