PT Timur Bahari: Custom Waterproof RTK GNSS System

MARINE ENGINEERS AND DREDGING OPERATIONS IN INDONESIA USE TRIMBLE TECHNOLOGY TO IMPROVE PROJECT EFFICIENCY

Established in 2004, PT Timur Bahari is a specialist in marine engineering and dredging projects around Indonesia. They provide expertise and customized solutions for their customers during project execution and establishing its distinctive trademark for being an efficient and reliable marine contractor. Supported by their associate company in Singapore, East Marine Private Limited, PT Timur Bahari works on projects such as:

- Dredging and construction of breakwater to piling works for port rehabilitation
- Dredging at harbors and fairways to facilitate smooth transportation network
- Environmental dredging and disposal of contaminated sediments

Figure 1: Clam shell dredger and marine construction operation

Solutions

Trimble BX992

Compact dual-antenna GNSS receiver with inertial navigation system

- Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- Centimeter-level position accuracy
- 336 channels for multi-constellation GNSS support
- Trimble RTX and OmniSTAR support

Trimble AV28

Accurate, lightweight antenna

- Ideal for triple frequency RTK systems
- Advanced multipath rejection
- Increased system accuracy
- Good signal to noise ratio

TIMUR BAHARI

Overview

Dredgers and marine engineers from PT Timur Bahari experienced a jump in productivity using cranes to place down pipes in the correct position with greater accuracy. Integrating Trimble high-precision GNSS technology into their custom dredging system allowed the application to receive heading and positioning data with higher accuracy and place pipes with greater efficiency.

Location: Indonesia

CHALLENGE

PT Timur Bahari was hired to place seawater intake pipes and risers for Tanjung Jati B Expansion (Jawa-4), a coal-fired steam power plant. The project site was located at Jepara – Central Java in Indonesia about 100km from Semarang City, and was scheduled to take about 18 months.

Figure 2: Site Map

The scope of the project included dredging the existing seabed along the pipeline which was about 1.4 km in length and the trench depth varied between -8m to -16m.

PT Timur Bahari encountered many issues with the project, which slowed productivity. Issues included:

- Operations halted during rainy and windy conditions
- Had a lack of manpower to operate the system
- Correct crane positioning took an extended amount of time to achieve
- Limited installation distance to work with
- Installation was not possible during nighttime or low light conditions

APPLICATION OVERVIEW

The application is used to discharge gravel for bedding and pipe placement underwater. The installation of a saddle was needed, along with lifting the unit pipe by using a crane, spreader bar and two webbing slings per pipe.

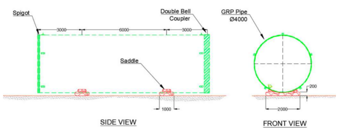

Figure 3: Single pipe laid on dredged sea bed and laid saddle

How it Works

The pipe is lowered into the water with guidance of a surveyor and diver. For a single pipe installation, a 7m spreader bar (SWL 15T) was used, while the module installation used a 20m spreader bar (SWL 30T).

Eleven ton concrete blocks are needed to be placed at both ends of the pipe location. Once the GRP pipes are lowered down, the concrete block is connected to the GRP pipe with a come along jack (CAJ). The concrete blocks act as sinkers and adjust the position of GRP.

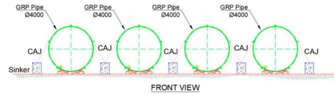

Figure 4: Front view of required pipe laying

After a proof of concept version was tested, a custom solution built for underwater operations was rolled out with components that included a Trimble BX992 RTK GNSS unit, a Trimble AV28 multi-frequency antenna, a Trimble/Pacific Crest XDL modem, and a battery charger unit to charge one battery while the other was in use.

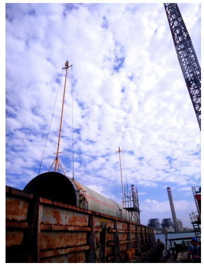

Figure 5: Prism and guide bar in the original method

CREATING A SOLUTION

Mr. Hendi Setiawan, a registered CAT B Surveyor who has worked at PT Timur Bahari since 2012, approached Miltrade Technologies Pte Limited to offer a better solution to this challenging task. Lee Hip Mun of Miltrade, was tasked to develop the system, and carries more than 40 years of experience in offshore oil and gas, hydrographics, dredging and marine construction and underwater electronics and GNSS technology. Many requirements were needed for the success of the project:

- An RTK system with an antenna mounted on the pipe in place of the prism target
- System needed to be waterproof in case the canister is submerged in water during operations
- System needed to be rugged against vibrations, shock and water ingression
- Needed to be able to transmit the computed position to the dredger's office in order to be integrated with the navigation unit
- Needed to have a self-powered function and able to last for the whole duration of the pipe installation

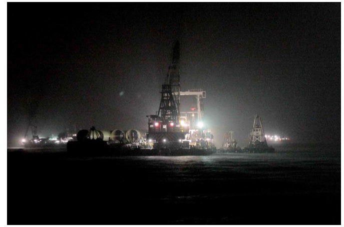

Figure 6: Operations running around the clock

In order to operate the system, the team began with connecting the battery pack to the system on the larger canister. The GNSS unit in the main canister received information - L1/L2 and GLONASS data - from orbiting satellites and allowed it to compute its uncorrected position.

The Pacific Crest Modem received correction data from the RTK reference station on shore and was able to route the correction to the GNSS unit. The correction received was applied to the uncorrected data to obtain an accurate RTK position of the antenna, as well as the heading formed with the smaller antenna canister.

The new antenna position and heading was transmitted back to the Pacific Crest modem over the air on a different frequency. The position and heading is received on the dredger's control and routed to the navigation system, allowing the pipes to be laid accurately.

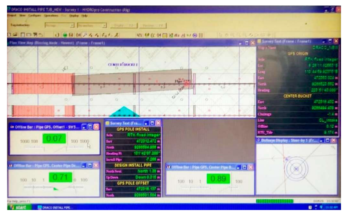

Figure 7: Screen shot of crane operator desktop

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With the Trimble BX992 high-precision enclosure and AV28 multi-frequency antenna aboard the system, the crane operator could accurately lay the pipes as required underwater by simply controlling them from the crane on the barge

Figure 8 & 9: Version 1 (left) - Single RTK positioning of pipe, Version 2 (right) With heading capability

Components Used:

- Custom designed machine from Delrin material (main canister) was designed for underwater operations with subsea connectors and pressure release nuts with following built in:
  - Trimble BX992 RTK GNSS unit
  - Trimble AV28 multi frequency antenna
  - Trimble/Pacific Crest XDL modem
- Custom design machine from Delrin material (antenna canister) with the following built in:
  - Trimble AV28 multi-frequency antenna
- Two units of sealed battery packs with subsea connectors and locking sleeve
- Battery charging unit made to charge one battery while the other is in use.

Figure 10: Full photo of Version 2

CONTINUED TESTING

Moving forward with this project, continued monitoring and improvements will be made to ensure full success of dredging operations.

The interference caused by the boom of the crane can, at times, cause occasional unstableness. This needs to monitored continuously to achieve ultimate accuracy. The primary and secondary distance for the antenna heading seemed to be too short, at about 1m, making the heading very sensitive. Future testing will determine if using a longer wire is needed to increase the primary and secondary distance of the antenna to improve the heading. Because the system was facing a strong current and the pipe movement is very fast, the 2 second output can be modified to a 1 second output in order to monitor accurate pipe movement.

RESULTS

With the installation of the system, PT Timur Bahari saw a considerable increase in productivity and efficiency. The ease of control and accurate underwater pipe placement saved time and work for divers and surveyors. With the integration of Trimble technology, the heading and RTK positioning information showed the true orientation of the pipeline. The rugged GNSS unit and modem were able to be configured without opening the underwater canister.

Since the system was easily transferable from one vessel to another, PT Timur Bahari was able to increase their productivity from one to three vessels using the same system, laying down 8 pipes per vessel, per week (24 pipes per week).

TRIMBLE

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