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.

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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.

*1 National Institute of Standards and Technology, USA
*2 International Laboratory Accreditation Cooperation’s Mutual Recognition Arrangement
*3 Japan Caliation Service System
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.
Limited working space

The support structure had to be constantly assembled, which formed the axis of the giant Ferris wheel. The spindle itself weighs 180 tons and holds 112 radial cables, making it a critical part of the entire construction process. While the engineers were busy fitting the spindle, the most important part of the entire process was lifting the capsules to be fitted to the perimeter of the rim structure.

The tip of the support structure stands 85 meters high and the cramped work space required a steep zenith angle to measure the tip of the 165 meter tall support rim within the greatly reducing 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.

Using the NET1200, engineers were able to confidently measure the tip of the 165 meter tall support rim within the 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 engineers, UTOC surveying engineers preplanned and attached reflective sheets to the support and rim structure components on the ground before actual construction began.

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

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 more than 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 radial cables 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 lifting the spindle, the support structure had to be constantly monitored to ensure that both ends of the spindle were level despite differences in lifting speeds of the four lifting jacks used. This required an instrument that was both fast and accurate.

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.

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 to attach the capsules to be fitted to the perimeter of the rim structure.

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. 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.

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”

High accuracy and high-speed monitoring of environmental deformation expressed by GPS signals

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

The Republic of Korea is creating an infrastructure maintenance information network with the aim of creating a “ubiquitous Korea”. Implemented at 13 dams with the aim of realizing a “ubiquitous Korea”. Since 2001, comprehensive automatic deformation monitoring, aiming at the goal of a fully automated dam control, was put to work.

In this report, we talk with those involved in the testing and operation of this equipment in Korea.

Prism placement was also a challenge. Dams are roughly 30m wide, this type of prism was designed to be placed on an embankment, the face of the dam and surrounding embankments. Automatic measurement using reflective prisms is extremely important in monitoring applications as only one prism needs to be selected. The auto-pointing function uses a dedicated algorithm which is crucial to automatic deformation monitoring.

1. Assured visibility of approx. 40 measurement points on the unmanned observation room designed for the NET1.
2. Solid footing allowing the NET1 to be securely fastened
3. A location that doesn’t disturb the scenery of the public
4. A location that is out of the reach of the general public

SOKKIA Korea handled everything from installation to testing, overcoming the many challenges to setting up the unmanned observation room designed for the NET1. Increased data reliability fuels future demand for a visual representation of the processed data.
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 50m vessel found itself in dry dock at the end of last year with its riveted iron hull plates weakened 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.

The company’s credentials were put to the test on a chilly day in December 2007 when surveying engineer Jennifer Neuhoff headed north and arrived at the DNV’s yard in Kiel with 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.

Rare commodities

Instruments that can accurately scan large structures in 3D and ‘in situ’ are rare commodities, and the skills needed to utilise them effectively, 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 in partnership with Sokkia.

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FIG.3: A (virtual) generated 3D 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 2D 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 – is easy 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 supporters including 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 Fizgibbon for Geo : connexion Magazine. The original article can be viewed at: www.geoconnexion.com’

NEW PRODUCT NEWS

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

- 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 i8 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

0.5” and Sub-millimeter Precision

- 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 3.4 seconds in fine mode.
- Reflectometer measurement can be performed with “1mm+1ppm” precision to 100m (320ft.) range.

Advanced Features for Maximum 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.