

Customer:
Besix-Kier JV

Project:
South Hook LNG Terminal

Solution:
Trimble GS300 3D Laser Scanner

Case Study



“Integrated Survey Engineering” Key to South Hook LNG Terminal Project

As gas stocks in the North Sea diminish, it is planned that Liquefied Natural Gas (LNG) will be shipped to a number of import terminals around Great Britain by tanker. One such terminal being constructed in Milford Haven will receive gas from a reservoir called the North Field which is located off the coast of Qatar in the Arabian Gulf.

By cooling the gas to minus 160°C, it becomes liquid and occupies around 600 times less space than it occupies as a gas. Consequently it can be pumped into large specially built tankers and shipped from areas where a pipeline would not be economic.

The South Hook LNG import terminal will receive vessels of similar size to the very large crude oil carriers which regularly dock at refineries within Milford Haven, a safe deepwater anchorage strategically placed in south west Wales.

Existing Terminal

The LNG terminal is being constructed on the site of the former Esso oil refinery, itself built in the late 1950's and finally decommissioned in the late 1980's. Its geographical advantages and history of

handling large vessels made it an ideal choice for the docking of LNG tankers and storage and regassification of LNG.

In November 2004 the Belgian construction group Besix was awarded the contract for the marine works necessary to refurbish the original jetty and make it suitable to receive LNG carriers. The refurbishment would include the 1km jetty approach, access trestle to two berths, the demolition and rebuild of Berths 1 and 2, the demolition of Berth 4 and the making safe of Berths 3 and 5. The project would be carried out as a joint venture with Kier Construction.

Challenging environment

As a matter of course marine construction work throws up a whole range of safety

issues including gusting winds, high tides and having to work at height over water whilst wearing life jackets.

On top of this, the Besix-Kier JV team had to contend with a number of environmental issues including sub-marine specimens on the seabed, a protected 'red maerl' coral bed and a location within the Pembrokeshire Coast National Park boundary. Any work would have to be carried out without polluting the marine environment. All these factors

combined to make achieving a cost effective and accurate survey a major challenge.

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"On this project the new jetty and berth piles are being built alongside the old ones," explained Besix-Kier Survey Engineer, Denis Meremans. "Old piles have to be cut 1m below the seabed level with the inner part remaining there and new piles have to be driven through with the risk of overlapping. That's why early on, our Design Department in Brussels requested an accurate existing pile layout."

Optimum Methodology

"In April/May 2005 I started to survey the berthing line piles with a reflectorless motorised total station, shooting at the same level, 3 points on the top and bottom of each pile. To export and define each pile correctly, I generated a line and recorded the points with recognisable attributes and codes and this proved fine for visible and vertical piles. However I soon became aware of the limitations of this methodology. Any obstructions such as handrails or scaffolding caused a problem. On some of the larger platforms such as Berths 1 (1620m²) & 2 (1750m²) I was confronted by a jungle of 128 and 164 piles with some hidden by others and some impossible to recognise in the slab shadow. At the export stage some points were missing or not located properly because the laser had been obstructed or had not struck the target. Repeating the work would be difficult and costly. Even at the modelling stage there were problems. We generated 2 circles from the 3 points surveyed at upper and lower level which was fine for vertical piles. However, when you cut a raking pile with a horizontal plane, the section is no longer a circle but an ellipse. Finally, we were also losing some accuracy on the pile's diameter.

I'd already suggested that a 3D laser scan survey would be a good alternative to using traditional equipment to survey any inaccessible piles. After a few months surveying, spending hours trying to catch single piles or points and sending our Design Department unusable ASCII (.XLS) & 2D-CAD data, I contacted **KOREC** and another manufacturer's representatives to visit our site, understand our applications and requirements and perform a demo of their 3D-Laser products.

I was already familiar with the technology and I knew that surveyed point clouds should give a lot of information with very good accuracy. However three concerns remained - how could I extract the right information from thousands and thousands of points when 2 or 3 points would be sufficient to define a line, a plane or a volume? Would the software algorithms be strong, rapid and accurate enough to calculate and process all that data and of course would the software be user-friendly?" explained Denis.

Following **KOREC's** demonstration of the Trimble GS200, a trial scan was carried out at the end of the jetty to test the equipment's portability and then a scan of a mooring 'dolphin' at 60m and a berth at 120m to test the range, speed, accuracy, operability and usage of the GS200 and the field software. Back at the office the data was processed with Realworks and Denis assessed how best the scanner could be used on the South Hook Terminal project.

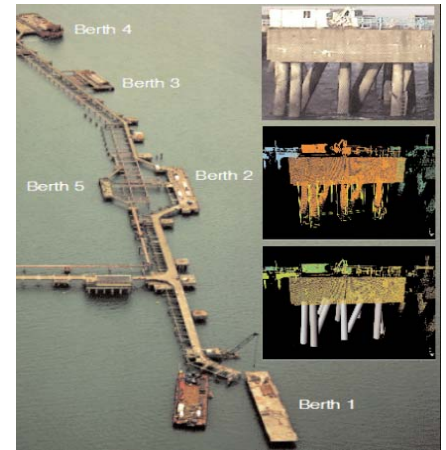
"Within minutes of downloading we were able to utilise Realworks' cylinder fitting routine to turn a mass of scanned pile points into CAD objects. Checks on the computed diameter of the cylinders confirmed the actual 700mm size within just a few mm. In summary, the demo proved so successful that we hired the GS200 for one month between the end of November and December and scanned the entire berthing line."

Denis continues, "Using the scanner for 20 days, we scanned and modelled more than 600 piles and even found 30 new ones previously undetected with the total station! This data was then used by our Design Department to calculate and assess the new piles and their design. Using 3D-CAD export and 'objects properties' spreadsheet, the Design Department can extend the pile's shape to the rock layer, increase the new pile's diameter to look for overlapping and avoid clashes and finally produce the final pile and structures layout. The benefits have been clear - a quick return on investment, less time on site for our surveyors, increased precision and increased data confidence.

We have now bought our own Trimble GS200 to scan existing structures and also to provide the as-built of the new structures...the applications are multiple."

GPS finds its place

Besix-Kier JV has also been using a Trimble DGPS system and Trimble HYDROpro software to position floating equipment including barges, jack ups and workboats. At the beginning of the project a permanently fixed GPS Base Station was established on shore. Once a Site Calibration had been carried out, the GPS was used to define the site geometry and to confirm the total station traverse control. The RTK DGPS solution is mainly used to position barges in the correct place to enable piles to be driven accurately (100mm tolerance) and also to record the exact location of the jack up legs so that the seabed can be monitored for environmental purposes. Each jack-up movement and positioning is monitored with Trimble HYDROPro Construction



▲ Berth's 1-5

software through two Trimble MS750 GPS systems receiving RTK DGPS corrections from a base. Two RTK DGPS backpack systems are also used for surveying and control. In total, 9 DGPS receivers and 6 radio-modems are currently running non-stop alongside the jetty, demanding constant care and maintenance.

Integrated Survey Engineering

On a project this complex, Denis is keen to point out that different surveying tasks and applications require different approaches and techniques. "It is no longer just a case of doing simple topography - we're talking about "Integrated Survey Engineering". In this way, the Survey Team - eight surveyors working day and night shifts - can achieve the best precision at the lowest cost by using a large range of survey equipment and advanced technologies from automatic levels through to robotic total stations, RTK DGPS and 3D laser scanning. In this project the survey technologies have been integrated together and backed up by confident survey suppliers and good technical support."

Besix

BESIX is Belgium's largest construction group and belongs to the BESIX Group, a collection of companies active in the construction and real estate sectors. The Group was founded in 1909 and since then has undergone impressive and regular growth.

All information kindly supplied by Besix-Kier Survey Engineer, Denis Meremans.

Contact us:

Please do get in touch for further information on any of the products or services mentioned in this case study, a demonstration, support or just a chat about your requirements.

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