BLT: how safe are your bollards?

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An oft overlooked area when it comes to the safe mooring of vessels in ports, shipyards and harbours is testing the safe working load (SWL) of bollards. With the size of vessels ever-increasing, the time has come to focus and raise the issues that have been experienced with bollard failure, as well as the challenges faced in testing the SWL of bollards.

This article aims to raise awareness to a significant contemporary problem and the certain increasing future problems that have been identified with relevant people in the marine industry through ongoing research and discussions. Information of a Patent Pending innovative product and method of testing bollards has been provided, and for the first time, we can recommend a practical, cost-effective and easy-to-use solution to test the safe working load of marine bollards.

The problem

Bollards and fixings may suffer from corrosion, fatigue and other effects which may weaken the bollard or supporting structure over a period of time. Such damage may not be immediately apparent and may have serious consequences on the ability of a bollard to withstand the force being exerted upon it.

Bollards are anticipated to have a long life, with many being in quayside use for 40, 50, or even 60 years plus. However, bollards with such a long life-span were not always designed to moor the new generation of mega-ships.

The forces experienced by bollards are considerable, magnitude may be up to 2000kn (200 tonnes plus) with even larger bollards used as supplementary mooring in storm conditions. Bollards experience multiple forces from any direction within 180 degrees of the quayside. Mooring lines will be used to limit movement caused by combinations of surge and other motions. The vertical component of the force may vary substantially by:

- different types of vessels moored
- vessel draught changes in ballast or cargo weight
- surging away from the quay by wind, water, current or tidal conditions
- passing vessel movement (ship draw)

A further problem identified is the move to use ultra-high molecular weight polyethylene (UHMwPE) rope as mooring line for vessels. It is not only vessels that have increased in size, mooring lines have also increased, and in some cases these have become too large to handle. Although UHMwPE is a fantastic product, 15-times stronger than high-quality steel, by using it in an effort to counter the weight handling issue may create as many problems as it solves.

For example, if a vessel with nylon mooring ropes was drawn off the quay for whatever reason, the mooring rope would have normally stretched due to its elasticity and then returned to its normal state, thereby absorbing the load. However UHMwPE has a very low elasticity and when the vessel is drawn off the quay, the load is transferred straight to the bollard and quay as a repeated shock load. This can be many times above the design factor.

Current methods of testing

Put simply; there isn't any. The much talked about and rarely witnessed use of a tug to test a bollard would be both expensive and highly dangerous. However, BLT has created a unique solution to this.

Launched in 2015, the Bollard Load Test equipment is a fully calibrated and safe method of testing the working load of bollards that is practical, portable and easily deployable (See Figure 1: Ref 1 and 2, plan and elevation view of testing SWL of bollards)

A hydraulic pulling cylinder is the tensioning means. The measuring device can be a load pin or a load cell measuring hydraulic pressure in the cylinder that converts to tonnes. A hydraulic cylinder is capable of producing the very large forces that may be experienced by a bollard when used for mooring a vessel. The tensioning means is by attaching a Dyneema® (UHMwPE) custom designed rope between the bollards and the hydraulic cylinder (See Figure 1: Ref 3 and 4 BLT equipment and Dyneema® rope)

The measuring device is a pressure transducer fitted to the hydraulic cylinder to relay pressure back to a digital gauge in a remote location. To carry out a test the maximum force expected to be applied by a moored vessel must be simulated.

Other tests can apply vertical tension to anchor or fixing bolts. However, such tests cannot guarantee the performance of the bollard under realistic loading conditions, which combine sheer force, tensile forces and overturning moments. They cannot verify the integrity of the full mooring assembly comprising of:

- bollard body
- anchor or bolts
- concrete or other supporting structure

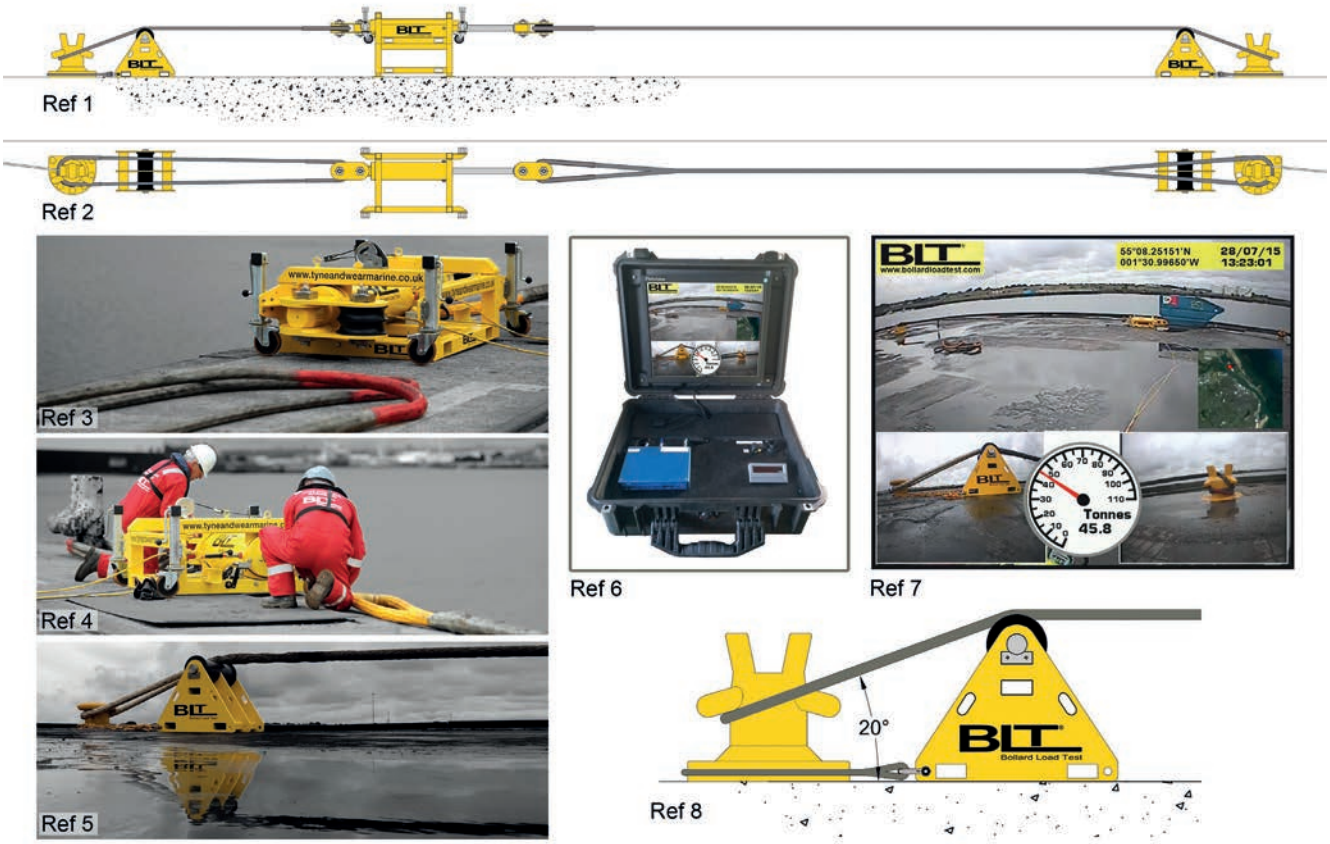
The objective of the bollard load testing equipment is to substantially reduce or to remove the identified problems. Although the bollard load testing equipment cannot simulate in every direction, it can simulate the spring lines at various angles up to 20 degrees. Depending upon the type of bollard and how the Dyneema® is attached to the bollard, it can simulate bow and stern lines, to create a turning moment, giving a great deal of confidence in the bollard and its surrounding structure. (See Figure 1: Ref 5 and 8, roller kickers simulating angles)

Data capture

Bollard Load Test data is recorded in a Data Capture Box that consists of (See figure 1: Ref 6, Data Capture Box):

- A recording medium
- 3 cameras: 1 for each bollard and 1 wide angle to look at the complete test area from a health and safety perspective

Figure 1



The GPS location of each bollard tested on that date – and other information – is gathered, enabling a SWL Test Certificate to be produced (See Figure 1: Ref 7, Bollard Load Test data)

BLT has a vision to build a global database. The said database would allow relevant actors such as ship owners, insurance companies and captains who are increasingly asking the question about how and when bollards have been tested, before mooring, to view the SWL of bollards worldwide. This would provide complete confidence when entering unfamiliar ports.

Consequences of bollard failure

Death, injury, and damage to quaysides and vessels have all been experienced. In all cases, the causes of the incidents listed below have been due to high winds increasing the load on the bollards. In some instances, multiple bollards were ripped out causing vessels to drift away from the quayside, and drift into other structures. Examples of past incidences include the below vessel accidents:

- The Carnival Triumph: one person killed, another injured, leading to US$2.9 million in repairs and $12 million in damages when the vessel broke free and collided with two other vessels
- The Costa Deliziosa: three people fell into the sea and had to be rescued when a gangway collapsed causing 50ft of quay damage
- The MSC Fantasia: a gangway collapsed leaving four people needing to be rescued from the sea. All were taken to hospital, one sustained serious head injuries
- The King of Scandinavia: when a spring line bollard failed and all subsequent mooring lines parted causing the vessel to drift into an oilrig, this led to around $100,000 in damages to the quay

These and other consequences suggest it is wise to test quayside bollards at regular intervals. Due to the increasing size of vessels, it should now be mandatory.

About the author

Jeff Main is Managing Director of privately-owned company Tyne and Wear Marine which has been providing bespoke marine engineering solutions to clients for over 30 years. He has an extensive and diverse maritime background, having previously built a salvage vessel and starting his own company. Jeff's mission is to make clients problems go away; to solve them by providing innovative thinking, outside-of-the-box creative approaches, and cost effective, highly practical solutions. It was by having such an approach and mission that the Bollard Load Testing Equipment was created.

About the organisation

Bollard Load Testing Ltd (BLT) is a wholly owned subsidiary of Tyne and Wear Marine Ltd (TWM), and began formal trading in April, 2015. BLT was established to deliver an innovative solution for testing the safe working load of marine mooring bollards in ports, harbours and shipyards.

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