28. Trendsetter Vulcan Offshore - Next Generation Lashing System

supports that reduce container motion and control the dynamics of container stacks

the challenge

Based on a 3-year running average, approximately 1,800 containers are over boarded at sea each year, leading to significant economic, safety, and environmental concerns.

Causes of Container Losses:

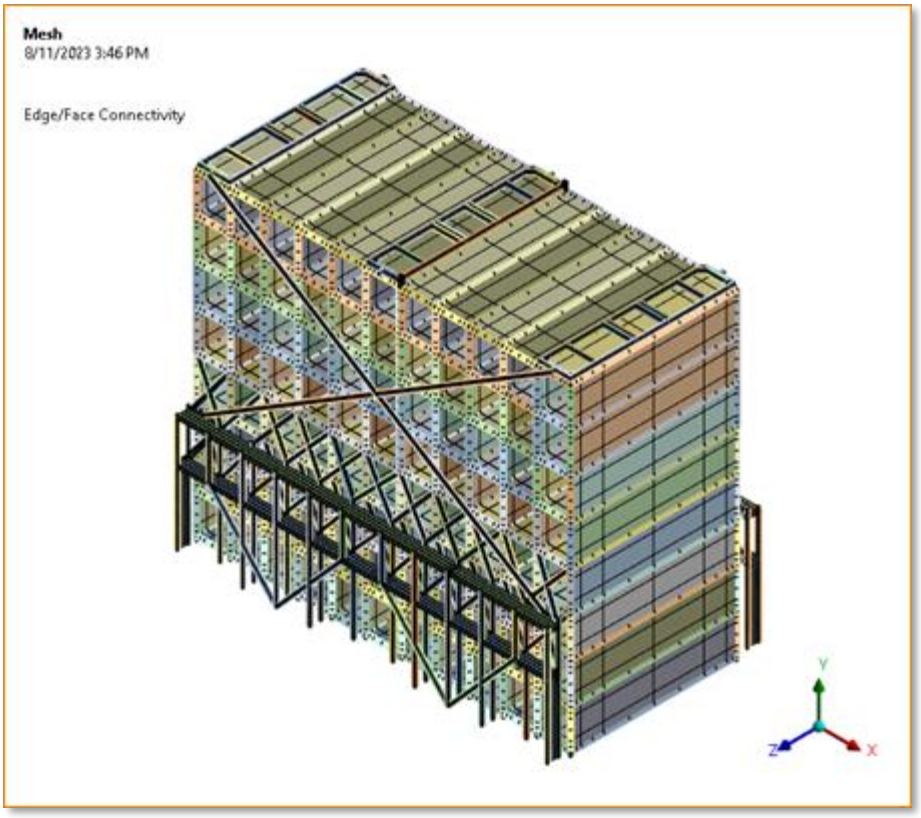
- Weather and Rough Seas: Areas like the North Pacific and North Atlantic are frequently subjected to hostile weather conditions. Massive waves in such conditions can pose threats to ships. If a vessel isn't adequately equipped, or if it faces severe meteorological adversity, containers can be at risk of being dislodged and lost.
- Incorrect Stowage and Lashing: Proper container lashing is essential for maritime cargo safety. In cases where containers are not anchored securely using appropriate lashing bars and twist locks, they are at risk, especially in rough waters or during significant ship movements.
- Ship Design and Stability: The stability of a ship is often contingent upon its load. Certain loading configurations can compromise a ship's balance and can make the vessel more susceptible to certain undesirable movements. In addition, phenomena like parametric roll observed in some ships, particularly longer vessels, can escalate the risk of container loss.

A system is needed to improve container stability in rough seas and reduce the risk of over boarding. Until now, no solution has adequately addressed this challenge, leaving millions of tons of cargo at risk and creating potentially life-threatening conditions for crews.

the innovation

Trendsetter Vulcan Offshore (TVO) developed a Next Generation Lashing System (NGL) that addresses the container loss problem by introducing supports that reduce container motion and control the dynamics of container stacks. By tethering the top of the outermost stacks, the NGL creates a wing wall that stabilizes the containers in the bay via enhanced tension stability. The NGL provides additional restraint at the top of the stack, which can eliminate the dynamic twistlock tensions that have been the initiating cause of many container stack failures.

The system design includes: an anchor platform that connects to the container stack via conventional twist locks, a robust tether that connects the anchor platform to the vessel, and a unique tensioning system that provides the preload that energizes and enhances the stability beyond static lines. Through stronger fastenings, this system allows for higher container stacking and reduces the risk of container loss.



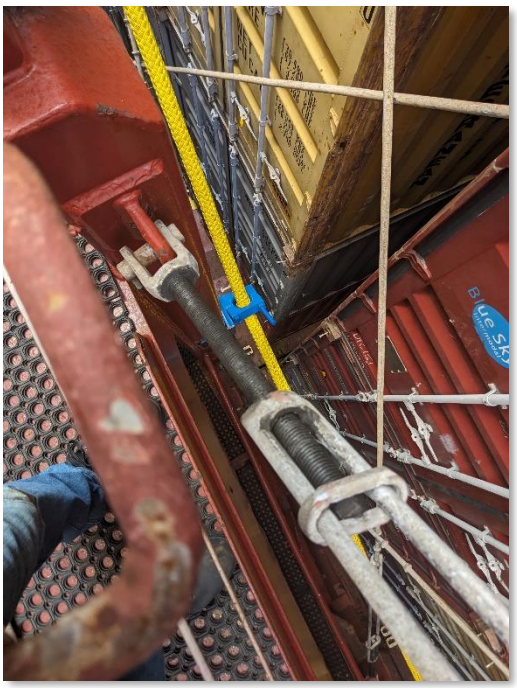
Integrating TVO's proprietary Janus Monitoring System sensors into the NGL allows the tether tensions and stack dynamics to be actively monitored, adding a level of confidence to container retention. The Janus system's monitoring capabilities include both predicting and

Installed Starboard side

detecting parametric roll, allowing evasive action to be taken before vessel and stack dynamics enter a destructive range.

The technology was adapted from a system used in subsea oil and gas applications to arrest blowout preventor (BOP) motions using a tethering system comprising piles and tensioners that hold the BOP in place and transfer loads to the tethering system, piles, and seabed instead of the wellhead. Adapting this technology to containerships can significantly improve safety and reduce container loss.

Tensioner with load pin



Installed tethers running through traditional lashings

how it was implemented

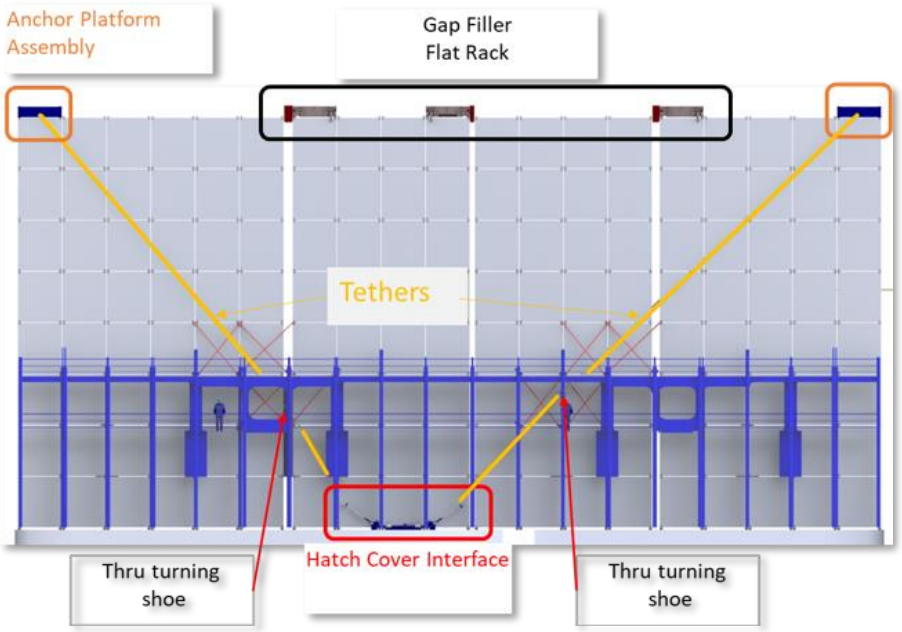
Finite Element Analysis (FEA) proved the viability of the NGL solution.

Open-source data from a containership that experienced container loss was used as input to model one bay fitted with traditional lashings and one with the NGL system. An arrangement of four stacks of containers 8 tiers high was used to analyse the effects of vessel roll on stack dynamics with and without tethers. Roll angle was analysed at 19 and 40 degrees, and tether models were analysed with 3 and 5 tonnes of preload.

The model was then enhanced to more precisely replicate the lashing bridge of the vessel used for source data. Analyses were carried out to understand the differences in performance between branded lashing material and wire rope as well as the differences in the NGL system's effectiveness on 8-tier and 9-tier configurations. The model was also used to understand how moving the anchor points from the hatch covers to the lashing bridge impacted performance, followed by 'what if' scenarios that included hatch cover movement and a single tether failure.

TVO simulations consistently found that the NGL system safely restrained the container stacks.

Sea trials were carried out onboard a 13,700 TEU vessel traveling from Salalah, Oman, to Tanjung Pelepas, Malaysia, in June/July of 2023. The NGL test bay and the adjacent bay were instrumented with the Janus Monitoring System to measure tension loads through the conventional lashings and accelerations via the stack top accelerometers. Tension loads were monitored via load cells integrated into the NGL's tensioning system.



result

Testing was successful, and the communications system worked exaclty as anticipated.

The sea trial demonstrated that the system can maintain tension throughout deployment, indicating that the NGL system is a practical solution for reducing instances of container overboarding and has the potential to enable higher container stacks without compromising vessel or crew safety. The trial provided another instance of the Janus monitoring system effectively monitoring the vessel, stack, and NGL dynamics and displaying the results onboard and remotly.

The vessel crew noted a visable reducetion in container motion in the NGL bay as compared to other bays throughout the vessel. Due to calm sea conditions the vessel did not experience higher roll angles and acceleration, but the data gathered via the Inetial Measurement Units (IMUs) indicate the NGL system can absorb and dissipate energy originating from the ship motions and external forces.

According to a COO in Salalah, Oman, "This is what needs to happen to fix the container loss issue," though he cautioned, "The system needs to be easier to install."

Lessons learned have led to design changes that will simplify equipment onboarding as well as connecting and removing the lashings. The NGL 1.0, which will be available commercially in Q1 2024, features considerable enhancements that use automation to reduce installation and tensioning times.

conclusion

The successful sea trial of the prototype NGL system proves that applying this tethering concept can improve safety onboard containerships and significantly reduce financial losses.

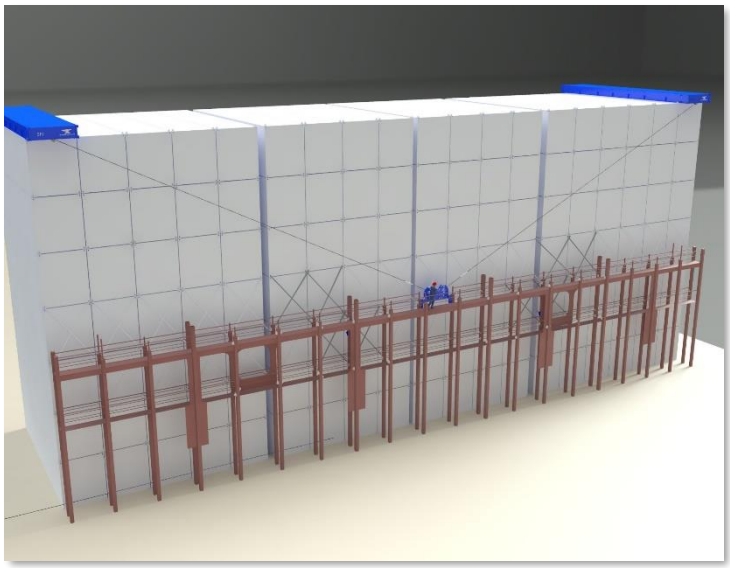
The transfer of proven technology from oil and gas industry applications introduces a way to improve transportation by containership and reduce loss and injury. This milestone achievement was acknowledged by a CO based in pilot container vessel: “No one has gotten this far in implementing a new lashing system.”

Ongoing testing and additional installations will allow TVO to further assess the system to determine its limitations so refinements can be made to improve its performance.

The next steps being taken by TVO will address this concern, simplifying system installation and removal to streamline the processes. Another area of study will be evaluating automated tensioning techniques that can be used to ensure consistent tension across the lashing system as sea conditions change.

The goal is to take this novel system to the next level, increasing reliability and expanding the operational window to help the maritime industry improve safety and reduce the risk of accidents and injuries.

An endorsement from a vessel captain on the pilot vessel, sums up the need for the NGL system: “Safety is my biggest worry. This [NGL system] needs to be on every vessel.”



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