

How ports benefit from a holistic approach to fender system design

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Summary

The aim of the paper is to share expertise and industry-relevant examples of the concept of a ‘holistic approach to fender system design’ and its influence on the productivity and safety at marine terminals. The paper starts by highlighting different aspects of a holistic approach and their influence on the performance of fender systems. It is followed by an honest look on typical problems of poor fender system design, resulting consequences and corrective measures to always ensure smooth operations at ports. The paper closes by a final review of the importance of a holistic approach to fender system design for the maritime industry.

Keywords: fender system design, marine fenders, holistic approach, marine terminals, ports

Introduction

In order to get a high-quality and durable fender system for a port to protect vessels, port infrastructure and people, a complex route lies ahead.

Many different aspects need to be taken into account when designing a fender system. If the focus is only on a few of those aspects, the quality, durability and the guaranteed safety that is expected from a fender are lacking. This is why a holistic approach is needed, taking all aspects into account and treating a fender system as one: it looks at the manufacturing process as well as the different components of a fender system and their interaction, and the project conditions.

Only when all of these aspects are valued equally, are interconnected and seen as one single process, will the fender system perform as expected.

When fender systems fail or are not working properly due to low quality or incorrect designs, then there is a cost to the port in terms of repair, downtime, or even accidents. These costs should not be underestimated. They can be avoided by pursuing a holistic approach to fender system design throughout the marine industry.

Influences on the performance of fender systems

Several aspects influence the performance of a high-quality and durable fender system.

1. The **manufacturing process** of the rubber unit plays a vital part in the ultimate performance of a fender system, same as for steel parts and PE. A holistic approach ensures that all manufacturing steps are interconnected.
2. The **different components of a fender system and their interaction** should be seen together. A fender system is made of different components: rubber unit, steel panel, chains, anchors, fixings and PE plates. A holistic approach makes sure they are all designed in the correct balance and work together properly.

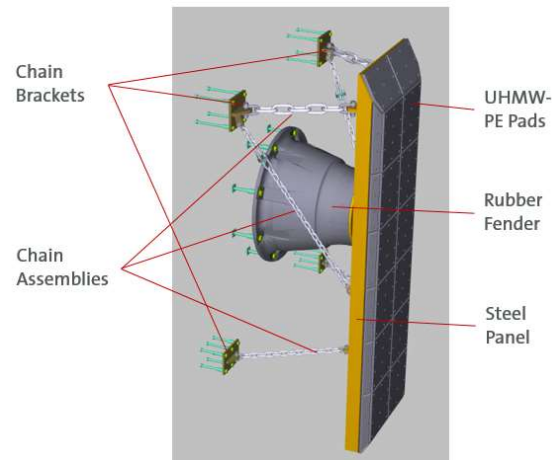


Figure 1 Different components of a fender system

3. **Project conditions**, such as berthing energy or local weather, are very individual. Those, and the different characteristics of various fender types are to be incorporated in the fender design process. A holistic approach considers all the many conditions to design a unique fender system.

Despite following their own holistic approaches, it is the interaction between all of these aspects that lead the way to the ultimate goal: a high-quality and durable fender system, performing as expected, protecting vessels, port infrastructure and people.

Typical problems of poor fender system design, resulting consequences and corrective measures

Although industry standards guide the way, there are still many examples of poor fender system design being visible at ports around the world. A shortcoming of addressing the importance of a holistic approach and seeing the previously discussed aspects as one can be identified as being one of the reasons.

The current guidelines from PIANC [1] and British Standard [2] address the topic but not to the full extent. So far, there is no standard which fully

covers the concept of a holistic approach to fender system design.

All steps of fender design go hand in hand and influence each other. Since the rubber units are mostly standardized in the industry, the main engineering and design challenge is with the steel panels, chains and the corresponding anchorage.

Typical problems in poor fender system design are:

- the rubber fender position on the panel,
- chain layout,
- the steel panel's internal structure,
- UHMW-PE protection pads, and
- coating system.

Figure 2 gives an example of three typical problems of poor fender system design: Unfavorable panel position (P1), chains with incorrect angle (P2) and low rubber quality with incorrect design (P3).



Figure 2 Three typical examples of poor fender system design

Poor fender system design has many faces with severe consequences for ports, ships and people. These are often a dramatic reduction in the operational life of the system. Several measures help to prevent failures and minimize risks, including correctly positioning the rubber unit on the steel panel, high-quality UHMW-PE or coating thickness according to specifications.

Application of fender system design

The consideration of fender system design is applicable to professionals working with waterfront structures and fenders for ports, inland waterways and marinas, as well as operators and authorities. Users and engineers should be aware of the fact that "what looks good in a drawings, might not work in the field".

One example is the design of the steel panel in connection with the rubber unit position on the panel. On the drawing, the panel might be shown straight and stable, but installed in the port, the panel could show drooping and tilting under its deadweight – this cannot be 'seen' on a drawing.

Another example is an incorrect tension chain design. Again, the panel and corresponding chain might look correct on the drawing, but in the field an incorrect tension chain design could diminish the energy absorption of the fender system at low level contact.

The importance of a holistic approach

If a rubber fender system does not perform as required, safety in marine operation and efficiency for marine terminals cannot be ensured. This is why it is important to take all aspects into account that influence the performance of a fender system and treat them as an interconnected process, being a holistic approach as described in this paper.

The lack of this concept in industry standards and the many examples of poor fender system design around the world emphasize the need for a holistic approach to fender system design in the industry.

In a first step, the awareness of all the aspects and their interconnection will increase the understanding in the industry about potential problems with fender system design. In a second step, including this process in industry standards will further ensure that all fender manufacturers follow the same route to a high-quality and durable fender system.

References

- [1] British Standard 6349: Part 4 (2014). Code of Practice for Design of Fendering and Mooring Systems.
- [2] PIANC International Working Group 33 (2022). Guideline for the design of fenders.