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The Strength of Sea-Containers

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Intro

The safe transport of containers container vessels requires accurate assessment of structural integrity and securing arrangements under operational loads. This paper presents an overview study combining experimental, numerical, and comparative approaches to improve container stack safety. First, experimental investigations on container corner castings and twistlocks conducted at TUHH are summarized, highlighting the influence of wear and deformation on load-bearing capacity and failure modes under various load conditions.

In order to investigate the locking strength between containers a test setup according to the DNVGL-ST-0068 standard was built, as can be seen in Figure 1. Load steps are applied in sequence: compressive force, racking force, and lifting force, with all previous loads maintained constant to simulate the movements of containers during transport. Fully-automatic locks use standard loads (compressive: 350kN; racking: 150kN; lifting: 275kN); semi-automatic twistlocks combine these with single twistlock loads (compressive: 350kN; racking: 210kN; lifting: 313kN). The lifting force is increased until the casting or lock fails to determine breaking strength.

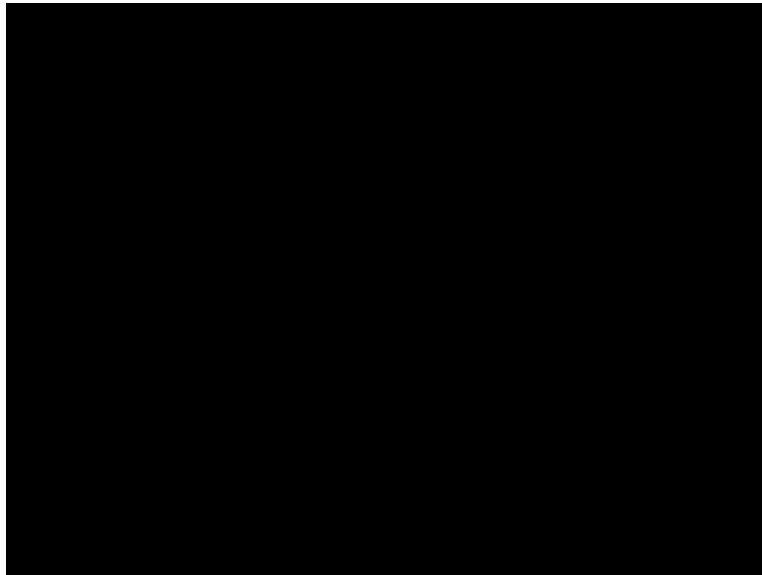
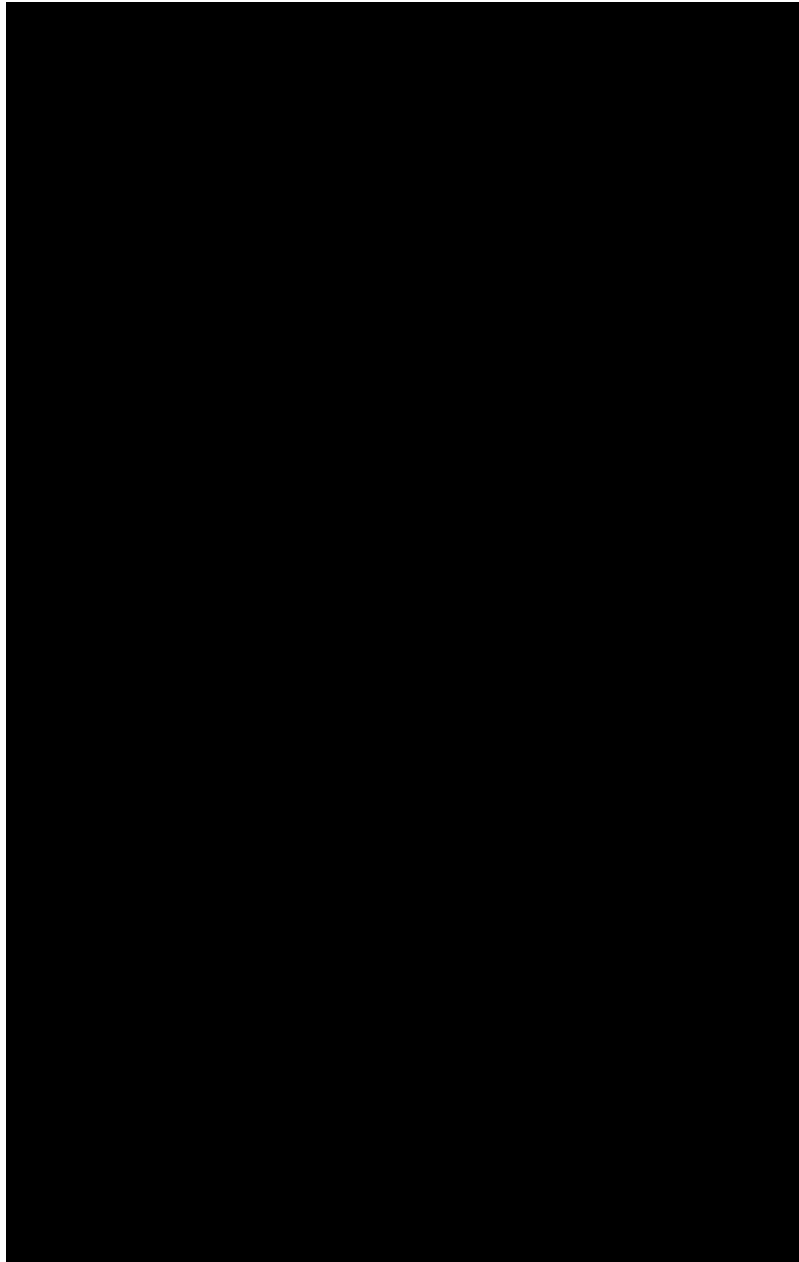


Figure 1: Test stand at TUHH

Experiments are conducted with different combinations of new and old twist locks and corner casts assessing differences in performance.

Second, advanced structural mechanic methods for evaluating container stacks are reviewed, including linear, semi-nonlinear, and fully nonlinear approaches, as well as finite element and analytical models. These methods address critical nonlinearities such as corner separation, lashing interaction, and lashing

bridge flexibility, which significantly affect stack response. Finally, a benchmark comparison of operational solvers from major classification societies is discussed, based on a 15k TEU reference vessel.



The paper concludes with remarks on recommendations for container monitoring and potential operational hazards.