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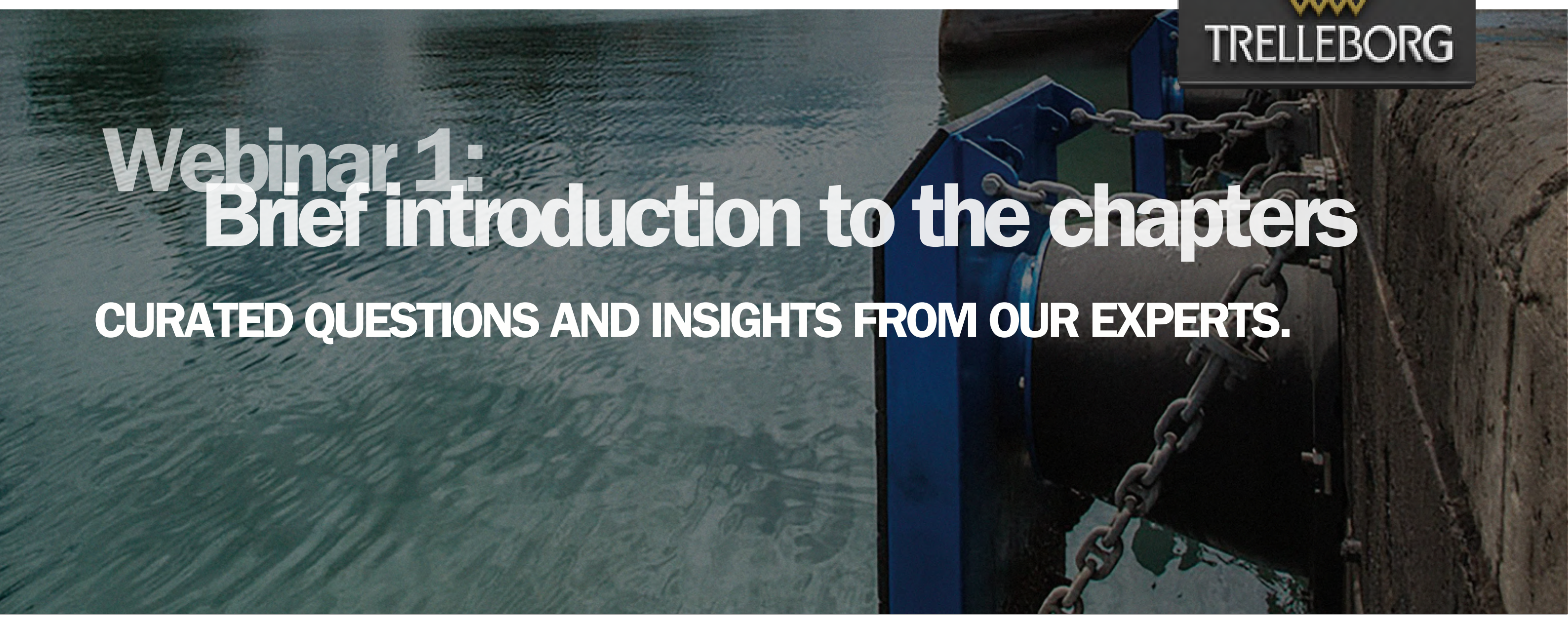

Webinar 1: Brief introduction to the chapters

CURATED QUESTIONS AND INSIGHTS FROM OUR EXPERTS.

1 In 2022, shipping accounted for 3% of global emissions, whereas fender manufacturing contributed a negligible 0.000003%. What impact are we discussing here?

Trelleborg recognizes that the carbon footprint of a fender is minimal compared to shipping or constructing a port. However, due to the increased focus on climate change by PIANC HQ, it has been highlighted in the WG211 report. Sustainability remains a top priority at Trelleborg, driven by our larger goal of creating a sustainable future for our customers and society. Though reducing the carbon footprint for a fender might have a small global impact, it is extremely important for us as a company due its significant environmental implications.

2 At a high level, what impact do you foresee on the design outcome of the fenders? Have any case studies been conducted comparing the adopted fender design from past projects with the new PIANC WG211?

The paper "Comparison of fender dimensions, PIANC WG211 and PIANC WG33" by A. Roubos et Al. compares the new WG211 with the WG33. The overall conclusion is that for "favorable" conditions, the fenders may become slightly smaller than before, and under unfavorable conditions, the fenders could become larger if site-specific information is not used.

3 What approach velocity should be used for calculating berthing energy for direct open sea conditions?

The berthing velocity is influenced by various navigation conditions, detailed in Table 5-1 of WG211. This table addresses several key factors: (1) vessel approach strategy, (2) resources for vessel control, (3) current, (4) waves, and (5) wind. While the open sea is not specifically considered here, it is addressed by these five aspects.

4 Based on your experience, is it realistic or feasible for the owner to provide berthing speed for the design?

PIANC WG211 Section 5.4.1 offers recommendations for obtaining site-specific information, such as berthing records, historical service performance, and input from pilots or harbor masters. Often, there is more local knowledge than at first glance. Also, emerging technologies, which may not be widely used today, are expected to become more prevalent in the future, providing owners with deeper insights into actual site conditions.

5 Are you testing angular and horizontal compression of fenders?

Trelleborg will be testing fenders in accordance with the new PIANC WG211 guidelines. For the "Type Approval Testing" (reference to PIANC WG211 chapter 10) both angular and horizontal testing of fenders is required. For "Verification Testing" only the horizontal testing is mandatory and the angular testing is considered as optional testing (to be specified by the client). Reference is made to PIANC WG211 table 10-1.

6 Is there a more detailed assessment to determine the abnormal berthing factor or any specific guidance depending on the characteristics of the berth?

The abnormal berthing factor is changed into the "Partial Energy Factor" which is determined in 8 steps explained in WG211 section 5.8. The Partial Energy Factor depends on (1) Navigation Conditions (2) Consequence Class (3) Variation in displacement (4) Berthing frequency (5) Single or multiple fender contact (6) Pilot assisted and (7) Local knowledge.

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Webinar 2: Chapters 1-5

CURATED QUESTIONS AND INSIGHTS FROM OUR EXPERTS.

1 Has the abnormal berthing energy factor 1 been removed in the new PIANC WG211 report?

The abnormal berthing factor is now the Partial Energy Factor; refer to section 5.8 of PIANC WG211. The old abnormal berthing factor considered vessel size and type as key elements. The partial energy factor is risk-based and considers: 1) navigation conditions, 2) reliability requirements, 3) variation in displacement, 4) berthing frequency, 5) single or multiple fender contact, 6) pilot assistance, and 7) local knowledge.

2 Is a probability of 0.02% extremely low? And in the case of soil conditions, is a probability of 5% enough to result in a very high berthing speed?

PIANC WG211 Table 5-2 provides recommended characteristic values of design variables, with a 0.02% probability of exceedance for the berthing velocity. This table should be used when no site-specific data is available. When the designer has insights and supporting data that allow for a lower probability of exceedance, they can use a lower percentage. Since berthing speed is dominant in the berthing energy calculation, its exceedance has significant consequences. This is why the percentage is much lower compared to, for example, the berthing angle, which has a 5% probability of exceedance. With a return period of 50 years, 100 berthings per year, and a probability of exceedance of 0.02%, WG211 considers one exceedance during this 50-year period. More information on probability calculations can be found in PIANC WG145 and Appendix A of WG211.

3 When will the new PIANC guidelines officially supersede the old ones?

PIANC WG211 has been released now and section 1.1 says: "This guideline completely supersedes the previous WG33". However the PIANC WG211 and WG33 are not standards or codes but guidelines so ultimately it's up to the industry to adopt the WG211 and implement it.

Note that WG211 in section 1.1 also refers to a 2-year transition period for the suppliers to re-organize their catalogs and it states that "Designers can start using the new guidelines but should be aware of what they are specifying for deliveries before this date"

4 With no definitions of wave height, wind speed, current speed, etc. isn't navigation condition extremely subjective and potentially a legal nightmare in potential post-event litigation?

Selecting the berthing speed as per the old PIANC WG33 was also based on subjective conditions such as "Easy berthing conditions, exposed" for WG33 figure 4.2.1 (Brolsma Curves) as well as a similar method (Favorable / moderate / Unfavorable) in WG33 Figure 4.2.1 (which provided even no guidance at all on the terms Favorable / moderate, etc.). Also the BS6349-4 section 5.2.2 uses subjective conditions. Therefore, PIANC WG211 taking this approach is no trend break. PIANC WG211 section 5.1.4 also suggest that "Allocating the navigation condition requires active discussion and must be performed and agreed upon with asset owner prior to commencement of fender design". We aren't aware of any post-event litigations that resulted from the old PIANC WG33 and BS6349-4 subjective methods for navigation conditions, so we don't expect a trend break with the new PIANC WG211. PIANC WG211 clearly states that this isn't the responsibility of a single designer but should be decided with relevant stakeholders.

5 Are there specific clauses about the type of rubber fender required for fishing vessels? Typically, rubber tires are used. Can you clarify if there are any particular regulations?

Ocean-going vessels, including fishing vessels, are covered by these new guidelines (see PIANC WG211 section 3.1.10). The scope of the new guidelines includes energy-absorbing fenders, whereas rubber tires are considered more of a protective measure and cannot be designed or engineered. Therefore, rubber tires are not covered by these guidelines. Chapter 6, Table 6-1, provides suggestions for fenders suitable for fishing vessels.

6 Are there any clauses related to accidental collisions ?

No, WG211 is clear in section 1.3 that collisions are not covered in these guidelines. While the principles of WG211 for calculating berthing energy and selecting fenders can be used, impact speeds, collision angles, and points of impact will differ significantly from normal berthing applications. WG211 does not provide guidance on this.

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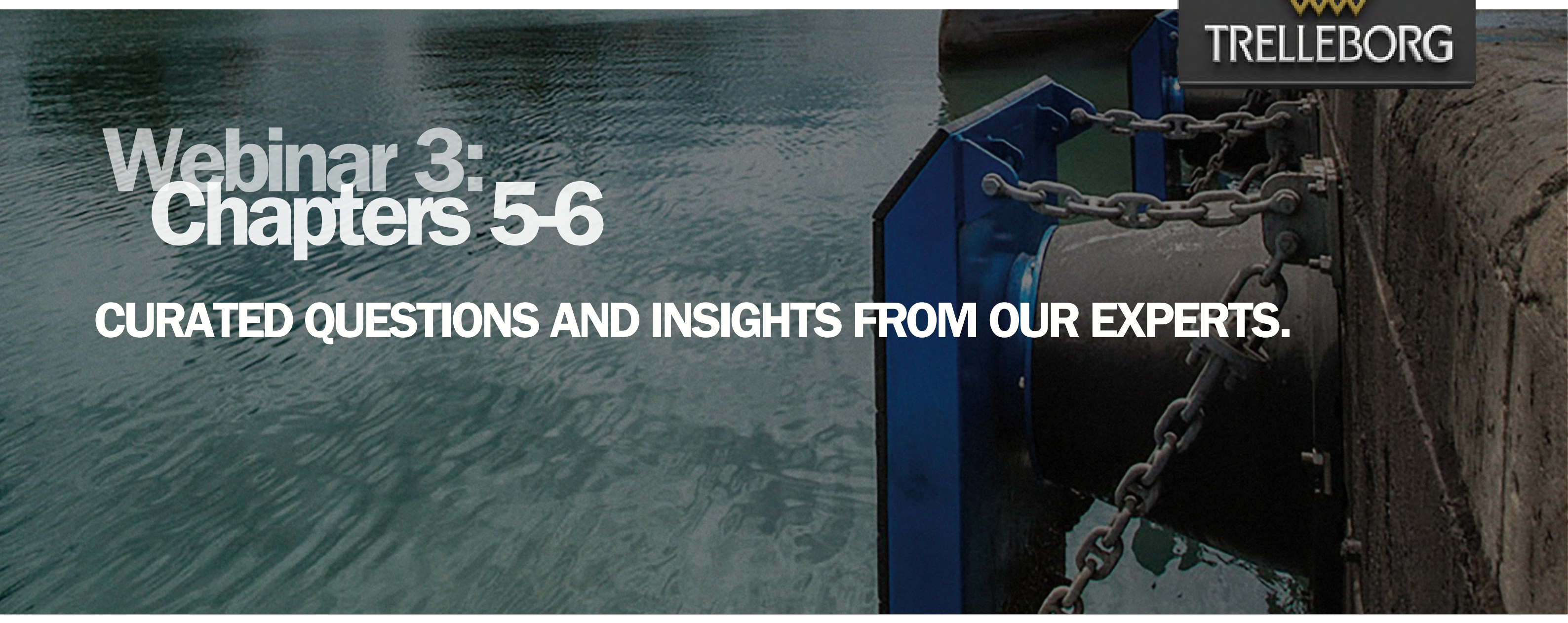

Webinar 3: Chapters 5-6

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1 In which design situations can single-point berthing be disregarded, and only multiple fender contact assessed? Shouldn't single-point berthing always be considered?

PIANC WG211 offers guidance in on this in sections 6.4.4 and 6.4.5. The document provides detailed guidance, but briefly, single fender contact is always used for island berthings. On continuous quays, multiple fenders are likely engaged based on the characteristic berthing angle, hull geometry, and fender spacing. When multiple fender contact is assessed and the engagement is verified, it will be evident that there is no multiple fender contact if this is the prevailing condition.

2 Which method is preferred for determining the fender pitch: using the formula or following the WG211 suggestion of P < 0.15 Loa?

WG211 offers Equation 6-3 to determine the maximum fender pitch. However, without a detailed assessment, often the case at the concept design stage, the maximum pitch can be estimated as 0.15 times the length of the smallest design vessel.

3 PIANC WG 211 Section 1.2 quotes, "The guideline includes best practice recommendations and takes into account the latest knowledge. However, WG 211 is not intended to be a tender/contractual document." Does this mean we have to wait until the WG 211 recommendation is incorporated into BS 6349 to be covered contractually?

The WG211 report provides guidelines to allow the asset owner and designer to make well-informed decisions and build their own specifications based on the guidance provided by WG211. Through the specifications, the right criteria will become part of the tender/contractual document. The BS6349 series is a code, but enforcement is limited. For the BS6349, it is better to take the same approach as WG211 using it as a basis for developing specification and enforce the BS6349 through the specifications.

4 For a project designed with WG33 that used extreme temperature (to determine the fender temperature correction factor), can the new temperature definition of WG211 section 6.6.3 be used and reduce the fender reaction forces?

Although WG211 states that the methods of WG33 and WG211 should not be mixed, there is no issue with using the temperature definitions from WG211 for the WG33 method. This is because WG33 does not provide a temperature definition for the temperature factor, so using WG211's definition is preferable to having none.

5 If you were designing a fendering system for a small fleet of identical ferries with the same trained set of captains and crew without tug assistance, how would you handle the partial energy factor for correlation and for pilot assistance?

The partial energy factor for correlation (γ_c) covers the reliability of a fender system in correlation with vessel size and velocity. This applies when there is a range of vessels to be able to develop the correlations. Since we consider only one type of vessel here, this effect cannot be determined. Regarding the partial energy factor for pilot assistance (γ_p), WG211 states, "For berthing maneuvers that are assisted by tugs alone, tug skippers are generally guided by the captain or master who may not be completely familiar with the local navigation conditions." However, in this case, the master seems familiar with the local navigation conditions. Therefore, the designer could consider not applying the partial energy factor for pilot assistance of 1.25 or consider using a lower value if site-specific information is available to support that.

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Webinar 4: Chapters 6-8

CURATED QUESTIONS AND INSIGHTS FROM OUR EXPERTS.

1 Is using zinc anodes in addition to coating systems to protect fender panels justified? Does using coating systems only suffice?

The use of sacrificial anodes is covered in PIANC WG211, Chapter 9, Section 9.4.3.2. These anodes protect steel by utilizing properties of electrical potential, current capacity, and alloy quality, and they only function when submerged in water. Since most fender panels are in the splash zone, the protection they offer will be very limited.

PIANC WG211 offers guidance on selecting a coating system in Chapter 9, Section 9.4.3.1. When chosen, applied, and maintained correctly, a coating system alone is often sufficient. While coating system selection is typically well addressed, proper application is often overlooked. Trelleborg can assist in developing a robust inspection and test plan (ITP) that covers all critical aspects of a good coating application and testing plan.

2 What advice would you offer to a port facility designer when choosing fenders in regions affected by ice cover (excluding impacts from drifting ice)? Would this alter the energy calculation?

The berthing energy is normally not affected by ice conditions; however, operational conditions may impact berthing speeds, hence impacting the berthing energy indirectly. When selecting fenders, it is crucial to apply the correct temperature correction factor, as fender reaction forces can be significantly higher at low temperatures than the performance published in the catalog (base performance). Additionally, ice conditions are addressed in PIANC WG211 chapter 8, section 8.9 (design of fender components in icy conditions), which provides practical advice for these specific circumstances.

3 PIANC recommends using the characteristic reaction of the fender for the structural calculation of the pier. However, for hull pressure calculations, the design reaction (inclusive of partial factors) should be used. Is this correct?

In section 6.7.1.4, PIANC WG211 suggests using the characteristic reaction force multiplied by the partial load factor and combination factor, as per national code, standard, or annex, for the support structure design. PIANC WG211 also suggests in section 6.7.1.3 (and Equation 6-18) that $R_{f,d}$ is used for the hull structure limit check. $R_{f,d}$ includes the partial resistance factor (γ_f) and load partial resistance factor (γ_R) (this applies to buckling fenders, reference PIANC WG211, section 6.7.1).

4 What materials, other than UHMW-PE, can be used to reduce friction during berthing?

For fender panels, we look for an optimal combination of material properties where the coefficient of friction, wear resistance, impact resistance, and costs and the potential to recycle and use recycled material are important. UHMW-PE is the optimal choice, as it meets all these criteria. While other materials like PTFE (Teflon) have a lower coefficient of friction, they wear out faster and are more expensive. For foam fenders, we use polyurethane (PU) to reduce friction because it can flex with the foam fender body.

5 Usually, the UHMW-PE pad friction coefficient is indicated as <0.2. However, if the friction coefficient needs to be increased to 0.3, what impact does this have on the fender? Additionally, what other materials can result in this increase?

UHMW-PE has a coefficient of friction of 0.15 - 0.20, depending on the testing standard, conditions (dry/wet) and various contact surfaces. For design purposes, often a coefficient of friction of 0.3 is used (recommended design value in BS6349-4 and PIANC WG211) to account for increased friction due to wear and tear and different circumstances than those covered in the theoretical value.

6 For submerged applications, can you provide buckling fenders with holes to let the water escape?

Trelleborg cone and cell fenders are designed with drain vents in the fender foot flange. The drain vents are large enough to drain the water in most design cases. For scenarios with very high compression speeds, we recommend contacting your local Trelleborg Marine Fender sales office for more information.

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Webinar 5: Chapters 9-13

CURATED QUESTIONS AND INSIGHTS FROM OUR EXPERTS.

1 When should we start using the new WG211? Can we use chapter 5 energy calculations but reference the current PIANC fender manual for fender selection, or should we wait for the new fender manuals? Should we draft specifications based on this new guideline now, or wait until manufacturers fully implement the new requirements?

According to PIANC WG211, section 1.1, the changes are substantial, and there is a transition period between WG 33 and WG 211 for reorganizing fender suppliers' catalogs based on the new guidelines. This transition is expected to require significant type approval testing and will end on May 1, 2026, two years after the publication of the WG 211 guidelines. Designers can start using the new guidelines but should be cautious about specifying deliveries before this date.

The Trelleborg brochure already displays CV performance data, which aligns with the new base performance, as well as all necessary performance correction factors to calculate the characteristic and design performance of the fender. This indicates Trelleborg's readiness for any new specifications referring to WG211.

Trelleborg is currently engaged in "Fundamental Testing" and will proceed to "Type Approval Testing," as outlined in chapter 10 of WG211. This process is expected to continue until the first quarter of 2025. When drafting specifications, it is important to account for this time frame.

2 What is the maximum lifetime of a fender used for an ocean port?

The service life of a fender depends on multiple factors, including maintenance, material quality, frequency of use, operational conditions, and geographical location. According to PIANC WG211 section 4.4, "fenders typically have an expected design life of 20 years." While this offers a general guideline, the actual service life can vary based on the factors mentioned above.

3 How can I determine if cracking during an inspection was caused by an overload (bigger vessel) or fatigue?

If a fender is relatively new, it likely did not fail due to fatigue unless made from poor-quality materials. Trelleborg cone fenders include an overload stopper to prevent excessive compression, protecting them from cracks. However, prolonged use can lead to rubber surface deterioration from external factors like heat, sunlight, and ozone. Over time, this reduces the rubber's ability to stretch (lower elongation at break), causing surface tears that can develop into cracks, which may be considered fatigue cracks.

4 Do you know the CO_2 emissions of a fender?

The carbon footprint equivalent (CO_2e) of a fender can be calculated and depends on various factors, including the size and type of the fender, project location, accessories, and materials used. Trelleborg is working on CO_2e calculations in conjunction with Life Cycle Assessments (LCA) and Environmental Product Declarations (EPD) that not only provide CO_2e calculations but also a complete environmental footprint, certified by a third party. We expect to start offering this for our products in the latter half of 2024.

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