Fenders: Can you afford the cheapest?

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No matter how good the rubber fender unit might be, the whole integrity of a fender system is compromised by poor quality and/or badly designed accessories. This trend has reached dangerous levels with inadequate or weak specifications and pressures to cut prices.

Those who specify fenders hope to get the best value for money, but exploitable loopholes mean they can end up with fenders that don't perform, need excessive maintenance and risk the safety of port staff, ships and structures.

This article will focus mainly on fender accessories and the specifications needed to reduce unnecessary risks and costs.

Rubber fender unit

If correctly selected and positioned, the rubber fender unit(s) will absorb the kinetic energy of the largest, intermediate and smallest ships to use the berth.

The rubber units need to cope with different compression speeds, high and low temperatures, berthing and bow flare angles, and occasional or frequent use. They may need to resist shear or tensile forces. They must be reliable and work to full capacity when they are needed the most – during an abnormal impact.

Inadequate paint and corrosion allowances mean high maintenance and early replacement.

Steel fender panels (frames)

These are complex steel fabrications and their design should only be entrusted to qualified structural engineers. Surprisingly, most rubber companies offering fenders do not use qualified people to do this work.

Panels need to resist combinations of bending, shear and local buckling. There are many 'limit state' design codes (BS5950, etc) and finite element software packages able to determine these loads and stresses, but very often unqualified persons use simplistic methods or even guesswork that lead to dangerously weak and under-designed fabrications.

It has becoming worryingly common to see steel plate sections as thin as 5mm, yet this is far below the minimum needed on any berth. In contrast, International Navigation Association (PIANC) recommends 12mm as the absolute minimum when exposed to seawater on both faces, 10mm for exposure to one face and 8mm for internal sections not exposed to corrosion. This means a panel should be a bare minimum of 160-180mm thick if standard internal steel channels are used to stiffen it. Bigger systems often need panels 250-400mm thick, yet panels as thin as 120mm are being promoted by some manufacturers. Are they cheap? Possibly. Fit for purpose? Definitely not!

Internal construction of a large panel with deep channel section reinforcement (before welding).

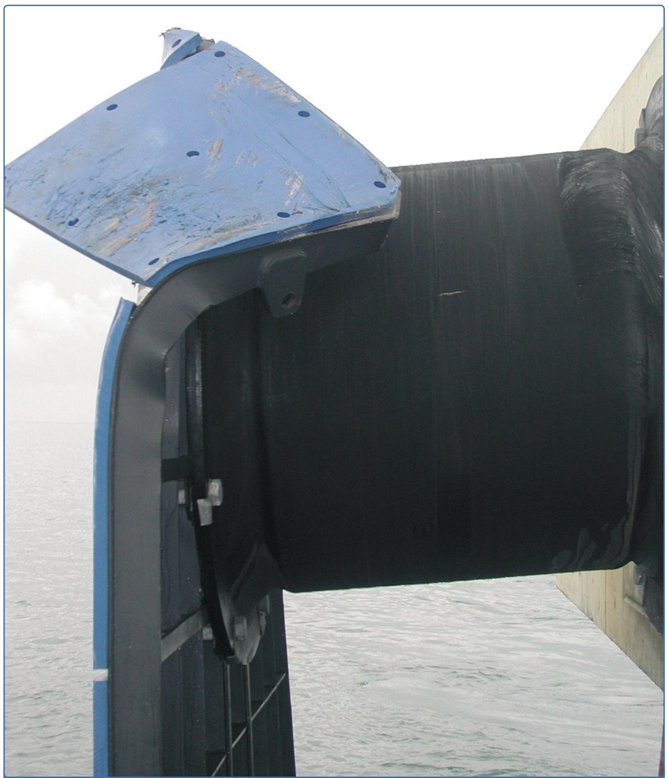
Paint coatings also vary in quality and no paint lasts forever; 10-15 years being typical. After this, the steel will corrode and weaken unless corrosion allowances are added. If corrosion allowances are not specified, they will invariably be ignored and the life expectancy of the panel will be drastically reduced. For cold water climates, a corrosion allowance of 3mm per exposed face might be suitable, much more where temperatures are higher and corrosion is greater.

Connections of the rubber fender and polyethylene (PE) face pads to the panel also need close scrutiny. Rubber fender fixing points should be locally reinforced and sealed to prevent water ingress if closed box panels are used.

Anchors and fixings

Any fender system is only as good as the weakest component. It is often assumed that whatever is shown in the manufacturer's catalogue is suitable for every application. Some fender suppliers offer anchors made of mixed materials, including stainless inserts and galvanised bolts – a risky cocktail which saves money, but is likely to fail early.

Calculations for loads should be presented, and fixings selected accordingly. In cooler waters, a galvanised fixing might be appropriate, but in warmer places, stainless steels are the only solution. Independent specialists like the British Stainless Steel Association suggest Pitting Corrosion Equivalent Numbers (PREN) of around 40 for highly corrosive environments like the Middle East and Asia. As a guide, 316 grade has PREN of 25-26 whereas 304 grades are below 19. Despite very poor resistance to pitting corrosion, 304 grades are still used by less scrupulous suppliers due to their low price. They get away with it too because most specifications don't stipulate a minimum PREN or grade.



Cost cutting and ignorance of design codes often leads to serious fender accidents.

Low-friction facings

If minimum thickness or wear allowance isn't specified, then competitive forces invariably mean pads of 30mm or less will be fitted to the panel. A 30mm pad with 3-4mm wear allowance may last less than five years. Increase the thickness to 40mm and wear allowance should be 8-10mm. You get over twice the service life for an additional cost of around 1-2% of the total fender price.

Only Ultra High Molecular Weight (UHMW)-PE pads should be used because they offer the best combination of price and durability. But if grade isn't specified, cheaper and faster wearing PE materials like High Density PE can and often are used instead. The ideal is to request a 'double sintered' UHMW-PE, which is not only economic, but has been work hardened for even better wear properties.

Fixing holes and chamfers involve added processing costs, as do planed sheets to ensure there are no 'steps' between the pads. Fewer fixings per square metre mean a higher risk of pads being knocked off. Unchamfered edges are likely to snag on even the smallest protrusion from a ship hull, such as a weld or repair plate. Uneven face pads will scrape and skim the paint from a ship very quickly.

Restraint chains

Not every fender system needs chains, but omitting them when they are needed is a costly error. If left to the discretion of a contractor of a fender manufacturer then chains will be avoided wherever possible. Careful thought must be given to the operations on the berth:

- Do vessels warp along the face during berthing?
- Is the panel heavier than the rubber can comfortably support?
- Is there a risk of tensile loads being applied?

If you take the risk of not fitting chains and find they are needed later, it will be very expensive at best and impossible at worst.

Connecting the chains to panels and the structure is often an afterthought. Panels will need to be locally reinforced, whilst anchorages for chains need very careful design to resist combinations of tensile and shear loads on brackets, which must often be located closer to the edge of the concrete than is ideal.

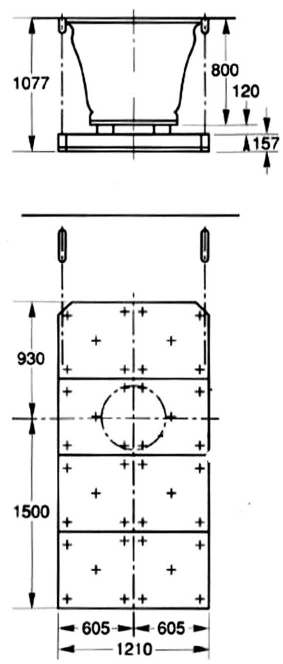
Corrosion of chains and accessories are a principle cause of early fender failure.

Shackles are another difficulty. They can act as a weak link to fail first, thereby avoiding damage to the whole chain assembly. But they may also fail too soon because of the tendency for shackle pins to corrode more rapidly.

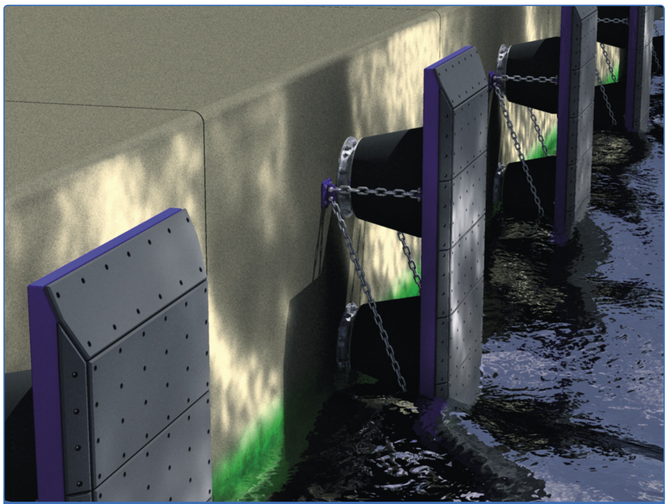
Chains are always a maintenance item and this should be considered in the specifications. Galvanising may last around five years, after which loss of diameter quickly weakens the links. Routine maintenance means chains should be easily and inexpensively replaceable, whilst permanently embedded items, like anchors, must last the life of the fender system.

Quality documentation

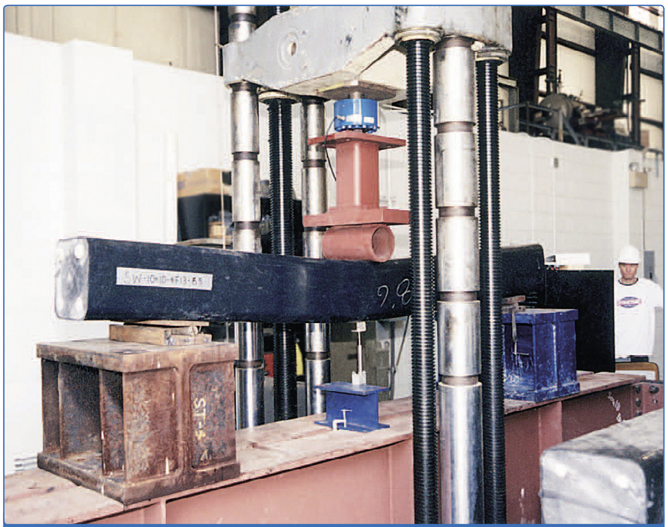
Verifiable records of manufacture and testing are one way of ensuring the right materials are used, correct production methods



Thin panels cannot resist bending, shear or local buckling.



Computer modelling can be used to predict fender performance before expensive mistakes are made.



Testing of materials and fenders ensures quality standards are maintained.

are employed, and the final product performs as specified. Unfortunately, in today's world, it is all too easy to generate impressive paperwork with a computer. The answer is to inspect the fender manufacturer's facilities, check their records and employ a qualified inspector to ensure all tests are properly carried out.

The following list is a guide to what should be expected in a fender system document package:

- Manufacturers warranty certificate for an appropriate period
- Manufacturers certificate of conformity
- As-built drawings
- Installation, operation and maintenance manual
- Inspection and maintenance logbook
- Rubber physical property test results for every size and grade of rubber fender unit
- 3.1.B mill certificates for steel panel materials
- Welder qualification certificates
- Weld procedures
- Hydrostatic pressure test report for panels
- Dimensional inspection report for panels
- Paint inspection reports
- 3.1.B mill certificates for bolts and anchors
- UHMW-PE certificate of conformity
- Chain-proof load test certificates (if applicable)
- Galvanising certificates for chains and shackles (if applicable)

Conclusions

As the saying goes, "nobody can afford to buy the cheapest." We all strive to keep costs down, but there is always a minimum cost to meet a given specification. Anything lower means corners have been cut and risks have been taken.

Undoubtedly a few fender suppliers cheat in the hope of winning orders, but it is mostly the ignorance and inexperience of rubber manufacturers which leads them to take risks; they lack the knowledge needed to understand the specifications. The ability to make a piece of rubber in no way qualifies a company to design complex steel fabrications or other parts of a fender system – this should be left to structural and civil engineers.

If price becomes the sole purchasing criterion, then it is the end user who ultimately loses. He takes risks with the health and safety of staff, and risks accidents and damage to ships and structures. He also risks the high ongoing costs of maintenance and early replacement of the fenders.

The only solution is better specifications and measures to ensure that these are adhered to.

For further reading

1. British Stainless Steel Association – www.bssa.org.uk
Calculation of pitting resistance equivalent numbers (PREN) and other articles.

2. PIANC – www.pianc-aipcn.org
Guidelines for the Design of Fender Systems: 2002 (Report of WG33).

ABOUT THE AUTHOR

Mike Harrison graduated in Mechanical Engineering from Imperial College, London in 1982. He has worked in the fender industry for over 20 years, for the last decade with Fentek (now part of the Trelleborg Group). He is accredited with designing thousands of fenders including some of the most sophisticated and advanced systems ever installed.

Presently Mike is Director of Marketing for Trelleborg Marine Systems which encompasses such well known fender brands as Fentek, Seaward and Trellex fender. Part of the senior management team, Mike has contributed to the phenomenal growth of Trelleborg Marine Systems which is now the world's largest fender manufacturer.

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