

An integrated approach to vessel berthing

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Introduction

From the 1960's onwards, there have been continually evolving developments in the size and complexity of oil and gas carrying vessels. This has resulted in the need for terminal owners to pay far more attention to potential risk factors when planning to handle these larger ships. Typically these would include:

- Possible damage to berths and dock structures during docking and whilst moored, due to tides, prevailing winds, wash from passing vessels, etc.;
- Environmental pollution caused by ruptured loading facilities, cargo tanks or bunker tanks in the event of any collision with dock structures;
- Major risk of fire, particularly in the case of crude, product or gas carriers;
- Dry docking of vessels for inspection or repair following any collision; and
- Insurance/demurrage implications in the event of any accident/damage.

Many terminals were simply not designed to accommodate such large vessels, and their owners faced the prospect of having to invest large amounts of capital into rebuilding and upgrading existing facilities. However, the introduction of the berth management system meant that the risks outlined above could be reduced to a safe and acceptable level and resulted in larger vessels being permitted to berth in smaller terminals. Even in the larger terminals however, berth management systems have been installed as they significantly improve terminal efficiency by enabling vessels to dock in more extreme weather conditions.

History of berth management systems

The first mooring load monitoring system was developed by Strainstall in the early 1970's for Esso Slagen in Norway. It used strain-gauged load measuring pins (which had recently been developed by the company) as the sensor installed into the quick release hooks to measure the tension in the mooring line (see Figure 1). Further upgrades to the system were made, but the biggest advances occurred when the PC became widely available and applications software became more sophisticated.

In 1990 Strainstall designed and installed the then most complex turnkey Berth Manager system into a coal terminal in Hong Kong.



Figure 1. Load Measuring Pin installed into quick release mooring hook.

This included mooring load monitoring on 3 jetties, integrating with existing sonar-based speed of approach measurement, environmental and meteorological sensors, carry-on-board laptop shipboard repeaters on radio telemetry links and fibre optic links to remote stations in the facility. A total of 13 computers were networked and interlinked to provide a fully integrated system which presented the terminal operator with a full set of ship behaviour data and associated environmental forcing functions.

Development of networkable digital conditioning followed, allowing jetty sensors and displays to be connected by a single cable loop, which provided significant cost savings to the client in the supply and installation of site cables. At the same time developments in the measurement of speed of approach were tending to favour radar or lasers over sonar, with eye-safe lasers becoming the measurement sensor of choice for providing the most accurate and reliable data in all conditions likely to be encountered during a docking operation.

More recent developments

There is however a restriction in using this method, as these lasers are only able to monitor the vessel when it is perpendicular to the jetty. In order to offer a speed of approach package suitable for front-end docking, an additional docking measurement system has recently been developed using DGPS, (Differential Global Positioning System), which provides centimetre accuracy. This also expands the ability to provide a small vessel traffic management capability, as it is able to monitor the approach of the vessel from a much greater distance from the jetty and from any direction - in effect from when the pilot boards the vessel. The basic system requires 2 DGPS sensors to be positioned onboard the vessel and a base station on the jetty. A palmtop can also be provided for the pilot to carry on board that presents him with continuous speed-of-approach during a docking.

Data display

A number of options are available to display the speed-of-approach data outside the control room. These include large digit displays and traffic lights that are mounted on the jetty and are visible for up to 200 250m, for use by the approaching vessel (see Figure 2). These are available for safe or hazardous areas and provide the pilot with numbers in an ergonomic heads-up manner. Pagers are also available for the pilot and/or shore based docking crews, and remote displays on the jetty for use by the shore based docking crews.



Figure 2. Large digit display located within a hazardous area in an oil terminal.



Figure 3. The Stevens design quick release mooring hook.

Quick release mooring hooks

Much discussion centres on the instrumentation used in these systems, but the quick release hook used to moor the vessel is often forgotten. The Strainstall quick release hook is based on the well-respected Stevens design, and has been upgraded in material selection and manufacture to provide safe and reliable operation in the environments encountered on jetties (see figure 3). They have also been designed to provide ease of installation, maintenance and fitting of mooring load system components. All operating mechanisms are installed within the side plates, which provides as much mechanical protection as possible to the release components (mechanical, electrical, hydraulic or pneumatic), but which are easily accessible for maintenance purposes. The hooks can be fitted with sensors to provide the status of the hook, i.e. open or closed, pressure of fluids in either hydraulic or pneumatic release systems, and oil level in hydraulic systems.

Information management and analysis

The data from all the berth management sensors are transmitted back to the control room where the operator workstation is generally located. This station can either be a desktop PC located on a convenient desk, or a rack-mounted PC assembled into a free standing rack. The station comprises a PC which utilises the Berth Manager software package customised for the particular jetty. From a competent supplier, the customer can expect a user-friendly software package, which provides complete control of system integration.

The system operates with simple controls via standard keyboard and trackball, and provides:

- A mimic of the berth and vessel during vessel approach, showing distances and speeds at the bow and stern and the relative angle of the vessel to the berth (see figure 4).;

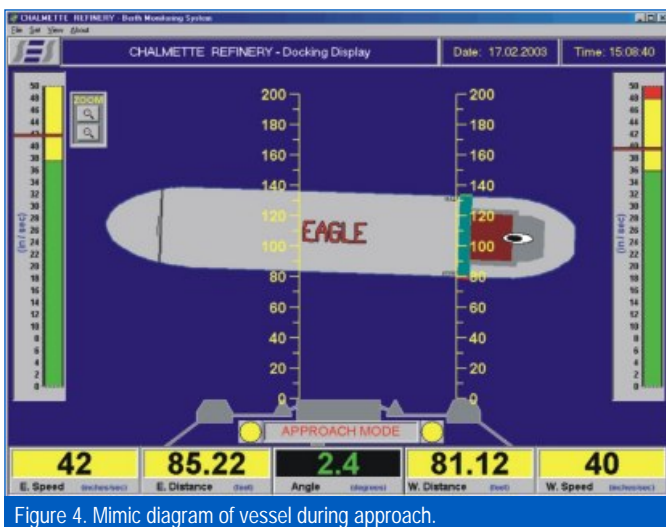


Figure 4. Mimic diagram of vessel during approach.



Figure 5. Display screen showing environmental conditions.

- A mimic diagram of the berth once the vessel has been moored showing vessel orientation, mooring lines, mooring points, with a display of mooring loads, vessel drift-off, environmental data, oceanographic data, etc.;
- A facility to set alarm levels for all parameters, e.g. speed of approach, mooring loads, environmental, etc. (The alarm levels for speed of approach can be set at different levels for different distances. This allows the allowable approach speed to be lowered as the vessel nears the berth to allow control of the all important impact speed);
- Storage and recall of vessel mooring configurations in a database to provide simplified set-up for regular vessels;
- Historic and trend display facilities; and
- Data logging output to printer and disc.

System capabilities

Summarising, the Berth Manager system has the ability to provide the facility operator with full data regarding:

- The approach of the vessel to the jetty, especially the all-important final speed of the vessel when it impacts the jetty at docking.
- Tensions in the mooring lines and drift-off whilst it is moored during cargo loading/unloading;
- Indication of position of the quick release hook, i.e. open or closed;
- Indication of oil level and pressure in hydraulic release systems on the quick release hooks;
- Indication of air pressure in pneumatic release systems on the quick release hooks;
- Environmental factors impacting on the vessel (see figure 5);
- Oceanographic factors impacting on the vessel;
- Alarms in the event of parameters outside operator settable limits, eg high speeds during approach, high/low mooring tensions, wind speeds, etc.



Figure 6. Centralised SCADA monitoring systems.

- Logging of all data and provision of alarm logs;
- Remote release of hooks following completion of cargo loading/unloading;
- Emergency quick release of hooks;
- Connection to the facility ESD system; and
- Connection to ship/shore links.

The future

The future of berth management systems, at least with new-build sites, will focus on even greater integration with the facility management networks, as part of the site-wide data monitoring, alarm handling and logging systems. This is driven by the need to

reduce operating costs by utilising fewer operators and using them more efficiently. The result is further centralisation of monitoring facilities, with alarms and event indicators being the main operator interfaces, and graphical screens being the second tier of analysis should a problem occur.

In such systems the BMS manufacturer will provide the sensors, jetty displays and 'black box' signal processing functions only, streaming processed signals back to centralised SCADA monitoring systems which will provide the data displays (See Figure 6). The ongoing Strainstall BMS development strategy is very much in tune with this approach and we can provide a range of compatible interfaces utilising a variety of industry standard protocols.

ABOUT THE AUTHOR

Sandy Thomas is Marine Director at Strainstall UK Ltd. An Engineer by profession, with a qualification in Mechanical and Production Engineering, Sandy has been involved in the design and implementation of advanced Berth Manager systems for over 20 years.

ABOUT THE COMPANY

Strainstall UK Ltd is a specialist designer and manufacturer of load monitoring systems and quick release mooring hooks, and in addition to those described here also supply systems for tendon and riser tension monitoring for offshore oil and gas structures, crane and winch load monitoring and silo content monitoring for both on and offshore use, and the StressAlert II hull stress monitoring system.

The company's experience, expertise and application skills have made them world leaders, and they are constantly striving to improve, enhance and develop their systems. Strainstall are registered to ISO 9000:2000.

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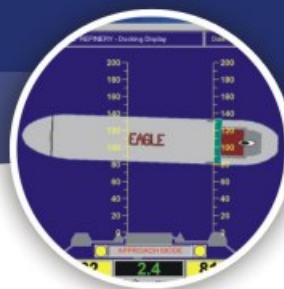
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The Integrated Approach to Total Jetty Monitoring & Management

- Mooring Load Monitoring
- Speed of Approach Systems
- Environmental Monitoring
- Load Arm Position Monitoring
- Berth Management Systems
- Quick Release Mooring Hooks
- Quick Release Towing Hooks

Strainstall monitoring and management technology is amongst the most advanced available in terms of flexibility and functionality in use.

Installed in many oil & gas terminals worldwide, we provide real-time interactive data during the critical phases of vessel approach and mooring management. Our systems not only improve terminal efficiency, but also ensure that safety requirements are met and any potential risks reduced.



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