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*Editorial*

# Ship Structures: Design Loads and Reliability Assessment

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In order to operate, ships and offshore structures heavily rely on bunker oil and marine diesel oil. However, emissions caused by the fuels, specifically sulfur oxides, nitrogen oxides, and carbon dioxide, contribute to air pollution. As concerns about global climate change increase due to the enormous amount of environmental pollution from industrial sources, the maritime industry faces stricter regulations regarding emissions from commercial seagoing vessels. Designing environmentally friendly ships requires a careful evaluation of structural responses, considering potential hazards such as fuel leakage. Therefore, it is necessary to determine appropriate design loads under accident conditions such as collisions, explosions, and groundings. Nevertheless, ensuring safety and reliability remains a complex challenge.

Kim et al. [1] introduced a system concept using the integrated computer-aided manufacturing (ICAM) definition for function modeling (IDEF0). They constructed a database and formulated a secondary energy conversion system, while developing reliability assessment algorithms and programs. They then validated the results by applying them to a representative movable wave power generator, demonstrating the effectiveness of the proposed process flow diagram (PFD) and reliability assessment program. Park et al. [2] performed a numerical investigation of the plastic deformation of flat plates subjected to slamming impact. The research approach involved examining the dynamic impact pressure of flat plates subjected to various weights and drop heights. The results of the simulation and the experiment showed a generally good agreement for the deflection range. However, because the initial plate condition was not reflected in the simulation, discrepancies were observed at maximum deflections. Vuong et al. [3] proposed a novel method for establishing the true dynamic bending moment of a propeller shaft using a single bridge of a strain gauge. They validated the results by performing experiments during the trial of a 50,000 DWT oil/chemical tanker at sea, where they detected significant fluctuations in the propeller force, leading to a non-uniform oil film distribution in the bearings. Kim et al. [4] conducted tests on widely used ship and offshore industry polymers, namely acrylonitrile butadiene styrene (ABS), polyethylene (PE), and polyvinylidene fluoride (PVDF). They examined the quasi-static stress–strain responses of the polymers at different strain rates and temperatures, and found that ABS exhibited a lower fracture strain and modulus of toughness compared with PE and PVDF. Gong et al. [5] investigated the sagging damage of a simplified hull girder (SHG) subjected to an underwater explosion bubble. Using the coupled Eulerian–Lagrangian (CEL) method, they simulated the damage mechanism of 11 SHG structures and identified regular plastic hinge lines, primarily dependent on the folding of the side plates. The study also revealed the influence of distant transverse bulkheads on the total longitudinal strength of SHGs under near-field underwater explosion conditions. Park et al. [6] examined the applicability of the triangular impulse response function (TIRF) method in evaluating the ultimate strength of liquefied natural gas (LNG) cargo containment systems under sloshing impact loads. Their study compared the structural responses and impulses obtained using the TIRF method with those from direct dynamic nonlinear transient assessments. Based on the findings, they proposed partial safety factors for calculating the ultimate bending and shear capacities of LNG cargo containment systems, taking into account the dynamic impact of sloshing loads. Kang et al. [7] conducted experimental and numerical investigations on cryogenic leakages within welded steel plates. In their study, they simulated cryogenic leakage conditions by subjecting welded plates to a temperature of −196 °C, using liquid nitrogen ($LN_2$). They measured temperature and strain variations using thermocouples and strain gauges, while assessing the residual stress of the middle surface section before and after the cryogenic leakage process. Garbatov et al. [8] proposed design solutions involving the use of aluminum honeycomb panels to replace inner steel shell plates. These solutions enhanced resistance to corrosion degradation, reduced hull weight, improved reliability, and lowered repair costs, resulting in approximately 11% lower ship-related costs compared with traditional steel solutions. Lee et al. [9] analyzed the failure causes of oil pumps based on actual accident records, focusing on key components such as bearings, couplings, sealing elements, and screws. They developed test infrastructures to gather data under normal and abnormal operating conditions and determined the frequency of failure by analyzing vibration data using a fast Fourier transform (FFT).

The advancements discussed in this Special Issue contribute to the ongoing efforts in ship design and structural assessment, taking into account environmental impact, safety, and reliability. The integration of computer-aided manufacturing, numerical methods, experimental investigations, and reliability assessment techniques provides valuable insights into the development of eco-friendly and autonomous ships. Future research should continue to explore innovative approaches aiming to enhance ship performance and address sustainability challenges within the ship and offshore industry.

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