Transformation of a 30 year old Oil Terminal into a modern double LNG Terminal – Part 2: Reconstruction of the New Berthing Line

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Summary

The South Hook LNG Import Terminal is located at the former Esso refinery at Milford Haven, Wales. The original oil unloading jetty, built at the end of the 1950s, consisted of a 1km long approach trestle and a berthing head with five berths. The structure was closed in 1983 and was fully decommissioned in 1990. In 2003 it was decided to transform the Jetty into a modern LNG terminal by refurbishing the approach trestle and replacing the berthing line with two new state of the art berths and a control building platform.

This paper describes the reconstruction of the berthing line. As the upgraded structures were constructed in the location of the existing berths and approach ways, a range of practical problems were encountered. The first challenge to arise was the demolition of the existing trestles and berths, a process that required extensive planning and preparation. A second issue was the debris from the existing piles. Before demolition, a 3D laser scan was undertaken to determine the exact locations of numerous existing piles. All new structures were adapted to ensure that no clashes would occur between the new piles and the remains of the old piles. This was achieved by introducing the results of the 3D laser scans into the 3D calculation models. In the limited cases that conflicts were reported on site, the design team would rework the structures immediately in order to limit construction delays as much as possible. Finally, an innovative solution was developed to ensure that any debris lying on the seabed that could be collected inside new piles during driving would not prevent the drilling of pile sockets.

Keywords: Offshore Structures, LNG terminal, Ecologically Sensitive Environment, Pile Removal, Piled Structures, 3D Laser Scanning, Demolition

1. Introduction

The South Hook LNG Import Terminal, located in Milford Haven, Wales, is the largest terminal that has been built in the UK to date and is capable of handling the largest LNG ships that are currently used in the world. This paper describes the reconstruction of the berthing line, first focusing on the demolition of the old berths, then discussing the challenges encountered during the new construction.

2. Demolition of old Berths

The demolition works consisted of the removal of approximately 30,000 tonnes of concrete and 850 piles, both prestressed hollow tubular concrete piles and steel piles. As-built information regarding the existing slab reinforcement of the decks was very limited. This was not an issue for thick pilecaps as the concrete strength was sufficient to resist the tensile stresses during lifting. The berth decks, however, needed steel beams to be attached to the upper surfaces in order to eliminate the need to undertake extensive investigations or to take significant assumptions in the engineering calculations.

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As most piles had hollow cores, a high pressure water cutter operating at 2500 bars with abrasive grit was specifically constructed for the project. The cutter was lowered down through the inside of the pile to the correct level where it then made a single pass around the inner diameter of the pile, cutting the concrete, reinforcement and prestressing wires. This was the most environmentally friendly way of removing the piles. In instances where the piles could not be cut internally, cutting had to be performed externally with a hydraulic guillotine. A number of options were considered for the disposal or re-use of the concrete slabs and piles. The selected option was to create a floating yard for receiving the elements, breaking the concrete and separating the reinforcement steel for re-use.

3. New Construction

New construction consisted of two new berths, 8 berthing dolphins, 16 mooring dolphins, a control building platform, Jetty Head structures and 250 m of roadway. Before the design of the new terminal berths could commence, a full model of the existing jetty needed to be created in order to prevent clashes between the new jetty piles and the existing pile stubs left in the seabed. This was undertaken using a 3-D laser scanner. Piling works involved the driving of 370 piles. To enable the accurate driving of piles, the SEPs were positioned using real time kinematic GPS. The piles were driven to refusal through the overlying weak sandy deposits down to the siltstone rock. Tension anchors were generally drilled 6m into the siltstone rock.

It was necessary to ensure that seals, dolphins & harbour porpoise would not be unduly affected by the noise created by piling. A cetaceous biologist was employed as a marine mammal observer to ensure that this was the case before and during each pile driving operation. A soft start regime was also adopted, thus giving time for any sea creatures so minded to vacate the area.

At the start of pile driving operations, it was found that the tension socket drilling activities were often disrupted due to the presence of debris. The debris would block, or occasionally even break the drill bits and were very difficult to remove from the inside of piles. An innovative solution was devised to tackle this problem, whereby an unreinforced concrete cone was grouted to the tip of the pile. The collection of debris inside piles was thus avoided and the full load bearing capacity of the piles was obtained, with the drilling taking place through the cones. This method proved to be a great success.

4. Conclusion

The construction of a complex jetty structure in a relatively remote location was possible whilst causing minimal impact on the environment.

Fig. 1: Jetty structural works completed