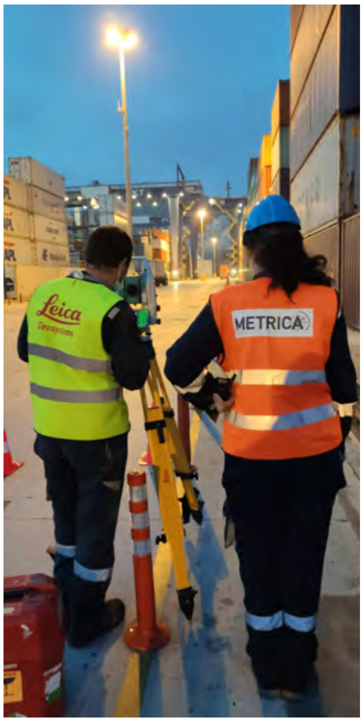
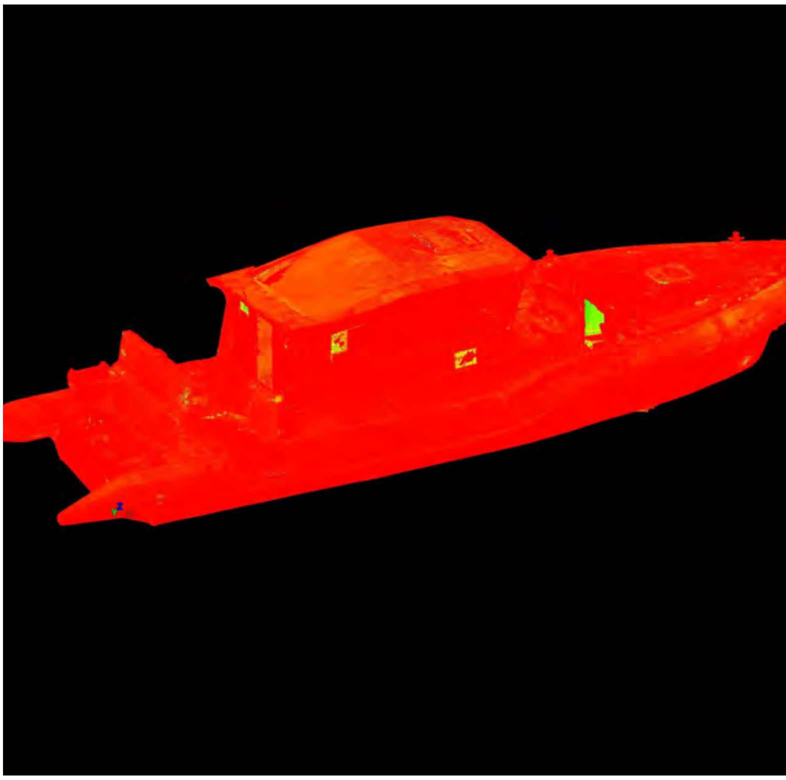
METRICA

When it's a matter of trust



MARITIME PROJECTS

METRICA offers measurement services in almost any kind of industrial application that includes alignment inspection or as-built documentation. Based in Athens, Greece, we operate worldwide with vast experience in a diverse range of applications. Our products and services are suitable for industrial and marine sites, shipyards and offshore installations, architecture, heritage, and large-scale urban projects.



APPLICATION NOTE / MARINE

Stay at the forefront of inflatable boat design

Overview

Inflatable boats and super yachts manufacturers always strive for perfection. For this reason, 3D laser scanning technology is the key that helps in every phase of a model's construction and future-proofs any further design and development of this model. As all the boat parts can be reversed-engineered, manufacturers have the luxury of sending newly designed parts to third-party companies where the plugs can be cut using CNC milling machines. In this way, the production of parts is more time and cost-effective.

In this case, the METRICA team performed 3D Scanning measurements of an inflatable boat, air cushions, deck, bridge, bottom part, chairs, roof rack, and other components. Then, we created the final 3d mesh delivered in .stl format using the dense point clouds.

Indicative Deliverables

- Demonstration in 2D, 3D or VR
- 3D Point clouds in Real Color
- 2D CAD Drawings- Cross Sections- Horizontal/Vertical Sections
- 3D Digital Models

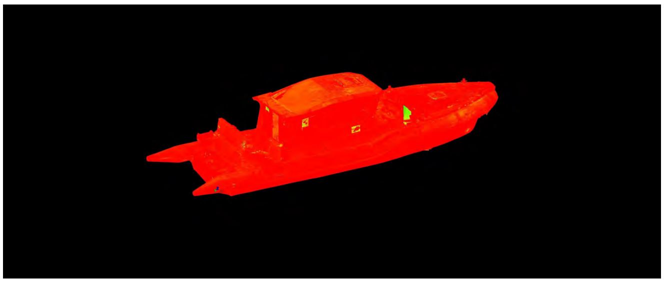
Benefits

- Time-saving
- Increased productivity
- Less rework
- Cost reduction

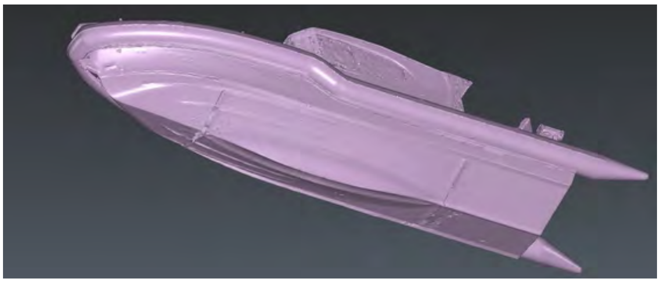
LEICA RTC360 LASER SCANNER

The Leica RTC360 3D reality capture solution empowers users to document and capture their environments in 3D, improving efficiency and productivity in the field and in the office through fast, simple-to-use, accurate, and portable hardware and software.

88A Ginossati st., P.S.14452, Metamorphosis, Greece I info@metrica.gr I www.metrica-isv.gr I T. +30 2102815440



Final unified point cloud



3D mesh inside Leica 3DR

Methodology

The whole measurement procedure lasted a single working day. Before the scanning procedure, our team defined the following:

- the proper route of scanning setups
- the resolution
- the quality levels
- the production of final deliverables

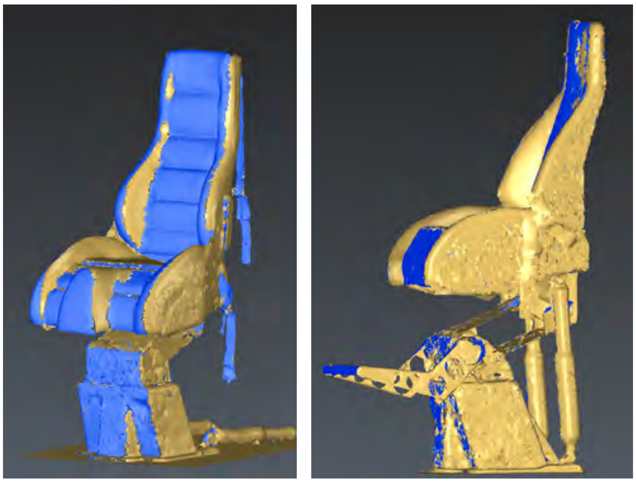
The project was covered through 62 laser scanner setups.

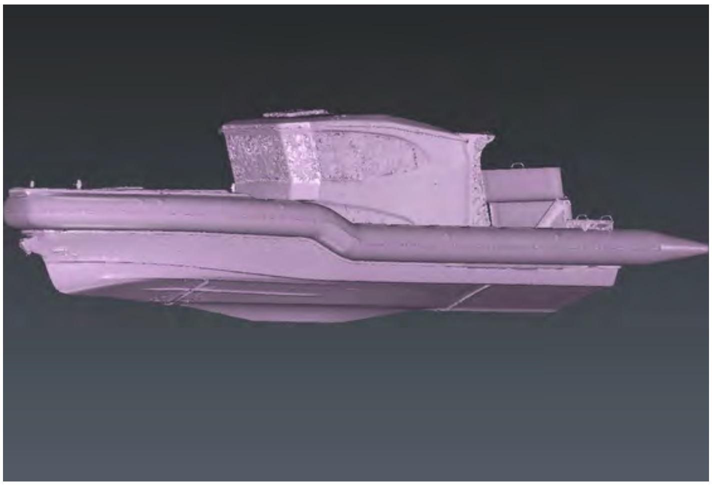
All point clouds were registered and cleaned from irrelevant objects on Leica Cyclone Software. For registration purposes, there were used cloud and target constraints. The mean absolute error for all registrations was 1 mm, and the max constraint error vector was 4 mm. Despite the valid registration results, we visually checked point clouds for possible residual errors. After the registration process and visual inspections, all point clouds were decimated and unified into a final point cloud which served as the base for further processing.

After a discussion with the naval engineer, the unified cloud was aligned to the best approximate coordinate system inside the Spatial Analyzer metrology platform.

After the definition of the UCS and the alignment of the point cloud, we created the mesh from the aligned point cloud utilizing Leica Cyclone 3DR software. The 3D unstructured mesh was inspected for topological errors.

The same procedure was conducted for the chairs, the roof rack and the equipment (Pictures 7, 8). All deliverables were exported to. stl format as requested.





3D mesh inside Leica 3DR

Instrumentation / software

Leica RTC360 Laser Scanner
Leica Cyclone
Leica 3DR
Spatial Analyzer

Deliverables

- 3D mesh
- Sections, buttocks and waterlines in .stl and .dxf file format.

APPLICATION NOTE / MARINE

DIMENSIONAL INSPECTION

Overview

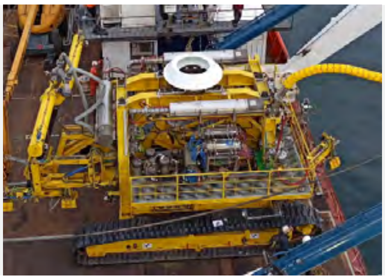
The main scope of this project is the geometric and dimensional inspection (DimCon Survey) of critical sensors which were positioned on a vessel. All sensors of interest were inspected in terms of position, direction, and inclination compared to the main vessel and equipment datums. The measurement collection was conducted using state-of-the-art instrumentation such as industrial total station Leica TDRA6000, Leica ScanStation P40 and Leica RTC360 laser scanners with relevant accessories. Our engineers used a combination of traditional surveying and modern laser scanning techniques.

Benefits

- Time-saving
- Increased productivity
- Cost efficiency

Challenges

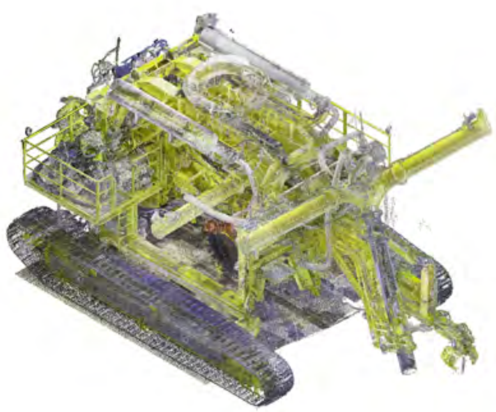
- High precision-quality result with detailed documentation
- Complex geometries and unique principles of operation to examine
- Tight schedule for fieldwork and office work
- During the measurement service, the vessel was under afloat conditions



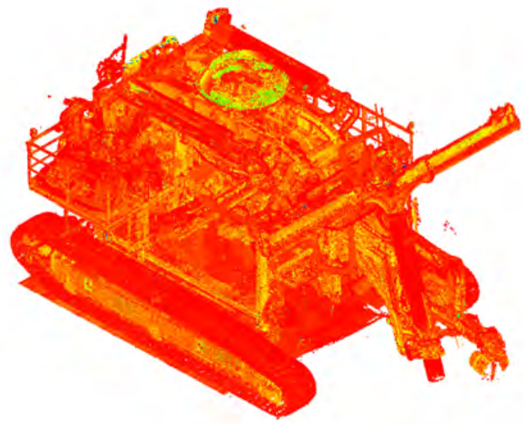
Methodology

Our team collected, imported, processed, and presented geodetic observations and point clouds using state-of-art sensors and software/hardware resources. Our engineers used terrestrial laser scanning technology, Leica RTC 360 and Leica ScanStation P40 laser scanners, combined with conventional surveying techniques with industrial total station TDRA.
Office work: Before any registration attempt, all raw point clouds were filtered – cleaned from noise and other reflections, such as moving or/and afloat objects, personnel, abnormal material responses Etc. Scan setups were registered into one final scan dataset using cloud and target constraints on Leica Cyclone Software. After the registration process and the approval of the final statistical results, our team inspected all point clouds so that there were not any visually cross errors or any remaining remarkable gaps. Because of the resulted large number of points, it was necessary to decimate the final dataset. The unification process reduced the size of the point cloud, helping performance quality degradation of the final dataset and generally led to better manipulation and usage during the evaluation of sensor positions. Finally, the unified point clouds were aligned to the best approximate ship coordinate system. After that, our team created a detailed presentation with summary tables for all vessel's examined sensors.

Laser scanner targets were surveyed during the measurement of control network



Point cloud (True color)



Point cloud (Intensity color)

Instrumentation / software

Leica RTC 360 Laser Scanner
Leica ScanStation P40
Industrial Total Station Leica TDRA6000
Leica Cyclone Field 360
Leica Cyclone / Cyclone Register 360

Deliverables

- Summary tables with the dimensional and geometrical results for all vessel's sensors.
- Detailed presentation of examined sensors

APPLICATION NOTE / **OFFSHORE**

3D SCANNING & 3D MODELLING OF AN OIL RIG

Overview

METRICA S.A. accomplished 3D Scanning measurements and delivered the 3D model of a specific deck of an oil rig. Fieldwork took to our engineers two working days to capture the necessary information. Our team prepared the 3D model within twenty days.

Challenges

- the complex industrial environment
- the unapproachable character of interest zones
- the narrow passages on the scanned deck
- the necessity for quick on-field measurements and
- the high safety measures

Benefits

- elimination of field interferences
- less rework
- increased productivity
- fewer requests for information
- cost reduction
- time-saving

LEICA SCANSTATION P40

Leica ScanStation P40 deliver highest quality 3D data and High-Dynamic Range (HDR) imaging at an extremely fast scan rate of 1 million points per second at ranges of up to 270m. Unsurpassed range and angular accuracy paired with low range noise and survey-grade dual-axis compensation form the foundation for highly detailed 3D color point clouds mapped in realistic clarity.

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Leica targets in the area of interest

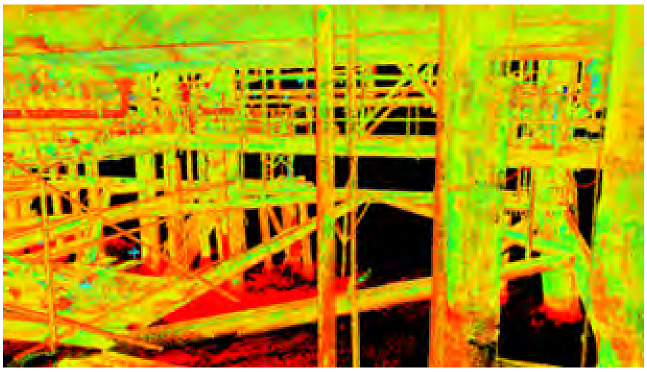
During 3D Scanning measurements

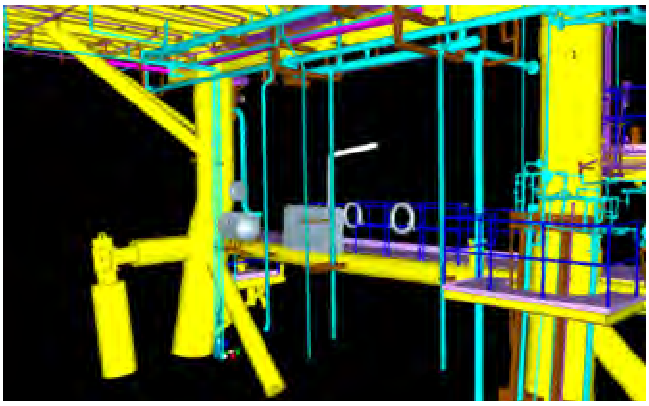
Methodology

Our team used Leica ScanStation P40 to capture the necessary information. The area of interest was covered through sixty three (63) laser scanner setups. Chequered targets were placed all over the installation and measured with the industrial total station Leica TDRA6000.

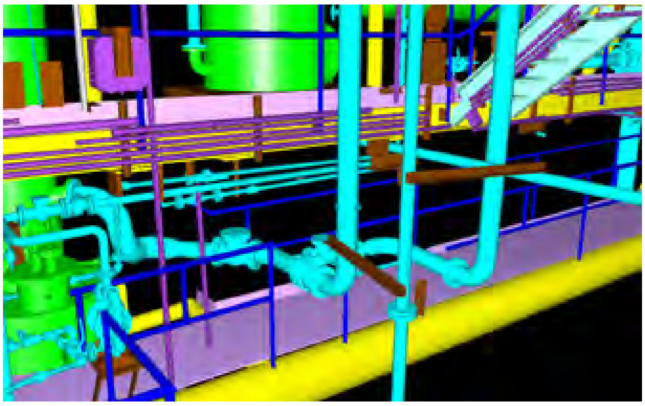
After measurements, all data were loaded to the Leica Cyclone software for further processing. Then, point clouds were registered to a final unified and aligned point cloud which was ready to be filtered - cleaned from all irrelevant objects captured during 3D Scanning. The installation was modelled through the usage of geometric primitives and other stored modelling libraries. The accuracy of the object was better than 5mm. The final deliverable was the 3D model in CAD format.

Point cloud





Part of the 3D model



MTU diesel engine drawing

Instrumentation / software

Laser Scanner Leica ScanStation P40
Industrial Total Station TDRA6000
Laser Scanner Registration Targets
Leica Cyclone

Deliverables

3D model of the area of interest

APPLICATION NOTE / **MARINE**

PROPULSION SYSTEM ALIGNMENT ON NEW BUILDING SUPER YACHT

Overview

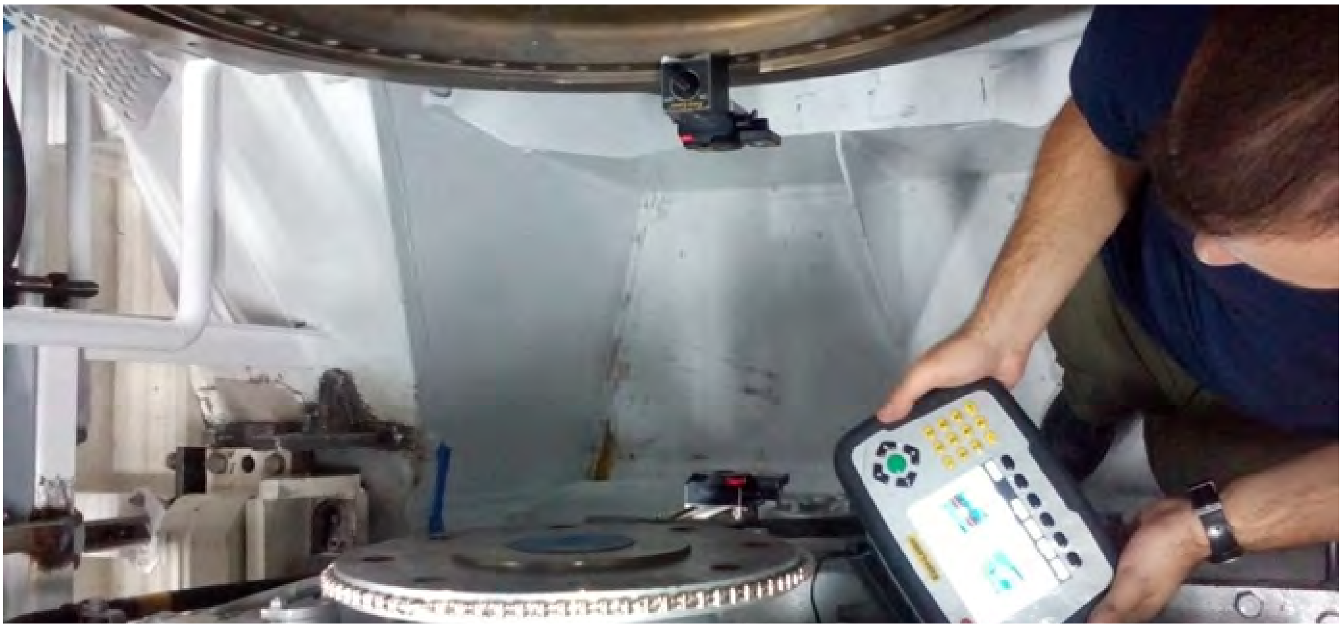
The measurements were realized in dry dock conditions. Special attention was given to the environmental conditions and the wind current as line bore application requires attention in detail, especially when the length of the shaft is long (21m approx). Our team used a high sampling (filter) to capture data to avoid turbulence, etc. The equipment used on this application was Easy Laser Bore Alignment System E 950 and E710 Shaft alignment system. The laser emitter was mounted on the aft v-bracket. Seven positions were inspected in total; the 7th position was on the gearbox flange. Four of them were located on the two v-brackets, two on the stern tube. The last position of the inspection was the gearbox flange. Our team performed measurements also to achieve fine alignment between the gearbox and the engine. This procedure was followed on both propulsion systems of the Super Yacht.

Benefits

- Time saving
- Precision
- Increase productivity

EASY-LASER® E950 - BORE ALIGNMENT

The Easy-Laser® E950 Bore alignment system makes the control and adjustment work of bearings and bearing journals easier, thanks to the wireless detector unit and measurement programs that guide you through the measurement process. All of the parts included in the systems are designed and built for even the most demanding workplace and for easy setup on any machinery.



Gearbox to engine alignment

Methodology

Line bore: The first procedure is the rough alignment of the laser beam to the axis of the rotation, then the fine alignment followed. The next step is the placement of the detector consistently to all seven essential positions. Then with our guidance, the personnel of the shipyard moved the bearing pockets to reach fine alignment.

Bearing pockets – Gearbox flange co-linearity:
Since we had aligned the bearing pockets and the gearbox flange, the next step was to check the alignment of the axis of rotation of the gearbox flange to the axis that the bearing pockets define. Our team used an advanced methodology based on its experience and deep knowledge, and after corrective movements of the gearbox, the co-linearity was established.

Gearbox-Engine alignment:
The final step was the alignment of the engine to the gearbox.
A series of measurements showed the necessary correction movements. The shipyard personnel, upon our guidance, moved the engine, and we reached fine alignment.
During the procedure, our team had access to real-time monitoring of the measuring values. At the end of every alignment session, the relevant series of measurements were repeated to verify the results. The same procedure was followed for both propulsion systems.

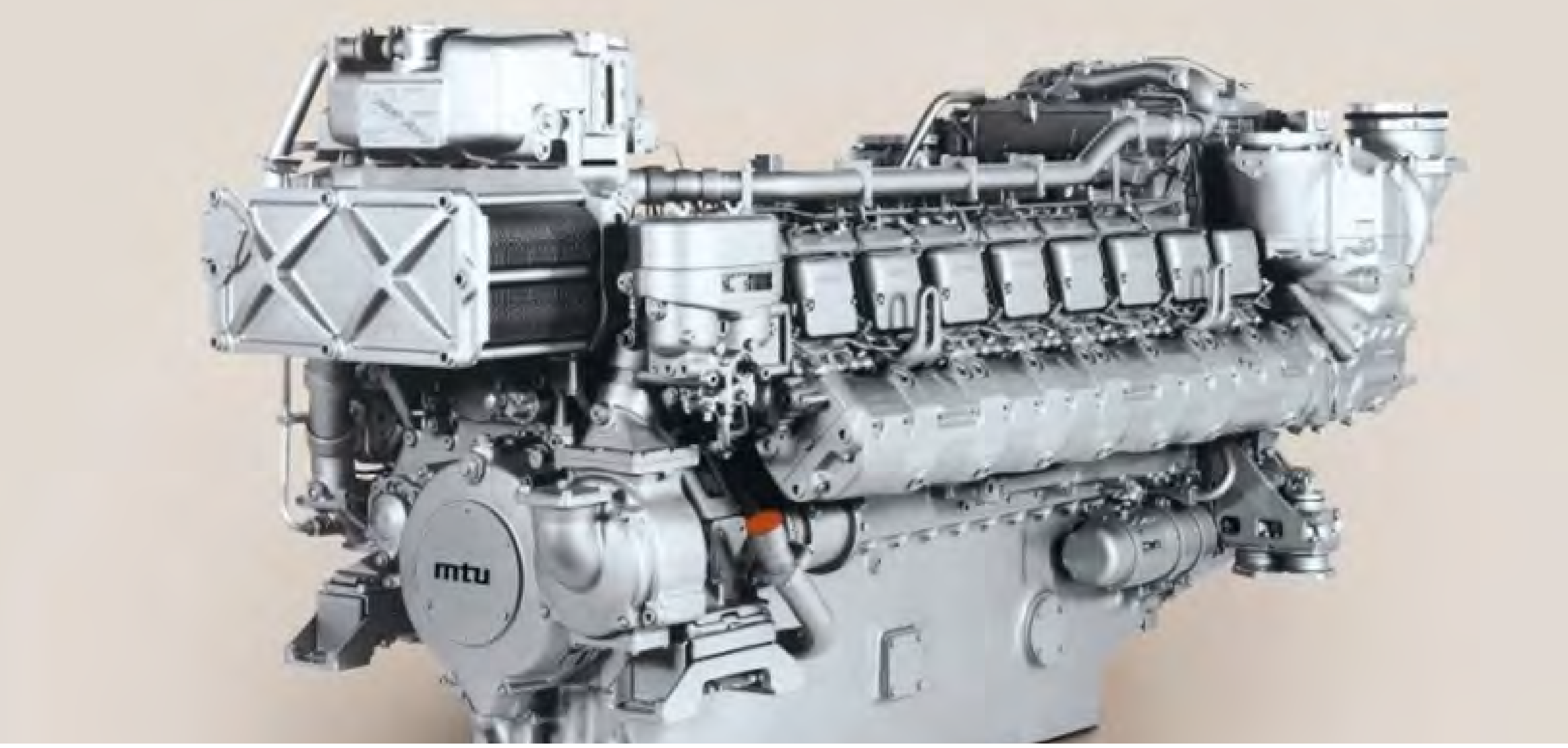
Laser transmitter on the aft V-bracket

Instrumentation / software

Easy Laser Bore Alignment System E 950
Easy-Laser Shaft Alignment System E710

Deliverables

Reports
A vibration free vessel



APPLICATION NOTE / **MARINE**

LINE BORE INSPECTION BED PLATE BEARING POCKETS

Overview

The main scope of this application was the alignment inspection of two MTU 16V 396 after machining the bearing journal pockets of the bedplate. The reason for these measurements was to verify whether the machining was successful or not.

For the inspection measurements, our team used Easy Laser E950 Bore Alignment system. This system makes the control and adjustment work of bearings and bearing journals easier thanks to the wireless detector unit and measurement programs that guides you through the measurement process. All parts included in the systems are designed and built for even the most demanding workplace and easy setup on any machinery.

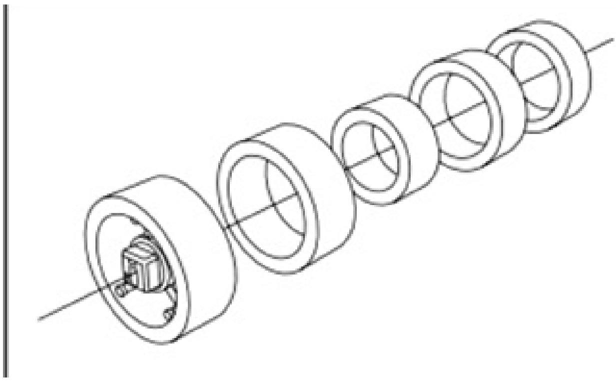
Challenges: The wind currents

Benefits

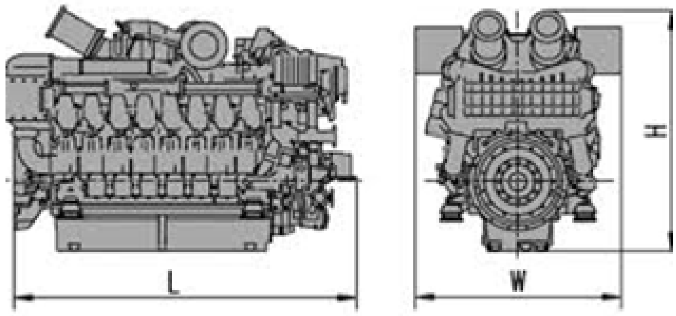
- Time saving
- Precision
- Increase productivity

EASY-LASER® E950 - BORE ALIGNMENT

The Easy-Laser® E950 Bore alignment system makes the control and adjustment work of bearings and bearing journals easier, thanks to the wireless detector unit and measurement programs that guide you through the measurement process. All of the parts included in the systems are designed and built for even the most demanding workplace and for easy setup on any machinery.



Principles of function



MTU diesel engine drawing

Methodology

The measurements took place in Perama Shipyards. Special attention was given to wind currents as line bore application is a demanding procedure in terms of accuracy. To avoid the effects of turbulence etc, high sampling period of time (filter) was used while capturing data.

The laser emitter was mounted on the first bearing journal on the aft side on both engines. All nine positions were inspected.
The first procedure was the rough alignment of the laser beam to the axis of the rotation of the crankshaft, then the fine alignment followed. The next step was the placement of the detector consistently to all critical positions.
Two series of measurements were performed for each engine to verify that no critical random error is included in the procedure.
Immediately by the end of the measurements, the software of the system created the report in pdf format. Note that the report from the software can be exported to any USB stick. In the office, a more detailed report can be issued if needed.

During measurements

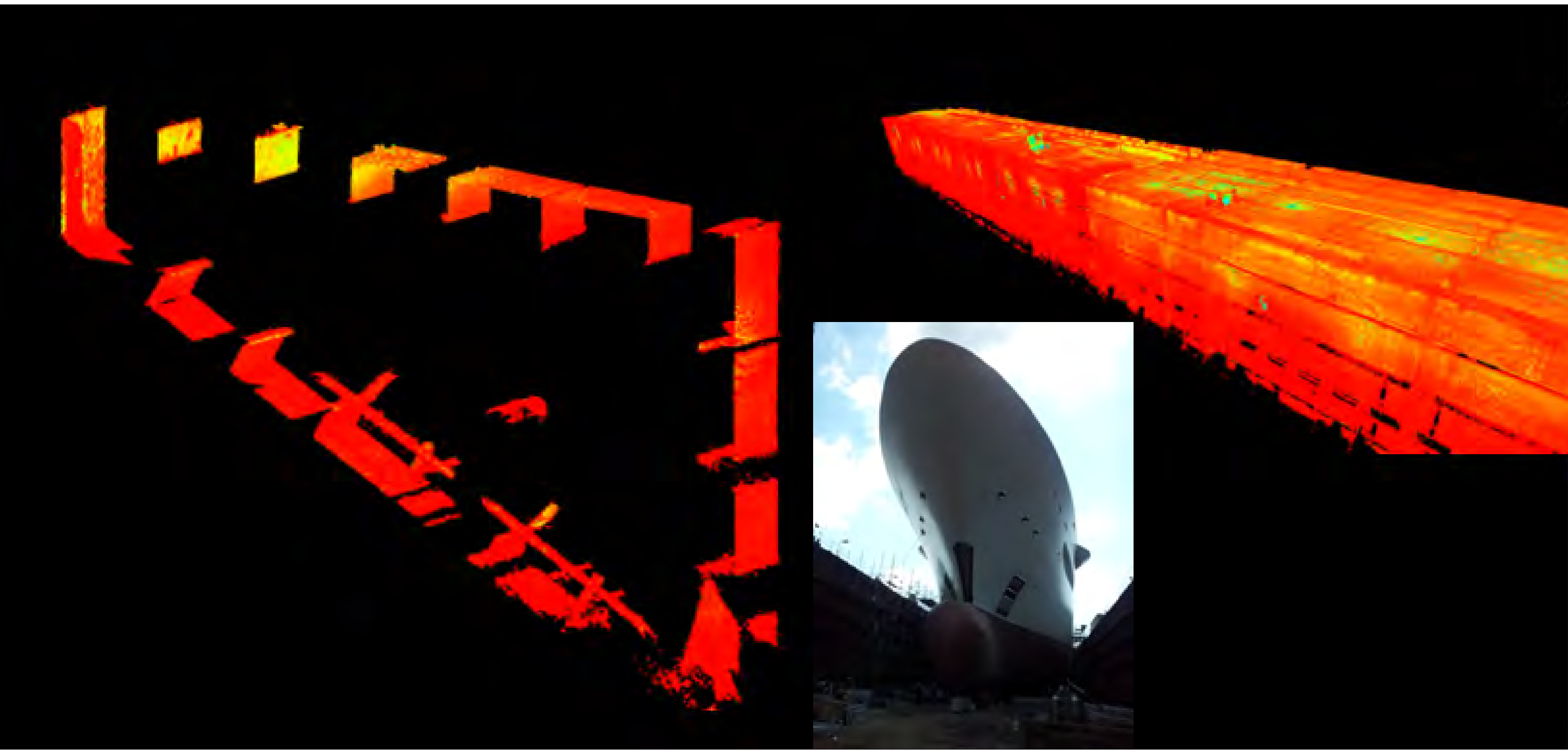
MTU diesel engine drawing

Instrumentation / software

§Easy Laser E950 Bore Alignment system

Deliverables

Report



APPLICATION NOTE / **MARINE**

SOUNDING TABLES PRODUCTION FOR 2 BULK CARRIER HFO WING TANKS

Overview

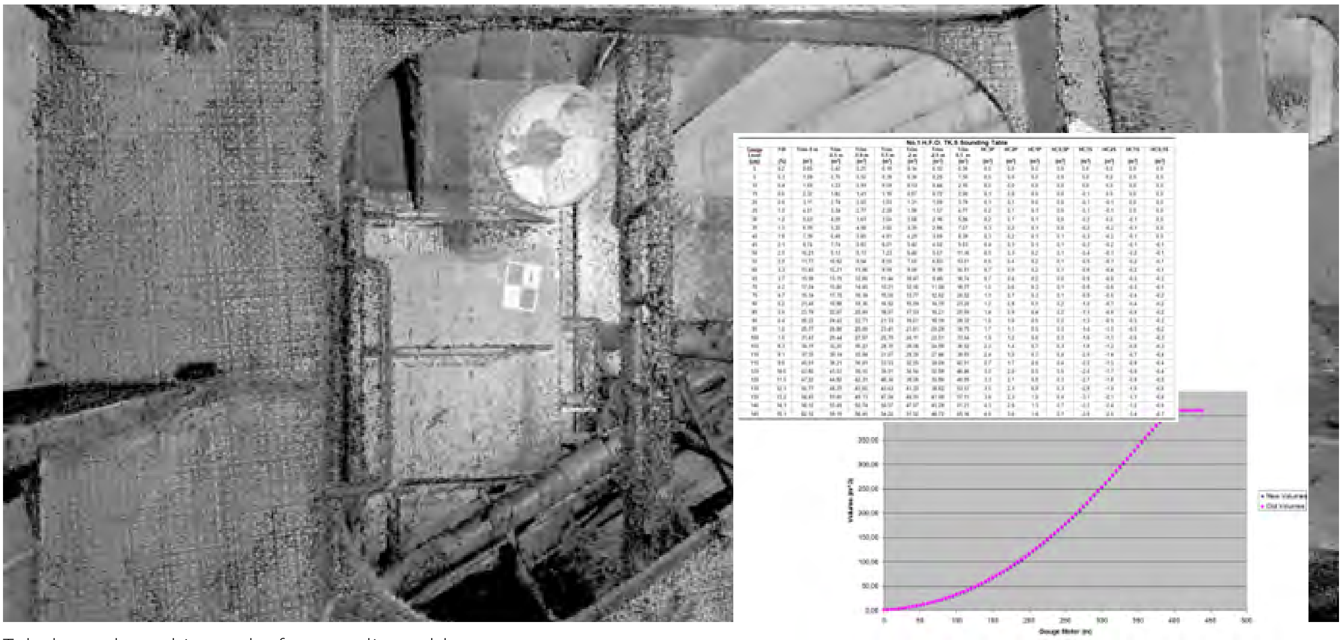
Ship capacity management is an important operating and economic factor. It is crucial for crew and shipping agencies to have reliable information about the accurate ship capacity plan to schedule any orders for fuel, raw materials, and ship commanders to manage ballast distribution. In this project, METRICA team was contracted to scan two heavy fuel oil tanks. Our team used Leica ScanStation P40 to capture the necessary information.
Field work: less than a working day for each wing tank, 2 staff members
Number of scans: 34 laser scanner setups
Office work: 1 day registration, 1 staff member / 2 weeks processing

Benefits

- High accuracy tank surveying (as-built)
- Extremely fast measurement
- No need for dry-docking
- No usage of rough approximations and trigonometric equations
- Field measurements of any size/shape/deadwood

LEICA SCANSTATION P40

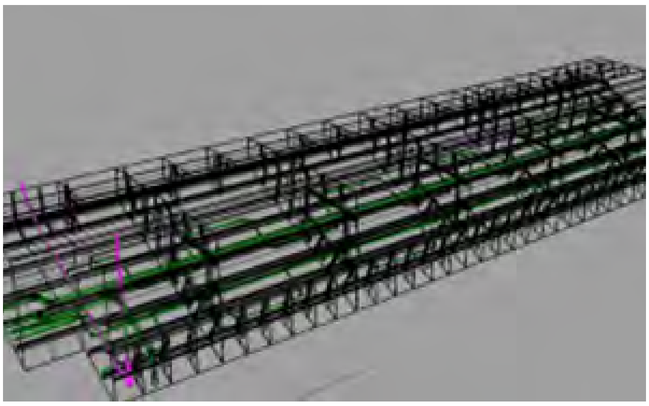
Leica ScanStation P40 deliver highest quality 3D data and High-Dynamic Range (HDR) imaging at an extremely fast scan rate of 1 million points per second at ranges of up to 270m. Unsurpassed range and angular accuracy paired with low range noise and survey-grade dual-axis compensation form the foundation for highly detailed 3D color point clouds mapped in realistic clarity.



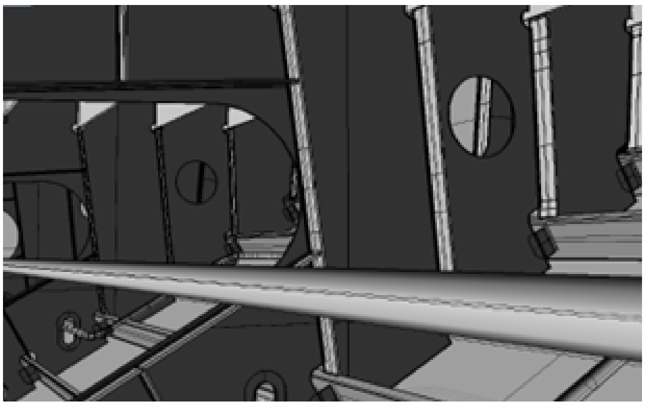
Tabular and graphic results for sounding tables

Methodology

Using Leica ScanStation P20 and the powerful point cloud software Leica Cyclone and CloudWorx, the scans of the wing HFO tanks were performed, registered and processed to a common coordinate system (ship CS). It took 34 setups and 16 working hours of measurements to cover the essential surfaces. This project was challenging because the oil sludge on wing surfaces hampered scanning and personnel movements. B&W targets were utilized mainly for registration purposes. After fieldwork, our team used Leica Cyclone software for the registration of the scans. Then HFO wing tank details, longitudinal, transverse frames, piping network and sounding pipe were modelled. The final 3D model was imported to a specialized tank calibration programming routine. HFO wing volumes were calculated for all possible trim and heel scenarios, even the keel condition.



Final 3D Model of one of the HFO wing tanks



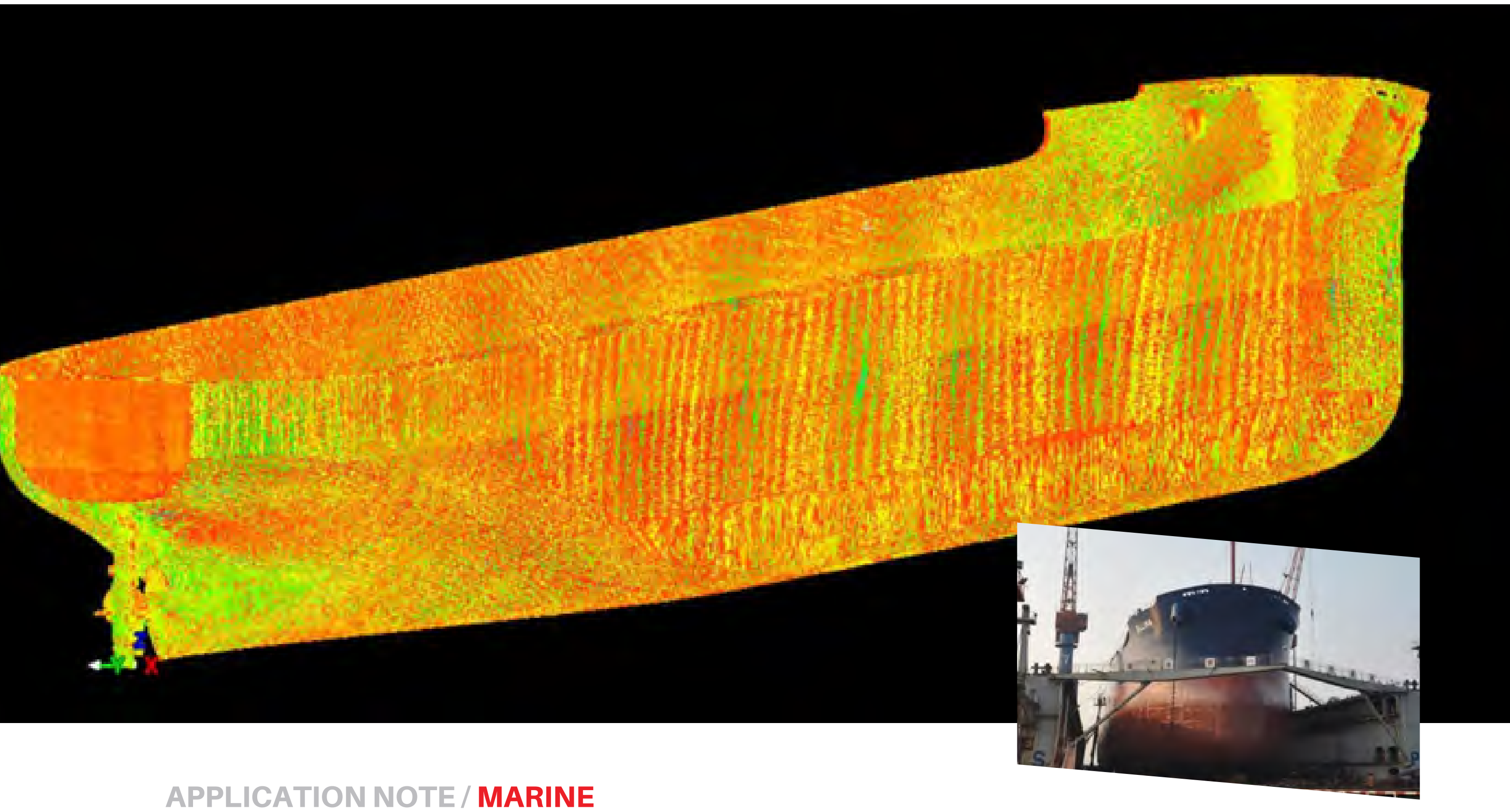
Tabular and graphic results for sounding tables

Instrumentation / software

Leica ScanStation P20
Leica Cyclone
Leica CloudWorx

Deliverables

Sounding tables for any trim/heel scenario
Intensity point cloud of HFO wing tanks



APPLICATION NOTE / **MARINE**

BULK CARRIER SHIP LINES & GEOMETRICAL INSPECTION OF KEEL LINE

Overview

Our team fulfilled 3D Scanning measurements and ship's lines production of a Bulk Carrier in Quindao Beihai Shipyards China. The ship's geometry was captured through detailed 3D scanning from every possible measurement position and allowed us creating a unified point cloud of almost a billion points.
For the measurements, our team used Leica ScanStation P20. Point clouds were registered with the use of targets and cloud constraints. Coordinates of the targets were measured using the total station Leica TS30.
Fieldwork: 2 days, 2 staff members
Number of setups: 130
Office work: 5 days, 1 staff member

Challenges

- Tight schedule
- Large number of surfaces & areas
- Complex geometries

Benefits

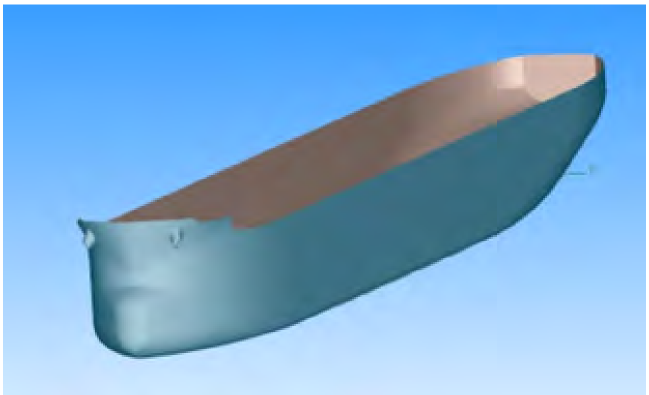
- elimination of field interferences
- less rework
- increased productivity
- fewer requests for information
- cost reduction
- time-saving


Leica ScanStation P20 in action. Scans were mainly taken during night hours. Total Station leica TS30 in action.

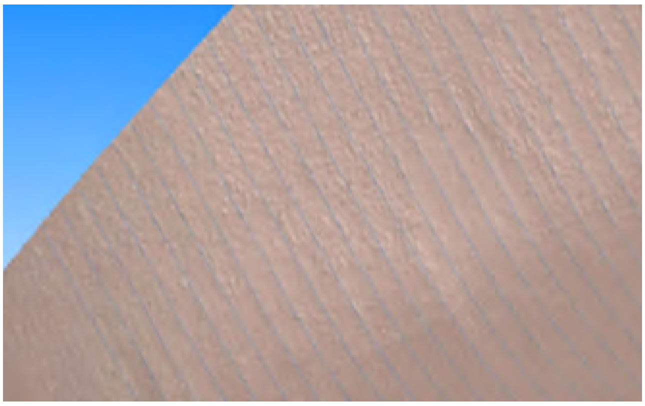
Methodology

METRICA team used Leica ScanStation P20 for gathering the raw data. For the registration of the point clouds, targets were placed and measured with total station Leica TS30 for more accurate results. It took 130 setups and only two days of measurements to cover the entire ship.

In the office, we used Leica Cyclone software for the registration of the point clouds. Then the points of interest were separated from irrelevant objects. After that, with the use of Leica AXYZ software, we established the coordinate system of the ship. Finally, using 3D Reshaper software, the registered point cloud was converted to mesh, to produce all the essential geometrical inspections (keel line deflections) and final ship lines.



Model of the ship as a 3D mesh derived from the point cloud



Mesh with the superimposed sections. Anyone can observe the closeness between the discernible frames of the mesh and the section lines (at the nominal frame spacing)

Instrumentation / software

Leica ScanStation P20
Leica TS30
Leica Cyclone
Leica Axyz
3D Reshaper

Deliverables

Point cloud of ship's hull
Ship mesh
As-built Ship lines extraction
Technical report

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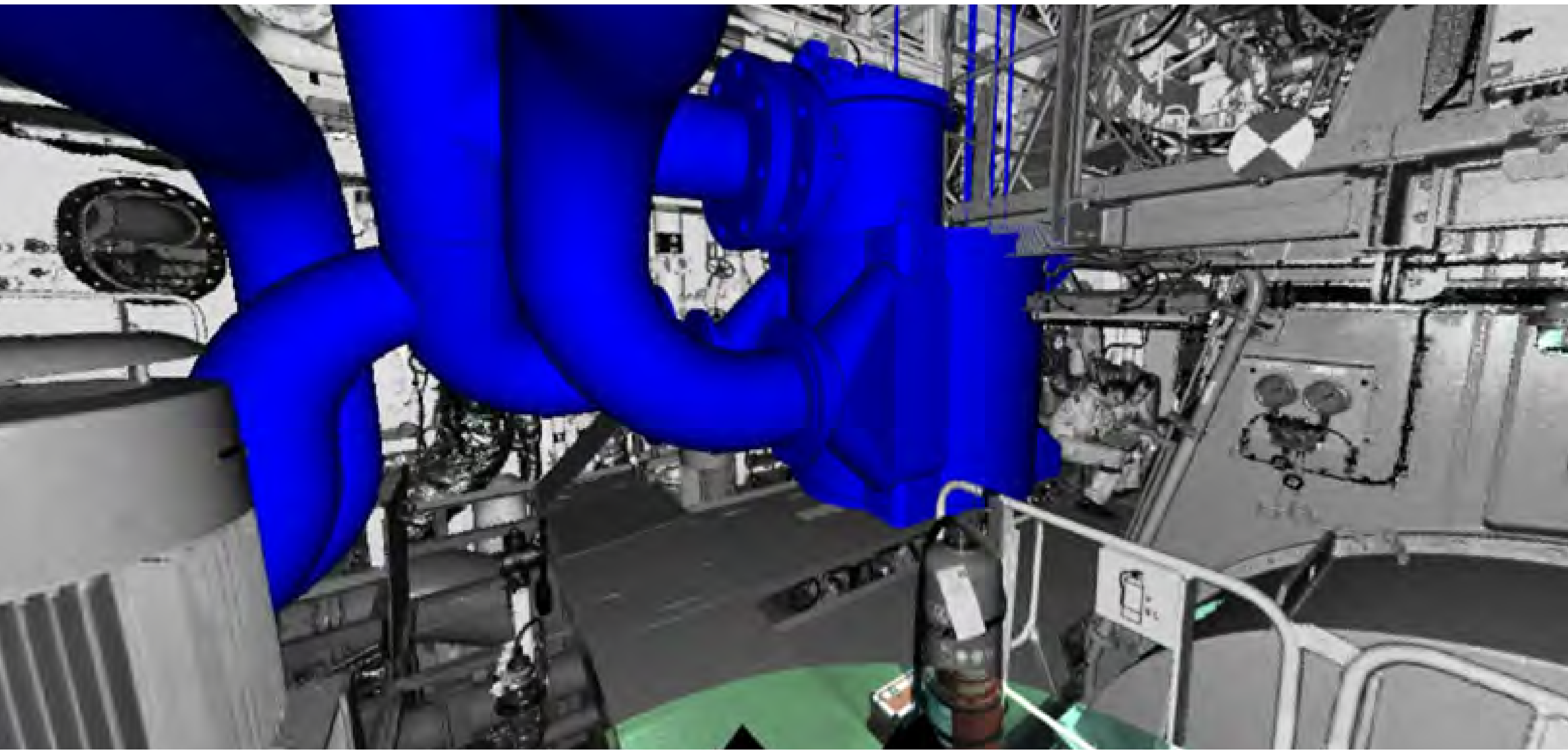


APPLICATION NOTE / **MARINE**

BALLAST WATER MANAGEMENT SYSTEM INSTALLATION MEASUREMENTS

Overview

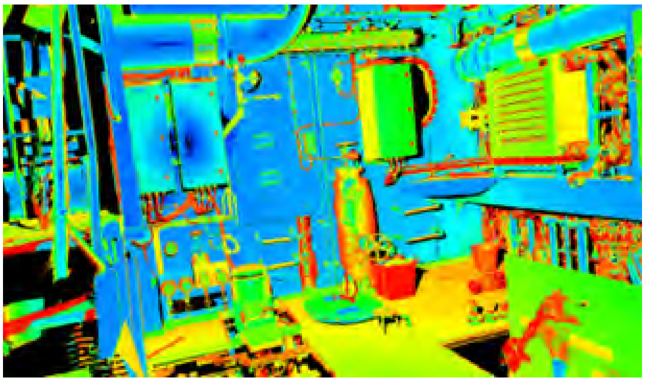
For the installation of a Ballast Water Treatment system available space is an undisputable factor for any further action. Measuring an engine room with traditional methods becomes a nightmare for a project engineer because of the complexity and the strict time schedules of the vessel's program that complicate the accurate and complete surveying. Additional many ships have not as-built drawings updated with any modifications. Terrestrial LIDAR technology is the state-of-the-art solution for such kind of cases. METRICA was contracted to scan a pump room to produce and deliver the accurate 3d model of the area. Our team used Leica ScanStation P20 to do the necessary fieldwork. We completed our job via 20 laser scanner setups in one working day.

Challenges

- Tight schedule
- Large number of surfaces & areas
- Complex geometries

Benefits

- High accuracy surveying (as-built)
- Time – saving
- Easy modelling
- Increased productivity
- On ship measurements / No need for dry docking
- No in-situ future rework
- Direct BWT installation system (CAD environment)

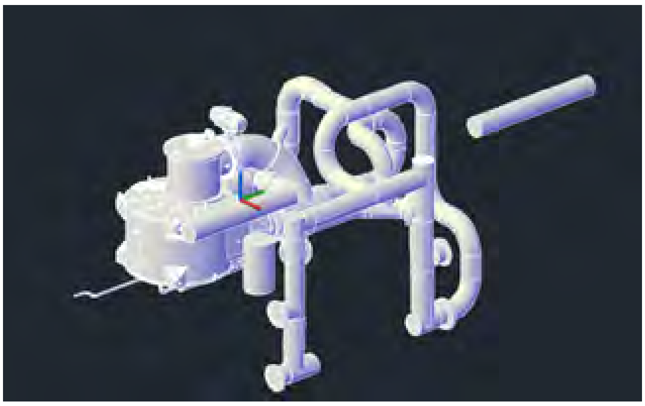
Registered point cloud of pump room (True Color and Intensity values)

Methodology

Fieldwork / Office work

With the Leica ScanStation P20 and the support of the Leica Cyclone and CloudWorx software, the scans of the pump room were measured, registered and processed to the same coordinate system. It took 20 setups and only 5 hours of measurements to cover the essential surfaces. By the time each scanning is completed, a real-time checking is accomplished via the instrument's (P20) screen to verify that critical data are acquired. That guarantees that no additional visits to the ship will be required. For the registration of the scans, our team used smart targets for accurate results.

In the office, our team used Leica Cyclone software for the registration of the scans. Then, the points of interest are separated from irrelevant objects. With the proper guidance of the project engineers, essential elements of the pump room for BWT pipes and details were modelled/drawn. The final 3D BWT model, best positioned to the pump room space, with registered point clouds were imported and presented to a web-enabled panoramic point cloud viewer (Leica TrueView). In this platform, any user can view pan, zoom, measure and mark up point cloud and the superimposed 3D model.

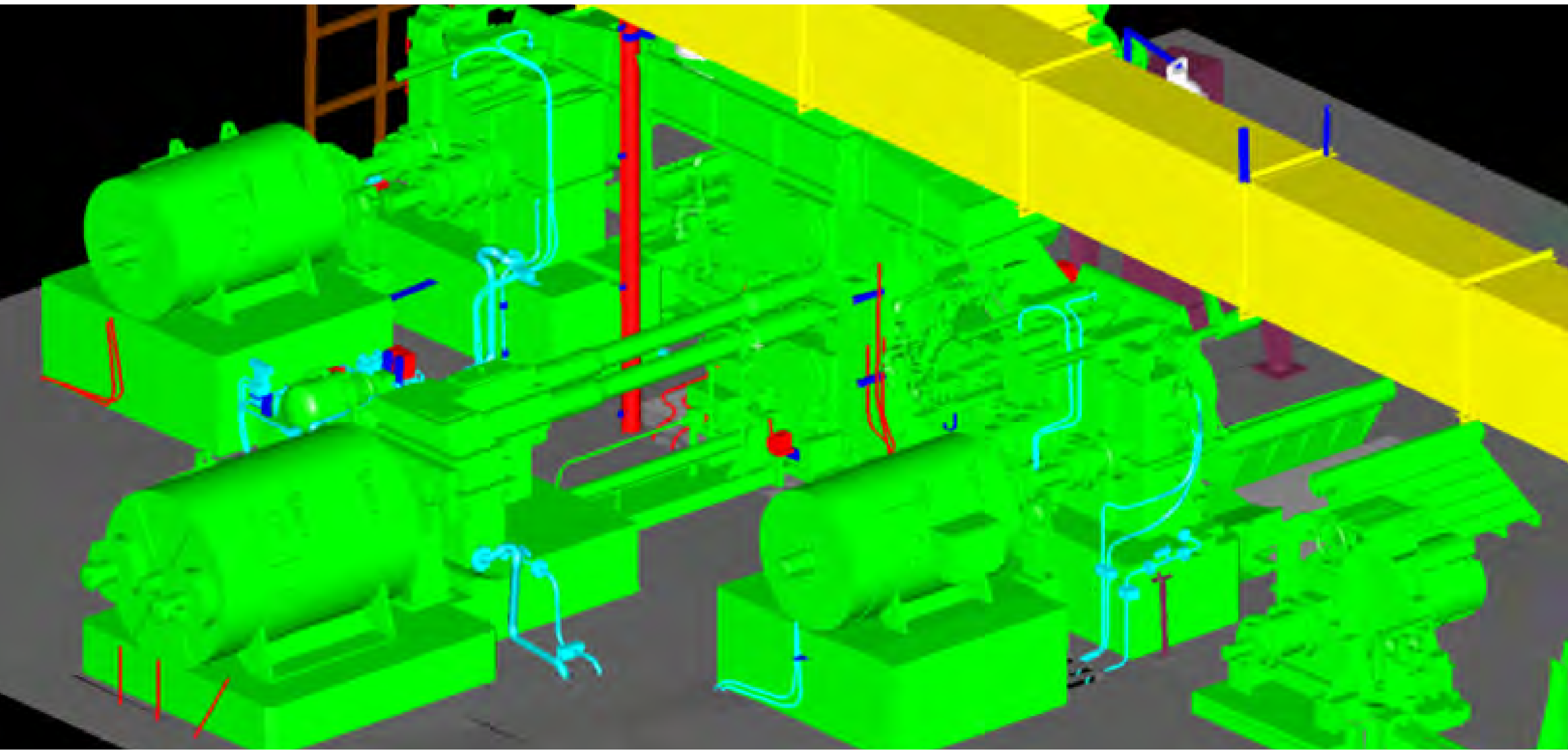



Instrumentation / software

Laser Scanner Leica ScanStation P20
Leica Cyclone
Leica Cloudworx
Leica TruView

Deliverables

Intensity or/and true color point cloud
Crucial pipes & engine room details drawing/modelling
Web-enabled panoramic point cloud viewer with the final Ballast Water Treatment Installation 3D model



APPLICATION NOTE / **INDUSTRIAL**

3D SCANNING & MODELING OF INDUSTRIAL INSTALLATIONS

Overview

As accuracy is critical in the revamp process of new production facility systems, our team was contracted to realize a series of 3D scanning measurements of the industrial area to create and deliver 3D models. To produce an accurate 3D model of the infrastructure, our team used the powerful Leica ScanStation P40 laser scanner to collect 3D Point Cloud data used to create a detailed 3D model (Infrastructure Model).

Challenges

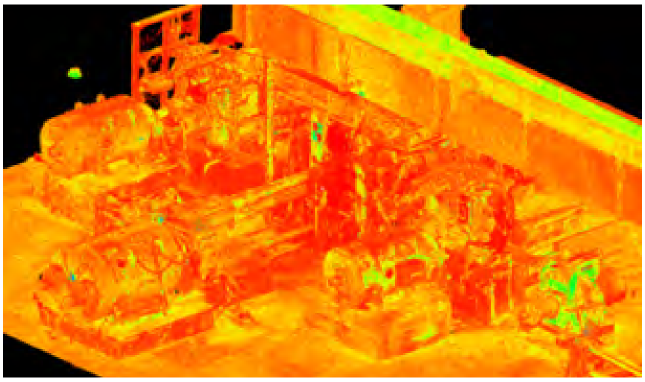
- The daily working schedule of the plant
- The complexity of the installation (the variety of materials, their reflection coefficient, oily or unclean external surfaces and accessibility)
- Elimination of movements/ vibration
- Cleaning condition of the external surfaces

Benefits

- Elimination of field interferences
- Less rework
- Increased productivity
- Fewer requests for information
- The decrease in time from the start of construction to facility turnover

METRICA
When it's a matter of trust

View of the industrial installation

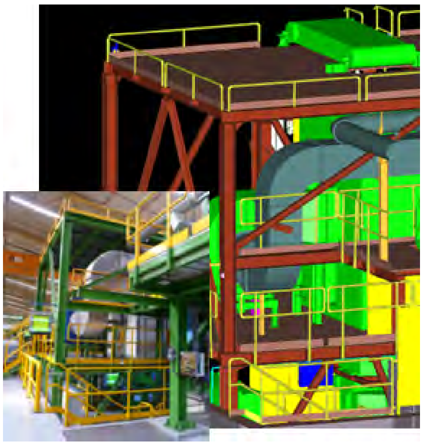


Initial Point Cloud *the 3D model appears in the front-page picture

Methodology

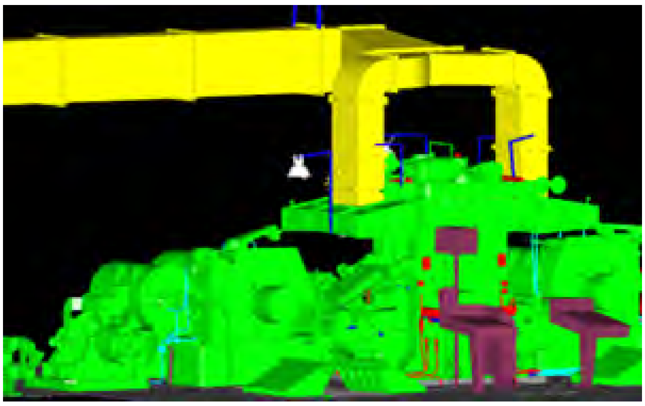
The first action was to place an adequate number of black and white targets around the installation. These marks were well recognizable, and they had the size of an A4 paper. Additionally, four smaller targets were used to offer additional constraints. The installation was covered through 47 laser scanner setup positions with over 2 billion points.

After measurement series completion, data were loaded to the Leica Cyclone 9.2.1 software for further processing. Then the point clouds were registered using the mathematical algorithm for 100% of the joint part between two point clouds. After connecting the point clouds, the final unified point cloud was ready to be cleaned of all irrelevant objects captured during scanning. After that, the creation of the model began. Our team used geometric primitives to draw the objects. The accuracy of the items is better than 5mm. The deliverables (3D model) were delivered for the design and installation of the system.



Existing Installation vs 3D Model

Production facility system



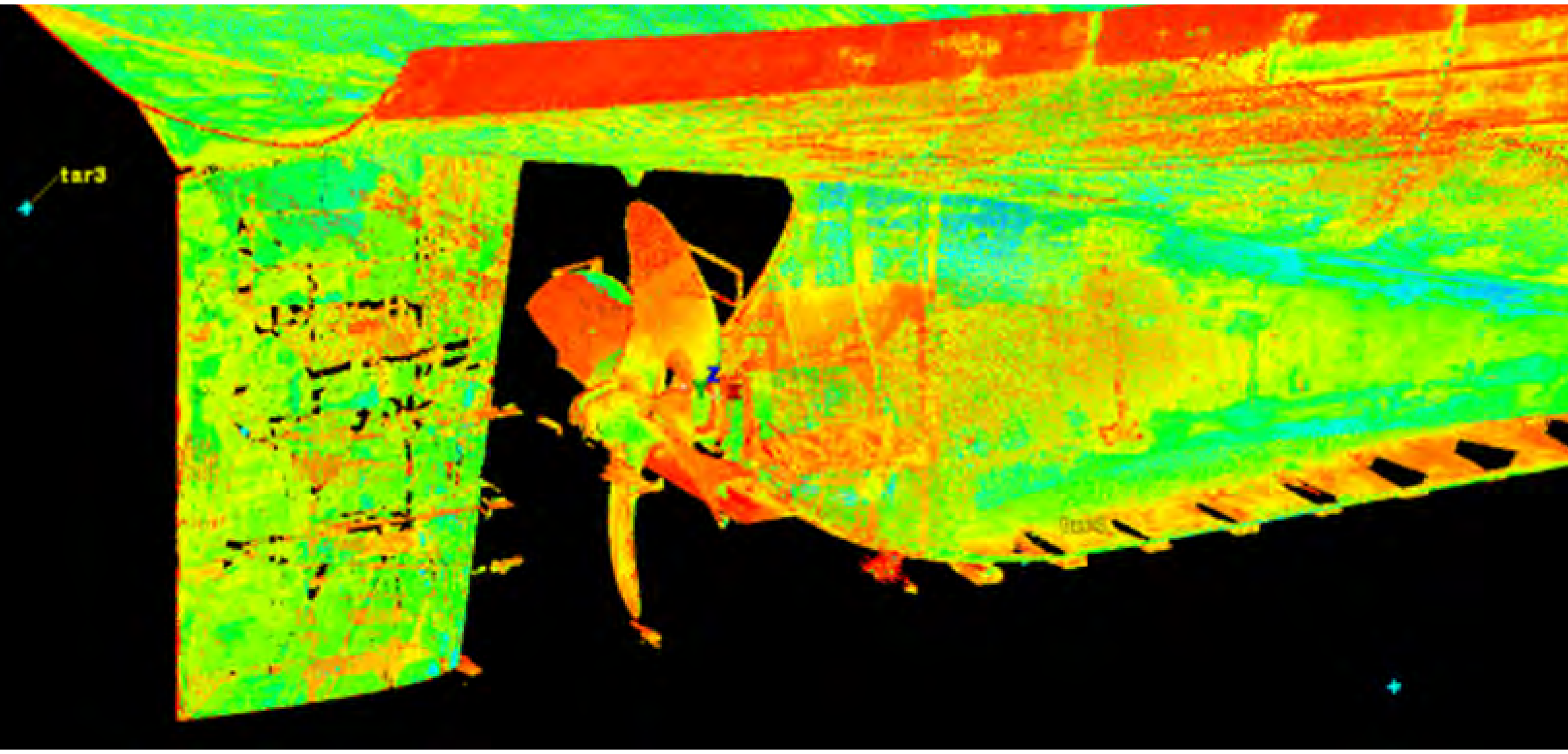
3D model

Instrumentation / software

Laser Scanner Leica ScanStation P20
Leica Cyclone
Leica Cloudworx
Leica TruView

Deliverables

Intensity or/and true color point cloud
Crucial pipes & engine room details drawing/modelling
Web-enabled panoramic point cloud viewer with the final Ballast Water Treatment Installation 3D model



APPLICATION NOTE / **MARINE**

BECKER MEWIS DUCT INSTALLATION

Overview

The scope of work in this project was the direct and accurate placement of Becker Mewis Duct on the stern position of a Bulk Carrier. Specifically, our team defined the excess material on the duct device and the exact installation position on the ship using Leica ScanStation P20 and the industrial total station Leica TS30.METRICA S.A. team accomplished the detailed scanning of the duct, the ship stern and marked the exact welding – cutting positions.

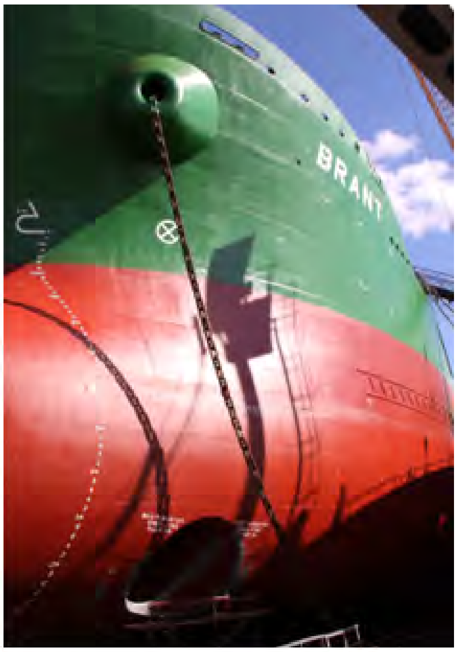
Fieldwork: 2 days, 2 staff members, Office work: 1 day, 1 staff member

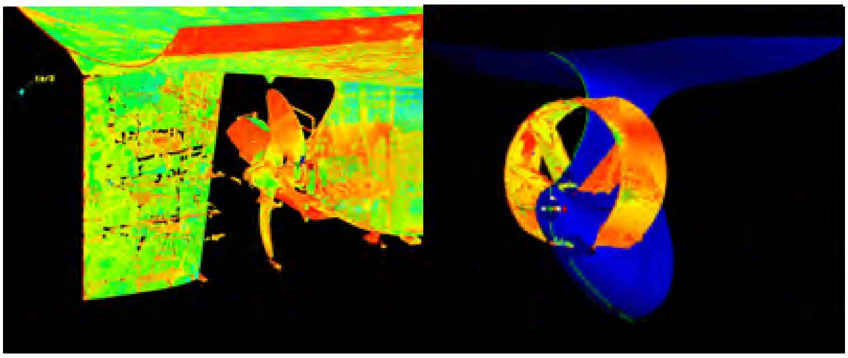
Using Leica ScanStation P20 and Leica Cyclone software, the scans of the duct and the ship were collected and registered. For the registration of the scans, targets were placed and measured with Leica Total Station TS30 for more accurate results. It took 16 setups and only 8 hours of measurements to cover the essential surfaces. In the office, point clouds were registered to a common coordinate system.

Benefits

- Accurate marking of cutting – welding points
- Fast and reliable process than traditional procedures
- State-of-the-Art Measurement Assisted Erection

Perspective view of the ship propeller system on which the duct will be placed –
Duct mesh and point clouds on Leica Cyclone software





Methodology

With the Leica ScanStation P20 and the support of the Leica Cyclone and CloudWorx software, the scans of the pump room were measured, registered and processed to the same coordinate system. It took 20 setups and only 5 hours of measurements to cover the essential surfaces. By the time each scanning is completed, a real-time checking is accomplished via the instrument's (P20) screen to verify that critical data are acquired. That guarantees that no additional visits to the ship will be required. For the registration of the scans, our team used smart targets for accurate results.

In the office, our team used Leica Cyclone software for the registration of the scans. Then, the points of interest are separated from irrelevant objects. With the proper guidance of the project engineers, essential elements of the pump room for BWT pipes and details were modelled/drawn. The final 3D BWT model, best positioned to the pump room space, with registered point clouds were imported and presented to a web-enabled panoramic point cloud viewer (Leica TrueView). In this platform, any user can view pan, zoom, measure and mark up point cloud and the superimposed 3D model.

Instrumentation / software

Leica ScanStation P20
Leica TS30
Leica Cyclone / Leica Register
Leica AXYZ
3D Reshaper

Deliverables

On site duct and ship installation markings
Technical Report

APPLICATION NOTE / **MARINE**

3D SCANNING & MODELING ON A M/Y

Overview

The main scope of this project was the detailed 3D laser scanning of specific internal areas on a M/Y. Our team performed measurements using state-of-the-art sensors such as the Leica RTC360 laser scanner with relevant accessories. As a result, our engineers used the dense point clouds to create 3D meshes for each area of interest for further modeling purposes.

Challenges

- Numerous surfaces to be captured
- Complex geometries and details
- Tight schedule for fieldwork and office work
- During the measurements, the vessel was under extensive repairing and renovation services

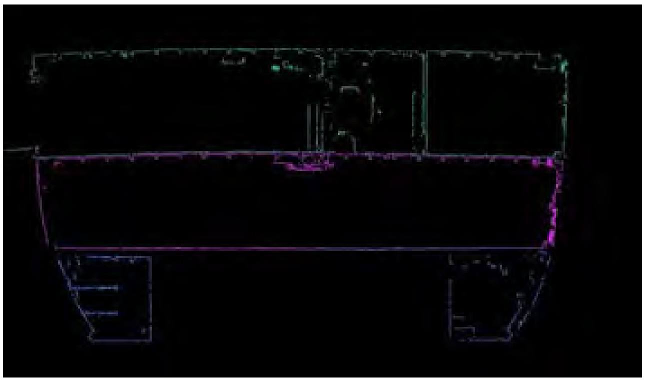
Benefits

- Time-saving
- Increased productivity
- Cost reduction
- True as-built information, no assumptions
- Less rework

LEICA RTC360 3D LASER SCANNER

The Leica RTC360 3D reality capture solution empowers users to document and capture their environments in 3D, improving efficiency and productivity in the field and in the office through fast, simple-to-use, accurate, and portable hardware and software. The RTC360 3D laser scanner is the solution for professionals to manage project complexities with accurate and reliable 3D representations and discover the possibilities of any site.

View from the 3D scanning procedure on main deck

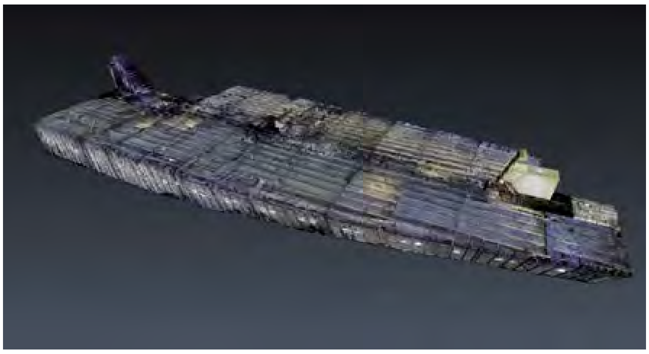


After registration, the point cloud of each deck was aligned to the established ship coordinate system

Methodology

Our team performed the collection, import, processing and presentation of geodetic observations and point clouds using state-of-art sensors and software/hardware resources. Our engineers used terrestrial laser scanning technology, Leica RTC360 laser scanner, and other classic geodetic techniques to capture every hull detail. Leica RTC360 measures up to 2 million points per second with the parallel usage of High Dynamic Range (HDR) camera for attributing true-colour tones to the final cloud. Furthermore, the sensor has a Visual Inertial System (VIS Technology), which enables the in-situ registration of station setups on a tablet (wirelessly) and evaluates the relative position of laser scanner stations in space.

Office work: Before any registration attempt, raw point clouds were filtered – cleaned from noise and other reflections, such as moving or/and afloat objects, personnel, abnormal material responses etc. Scan setups were registered into one final scan dataset using cloud and target constraints on Leica Cyclone Software.
After the registration process and the approval of the final statistical results, our team inspected all point clouds so that there were not any visually gross errors or any remaining remarkable gaps.
Because of the large number of points, it was necessary to decimate the final dataset, so our team unified all point clouds in one final dataset. The unify process reduced the size of the point cloud, helping the performance without quality degradation of the data. In addition, the unified point clouds were aligned to the best approximate ship coordinate system. After that, we inserted the point cloud data from each deck into Leica 3DR, and our team proceeded to create the 3D mesh.



View of the final point cloud (true color)
Main, Tween & Stowage Deck

Tween Deck 3D mesh

Instrumentation / software

Leica RTC 360 Laser Scanner
Leica Cyclone Field 360
Leica Cyclone / Cyclone Register 360
Leica Cyclone 3DR

Deliverables

3D meshes for each of the areas of interest

APPLICATION NOTE / **MARINE / YACHTING**

MEASUREMENTS FOR DRY DOCKING PROCEDURES ON M/Y

Overview

The main scope of the measurement series was the geometrical inspection of M/Y deformations during the docking process and the geodetic guidance to establish the afloat condition of the yacht in the graving dock (after the end of docking actions).

Challenges

- Tight schedule for fieldwork and office work
- Complex geometries

Benefits

- Accurate and fast geometrical inspection of afloat and drydocking conditions
- Actions for the proper placement of the yacht if needed
- Minimizing serious hull deviations that could disturb further alignment procedures on vessel propulsion systems

INDUSTRIAL TOTAL STATION LEICA TDRA6000

The Leica TDRA6000 is one of the most accurate total stations ever designed for industrial use. This Leica Geosystems Total Station automatically target both CCR and tape targets and can even measure without targets maintaining a typical reflectorless accuracy of 1mm. Optimized for use within 300 meters and combined with the Leica Geosystems PowerSearch module, the Leica TDRA6000's tracking performance is simply unbeatable.

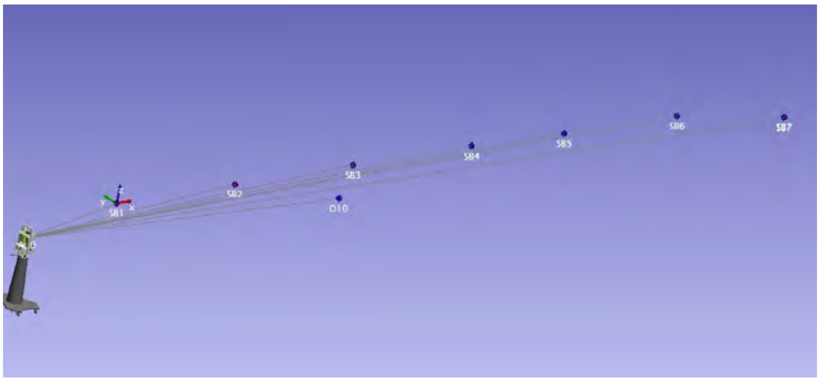


Image from Spatial Analyzer

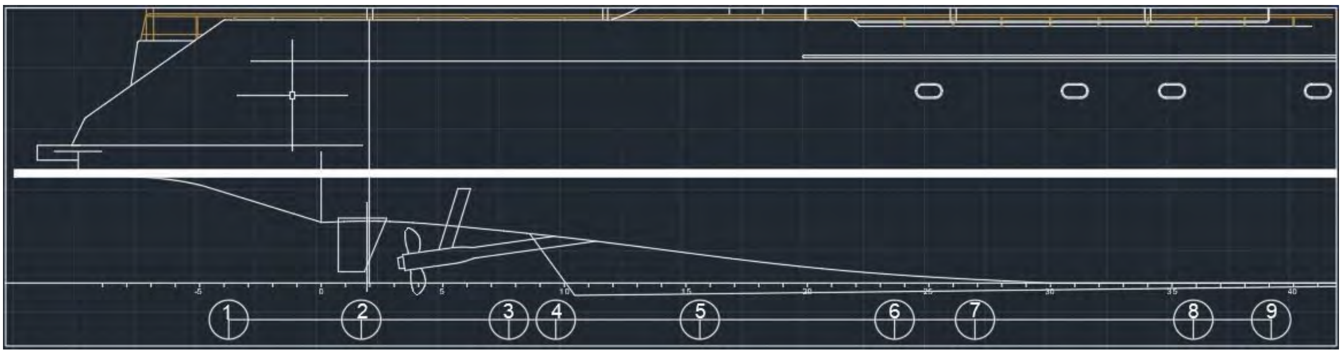
Measurements with Leica TDRA6000

Methodology

The monitoring of afloat and docking conditions took place by measuring a series of retro-reflective targets. Our team placed seventeen (17) marks on the bulwark and ship side corridors. The dense distribution was mainly focused above the vessel's propulsion system (from the engine room to the propeller). Targets had been pre-aligned to the common coordinate system (CCS).

All marks were measured from the vessel's aft position on both sides (SB and Port) for visibility reasons.

The positional accuracy had a standard deviation better than $\sigma xyz = \pm 0.5$ mm. Using Industrial Total Station Leica TDRA6000 our team ensured the proper shooting angles to the targets. The geodetic measurements were thoroughly planned not to disrupt the docking process and to have a direct result of the actual values of deformation and relevant corrections. It should be referred that dry docking was checked after the ship had been settled on basements and crane support had been removed.



Position of control points

Instrumentation / software

Leica TDRA6000 Industrial Total Station
Spatial Analyzer s/w

Deliverables

Technical Report with measurement procedures description and measurement results

APPLICATION NOTE / **MARINE / YACHTING**

3D LASER SCANNING FOR EXTRACTION OF NAVAL LINES

Overview

The main scope of this project was the 3D Scanning of the external hull of a 50 meters yacht for the extraction of naval lines. Our team performed measurements using the terrestrial laser scanner Leica RTC360 with relevant accessories. In the office, we used the dense point clouds to produce as-built sections of the yacht.

Challenges

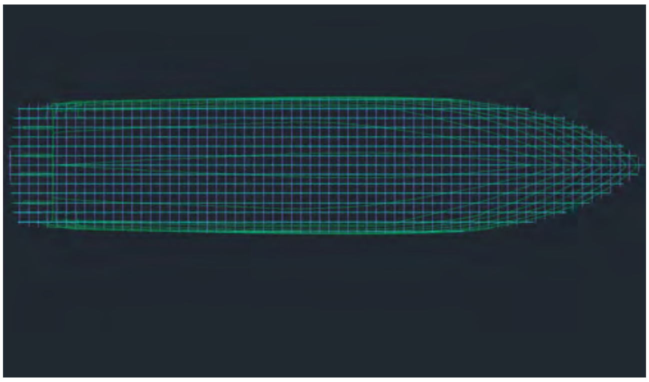
- Complex geometries and details
- Outdoor fieldwork - weather conditions

Benefits

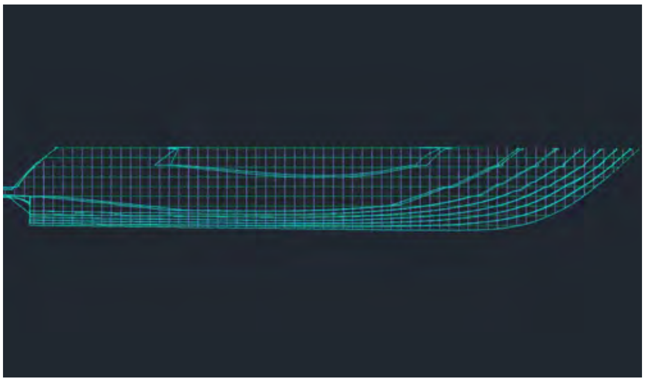
- Time-saving
- Increased productivity
- High accuracy
- Cost reduction

LEICA RTC360 3D LASER SCANNER

The Leica RTC360 3D reality capture solution empowers users to document and capture their environments in 3D, improving efficiency and productivity in the field and in the office through fast, simple-to-use, accurate, and portable hardware and software. The RTC360 3D laser scanner is the solution for professionals to manage project complexities with accurate and reliable 3D representations and discover the possibilities of any site.



Sections



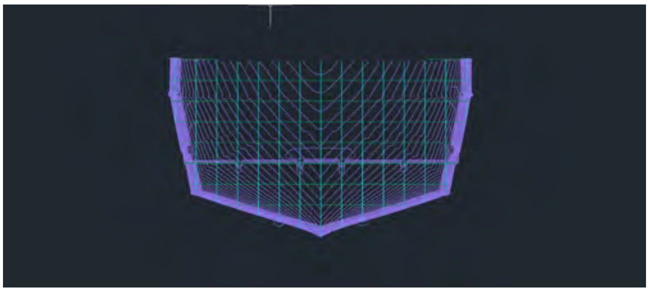
Waterlines

Methodology

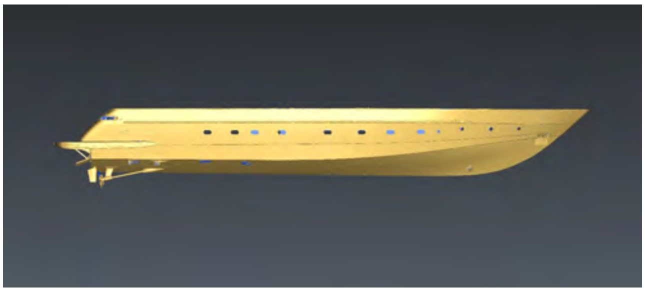
Terrestrial Laser Scanner technology was our approach combined with other classic geodetic techniques as the most suitable methodology to capture every hull detail. The whole measurement procedure lasted one (1) day.
Before the scanning procedure, our team defines:

- the proper route of scanning setups
- the resolution
- the quality levels
- the production of final deliverables

In this case, our engineers used a Leica RTC360 laser scanner with relevant black & white (HDS) targets. The external hull and the areas of interest on the main and sun deck were covered through 60 laser scanner setups.
Leica Cyclone Platform Software was used for registration and other point cloud processing. All point clouds were registered and cleaned from irrelevant objects on Leica Cyclone Software.
For registration purposes, there were used cloud and target constraints. The mean absolute error for all registrations was 2 mm, and the max constraint error vector was 8 mm. All scan setups were registered into one final scan dataset using cloud and target constraints. After the registration process and visual inspections, point clouds were joined together to form one unified point cloud, which was aligned to the best approximate ship coordinate system according to the instructions of the project engineer.
After defining an approximate coordinate system and the alignment of the point cloud, our team created a mesh from the aligned point cloud utilizing Leica 3DR software. The 3D unstructured mesh was inspected for topological errors. From the 3D mesh, naval lines e.g. sections, buttocks and waterlines, were extracted (per 0.5m) and finally delivered in CAD format (.dxf, .dwg).



Buttocks



3D mesh inside Leica Cyclone 3DR

Instrumentation / software

Leica RTC 360 Laser Scanner
Leica Cyclone Field 360
Leica Cyclone / Cyclone Register 360
Leica Cyclone 3DR

Deliverables

Naval lines (Sections, Buttocks, Waterlines) in CAD format
3D Mesh model

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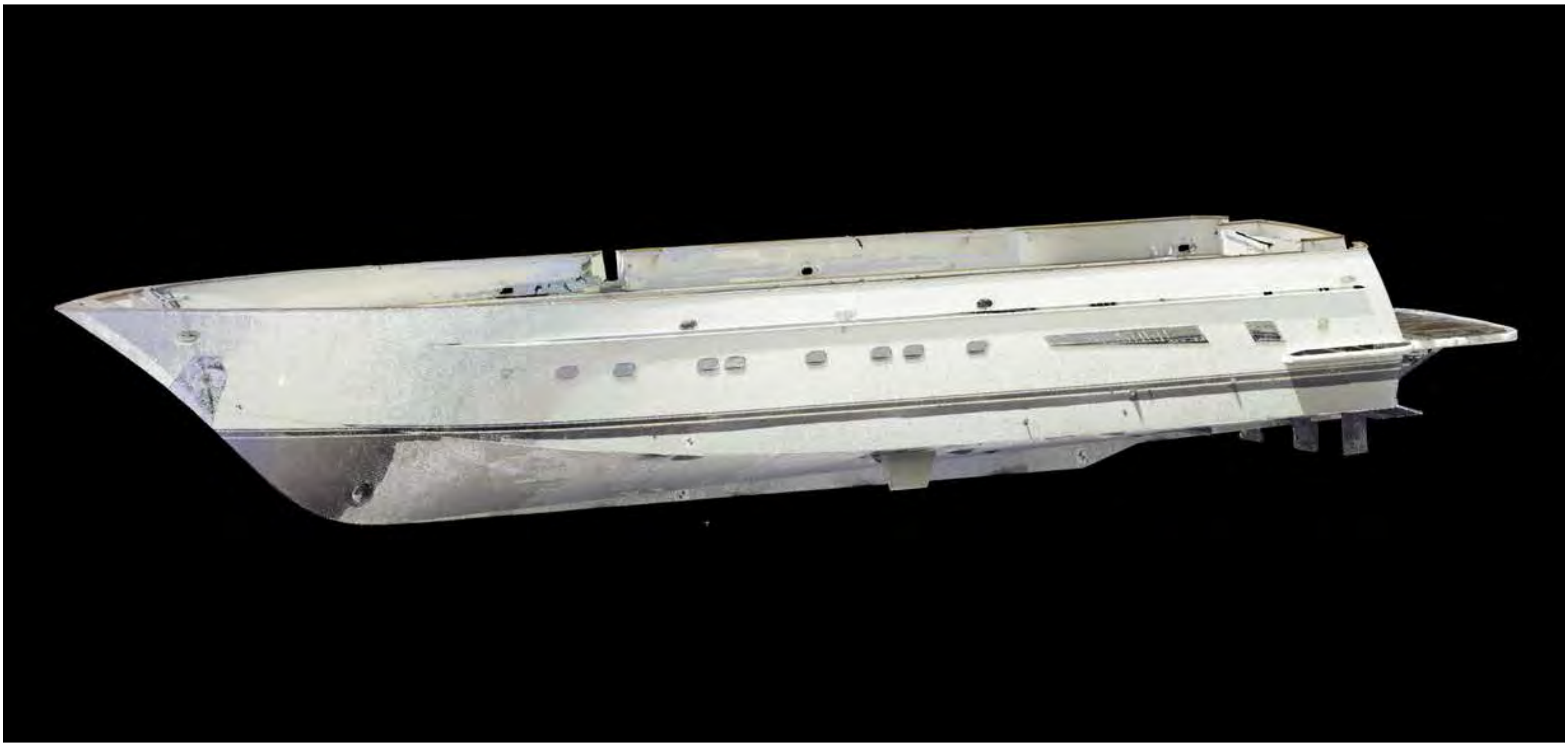


APPLICATION NOTE / MARINE / YACHTING

M/Y Yacht Ship Lines and 3D model Extraction

Overview

The main scope of this project was the detailed scanning of the external hull surface of the motor yacht and the extraction of ship lines and 3D models. The application was fulfilled via the usage of terrestrial laser scanning and industrial total station technology. As a result, our engineers used the dense point clouds, the 3d model and the as-built sections, to create buttocks and waterlines of the yacht.

Challenges

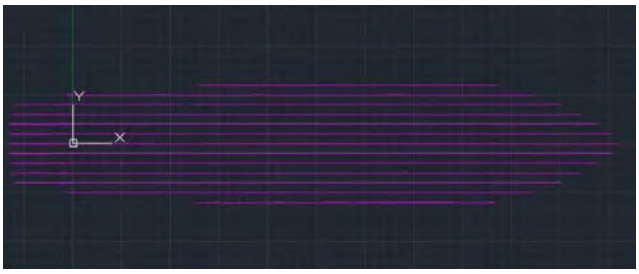
- Tight schedule for fieldwork and office work
- Numerous surfaces to be captured
- Complex geometries and details

Benefits

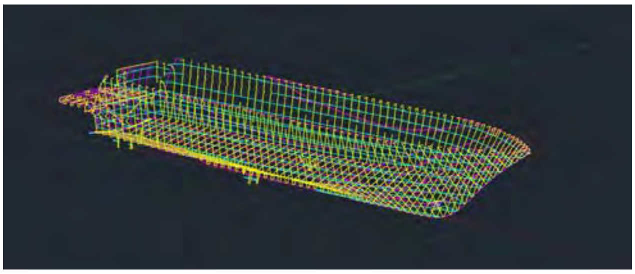
- Time-saving
- Increased productivity
- Less rework
- Cost reduction

LEICA RTC360 LASER SCANNER

The Leica RTC360 3D reality capture solution empowers users to document and capture their environments in 3D, improving efficiency and productivity in the field and in the office through fast, simple-to-use, accurate, and portable hardware and software.



Buttocks

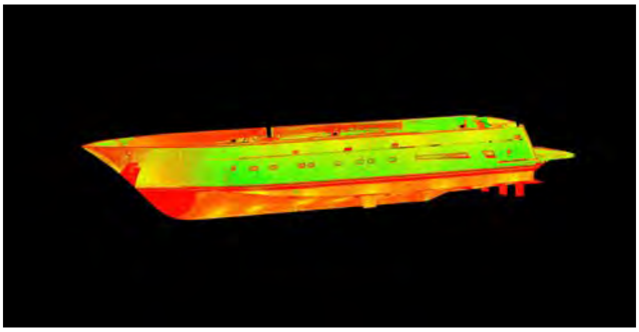


Lines in CAD

Methodology

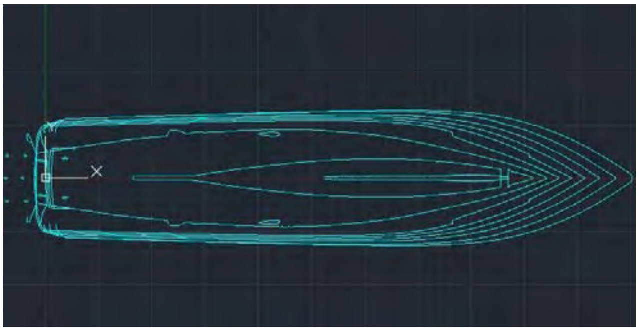
The team used terrestrial laser scanning technology combined with other classic geodetic techniques to capture every hull detail. Leica RTC 360 laser scanner, ultra-high-speed pulsed time-of-flight scanner, and Leica TDRA 6000 Industrial Total Station enabled the detailed and accurate description of the mold geometry.

Office work: All point clouds were registered and unified to a final point cloud using cloud and target constraints on Leica Cyclone Software. After that, the final point cloud was georeferenced to the ship's coordinate system, and we created the 3D mesh model using Leica 3DR software. Finally, from the 3D mesh, sections, buttocks and waterlines were extracted (X, Y and Z axis). The sections were designed every 0.5m and were finally delivered in CAD format.

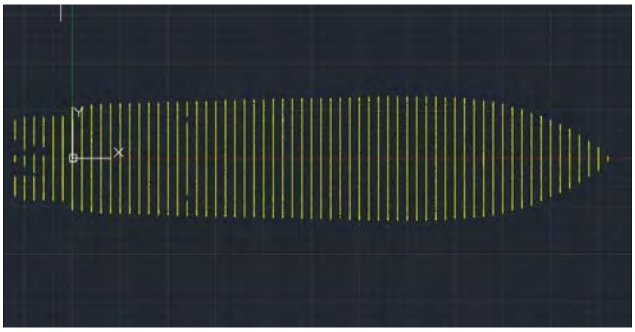


Point Cloud Intensity

Point Cloud True color



Waterlines



Sections

Instrumentation / software

Leica RTC360 Laser Scanner
Leica TDRA 6000 Industrial Total Station
Leica Cyclone
Leica 3DR

Deliverables

- 3D mesh
- Sections, buttocks and waterlines in .stl and .dxf file format

MARINE

METRICA
When it's a matter of trust

Propulsion system alignment on new building super yacht

Overview

The measurements were realized in Turkey Shipyards, in dry dock conditions. Special attention was given to the environmental conditions and the wind current as line bore application requires attention in detail, especially when the length of the shaft is long (21m approx). Our team used a high sampling (filter) to capture data to avoid turbulence, etc.

The equipment used on this application was Easy Laser Line Bore System E 950.

The laser emitter was mounted on the aft v-bracket. Seven positions were inspected in total; the 7th position was on the gearbox flange. Four of them were located on the two v-brackets, two on the stern tube. The last position of the inspection was the gearbox flange. Our team performed measurements also to achieve fine alignment between the gearbox and the engine. This procedure was followed on both propulsion systems of the Super Yacht.

Fieldwork

Line bore: The first procedure is the rough alignment of the laser beam to the axis of the rotation, then the fine alignment followed. The next step is the placement of the detector consistently to all seven essential positions. Then with our guidance, the personnel of the shipyard moved the bearing pockets to reach fine alignment.

Benefits

- Time saving
- Precise
- Increased productivity

EASY-LASER®

Gearbox to engine alignment

Fieldwork

Bearing pockets – Gearbox flange co-linearity:

Since we had aligned the bearing pockets and the gearbox flange, the next step was to check the alignment of the axis of rotation of the gearbox flange to the axis that the bearing pockets define. Our team used an advanced methodology based on its experience and deep knowledge, and after corrective movements of the gearbox, the co-linearity was established.

Gearbox-Engine alignment:

The final step was the alignment of the engine to the gearbox. A series of measurements showed the nesessary correction movements. The shipyard personnel, upon our guidance, moved the engine, and we reached fine alignment.

During the procedure, our team had access to real-time monitoring of the measuring values. At the end of every alignment session, the relevant series of measurements were repeated to verify the results. The same procedure was followed for both propulsion systems.

Laser transmitter on the aft V-bracket

Instrumentation / Software

- Easy Laser Line Bore System E 950

Deviverables

- Reports

Do you have a similar project?

Contact our team at info@metrica.gr

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APPLICATION NOTE / **MARINE**

RUDDER GEOMETRY INSPECTION ON A CONTAINER SHIP AFTER COLLISION

Overview

A rudder is one of the most important components in any marine vessel. It enables the helmsman to steer, control, and direct the ship in the sea. A damaged rudder poses a high risk to the structural integrity of the ship. In this case, our main goal was the geometry inspection of the rudder of a container ship after its collision.

Our team inspected the verticality between the thrust bearing plane and the bushes, the flatness of the thrust bearing, and the straightness (Forward-Aft and Port-Starboard) of the three bushes (Image 1).

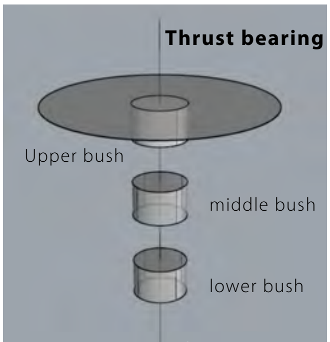


Image1: Principles of measurements

Accuracy was critical

The discussed tolerances of the inspected attributes necessitated the usage of state-of-art metrological hardware and software. Leica Absolute Tracker AT402 was used for the collection of the raw observations. Furthermore, spherical mounted reflectors with relevant accessories (e.g. magnets/nests) were used for the accurate definition of the examined points/lines/surfaces.

ABSOLUTE LASER TRACKER AT402

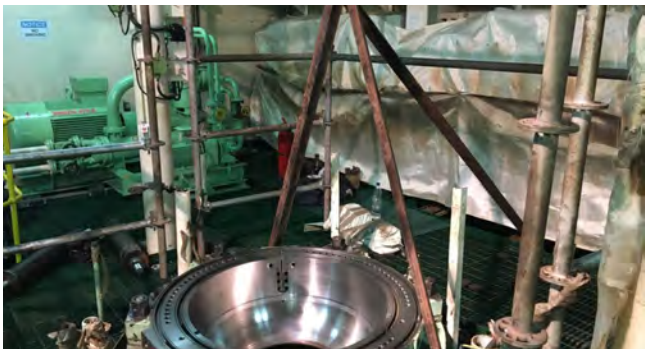
The Leica Absolute Tracker AT402 is a portable 3D Absolute Tracker for traditional inspection tasks or for fully guided measurement processes. It is able to be powered by its own internal battery and is able to work in the most demanding environment, yet maintains the highest level of precision and the largest ever work envelope. It is certified for outdoor use, even in the rain.


During measurements - Thrust Bearing Flatness Inspection

Methodology

The first thing for the specific application was the definition of the Ship's Coordinate System. After its definition, the rudder arrangement and the ship's characteristics were measured.
Our team also inspected thrust bearing by measuring its perimeter and constructing a plane by which fit details were taken into consideration for the measurements. Based on these measurements, flatness inspection was feasible.
Then, we measured the upper, middle, and lower bushes. Precisely, best-fit cylinders for each bush have been measured and constructed accordingly.

The inspections performed proved that the bushes had some critical deviations after the ship's collision. The thrust bearing showed variances regarding the flatness but was not very important. On the other hand, the inspection of divergence on the vertical axis showed results which should be considered, mainly in the AFT-FWD direction. According to the METRICA engineering team, the results should be submitted to the manufacturer to evaluate the condition.




Instrumentation / software

Leica Absolute Tracker AT402
Break Resistant Reflector
Spatial Analyzer Hexagon Metrology

Deliverables

-Report