Dept. of Naval Architecture and Ocean Engineering,
Division of Global Architecture

Ship Structural Integrity Subarea
Prof. Fujikubo and Assoc. Prof. Iijima

Researches into Structural Integrity and Safety of Ships and Marine Structures

Collapse Analysis of Large Structures

Severest waves are as high as ten-storey buildings, yet ships still have to sail in the cruel seas. When designing the ship structures, you need to secure the safety rationally even under complex loads generated by massive waves. We investigate into structural integrity assessment methods for ship's hull girder and its structural part, specifically, ISUM (Idealized Structural Unit Method), faster than conventional FEM are being developed. The numerical simulations are validated by experiments.

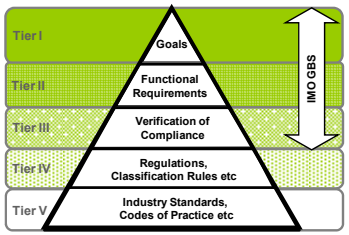
Photos of collapsed ships

Experimental collapse analysis by using a scaled model and computer simulation (L=8m, B=3m, D=2m)

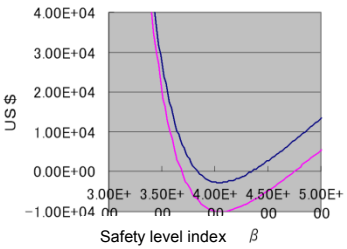
Risk-Based Safety Assessment of Ship Structures

Ships sail worldwide. Then, rules and regulations for ships have long been done internationally at IMO (International Maritime Organization), an agency of the United Nations. A new regulatory frame in which risk-based methods are employed is being discussed for rational and transparent rule-making, viz GBS (Goal Based Standards). We are researching into technology components of risk-based safety assessment of ship structures, such as risk evaluation methodologies, failure probability estimations, risk optimization, etc.

Oil spill risk by grounding



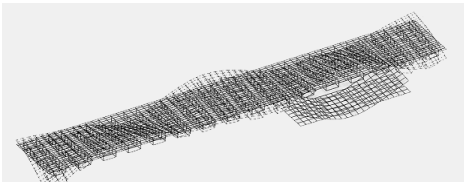
Five tier system for regulations



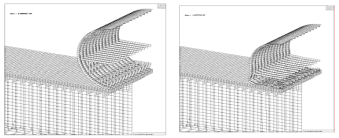
Monetary risk optimization vs target safety level

Structural Design and Risk Assessment of Very Large Floating Structures

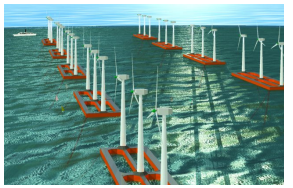
It is expected that large floating structures will be utilized for a platform of offshore wind farms, floating airports, etc. We have developed an analysis code for hydroelastic response of such large floating structures. In this code, various types of plane shapes, floater shapes, hull structure properties, and superstructures can be accounted for. Risk assessments of the floating structures are also being performed by using the code in conjunction with the collapse analysis and the reliability analysis.



Response of VLFS consisting of semi-submersible type runway and pontoon type apron.



Simulation of belly-landing of an airplane to VLFS



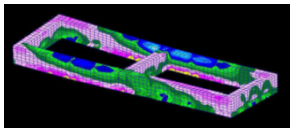
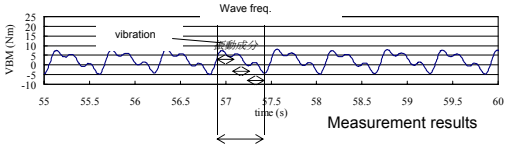


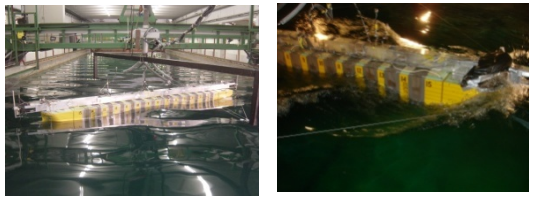
Image sketch of offshore wind farm and structural analysis results for a unit.

Hydroelastic Vibrations of Ships in Waves

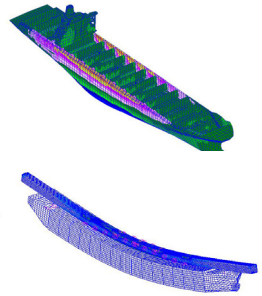
Ships made rapid growth in size and speed. Eg. capacity of the largest container ship was 6000 TEU (Twenty-feet Equivalent Units) 10 years ago, however, it is over 13000TEUs nowadays. The situation poses a problem of hull girder vibrations in waves. The vibrations induce a) increase of stress range, and b) increase of number of stress fluctuations. We are conducting researches to clarify these effects on structural design of ships by using experiments and numerical simulations.



Measurement results



Photos of experiment, a joint-research with NTNU (Norway)



Numerical simulations

http://www.naoe.eng.osaka-u.ac.jp/naoe/naoe4