



# Maritime Technical Advisory

MANAGING RISK



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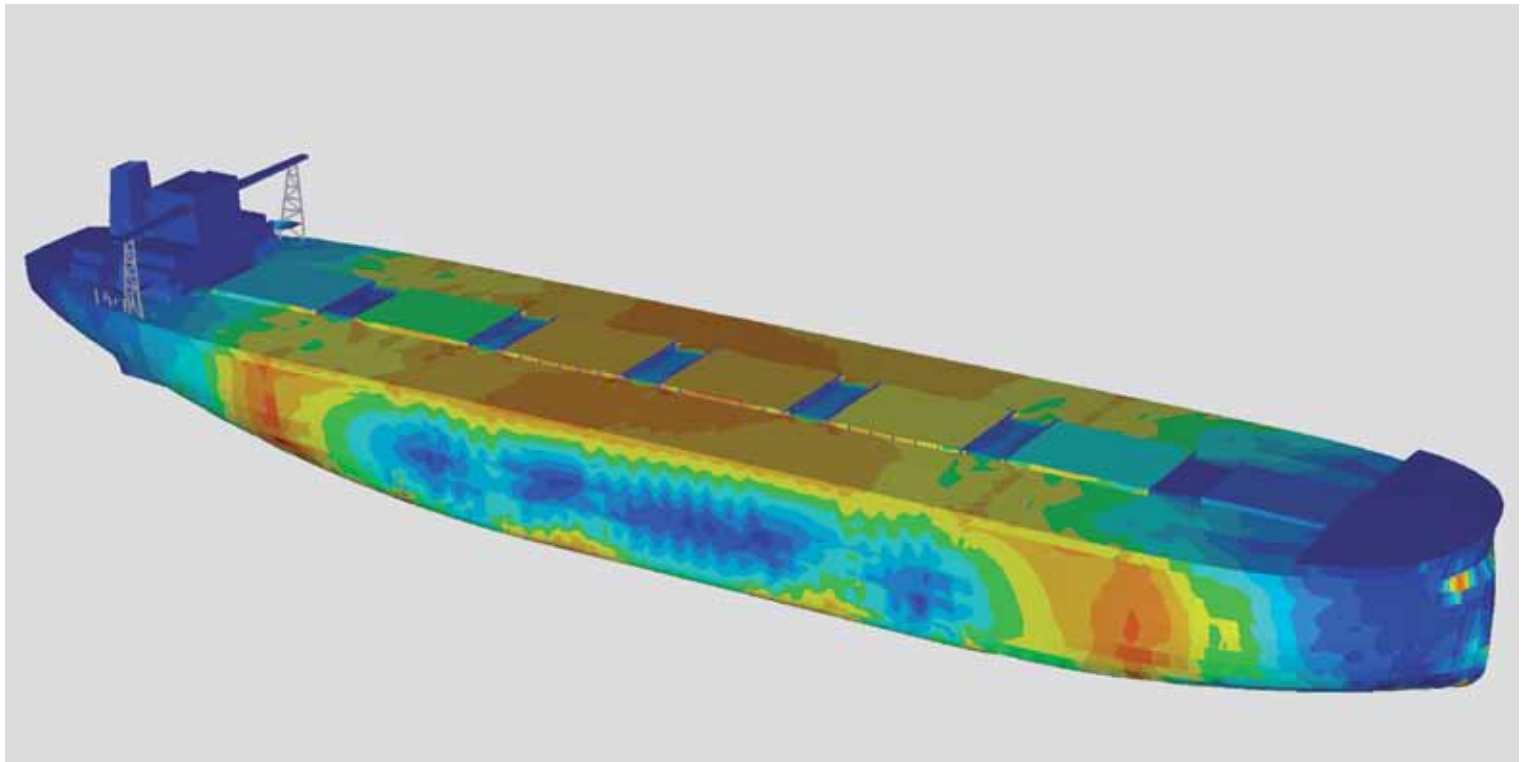
After several years with a booming ship building market, the world fleet is showing signs of major overcapacity. As this has coincided with a slowdown in world trade, the shipping industry is facing a tough time. The downturn represents an opportunity for the entire industry to think in new ways, and winners will emerge from those who apply smarter solutions for the future.

Delivering value to our customers through high-quality Maritime Technical Advisory services is what we strive for to obtain safety at sea. We assist shipowners, yards and other maritime players in managing their risks in all phases of a ship's life. Customer feedback is an essential driver in our development process.

Our consultants possess world-leading expertise in the engineering and technical aspects covering the life span of a ship. DNV combines practical experience from shipbuilding and the strengths of practical experience from shipbuilding and ship operations with technological challenges facing the maritime industry.

Our maritime technical advisory services cover:

- **Structural analysis services:** Assess and document responses of the hull structure, in order to verify its strength towards yield, fatigue and buckling. Document strength of ship structures and novel designs with respect to new material technology, accidental scenarios and extreme loads using advanced analysis tools.
- **Hull advisory services:** Training and technology to help ship owners gain control of their assets.
- **Hydrodynamic services:** Predict and assess ship motions and wave loads, and optimise the design with respect to resistance and propulsion.
- **Stability services:** Investigate intact and damage stability and/or longitudinal strength according to applicable rules and regulations.
- **Noise and vibration services:** Systematic evaluation of the noise and vibration levels on board all types of ships.
- **Rotating machinery services:** Technology for low-speed, medium-speed and high-speed machinery.



## Structural Analysis Services

Satisfactory hull strength is essential in order to avoid costly hull damages and fatigue cracks during operation. Strength analyses are normally carried out in order to develop and document strength of new designs, propose design changes or repairs, verification of strength or as basis for maintenance plans.

The analysis may cover all phases in the engineering and maintenance of ships, from concept evaluation to life time extension. DNV carries out analyses and evaluations of novel vessel designs, special load and response effects and damage troubleshooting. We provide strength calculations to document compliance with rules such as CSR, Nauticus (Newbuilding), CSA and PLUS.

Our services include:

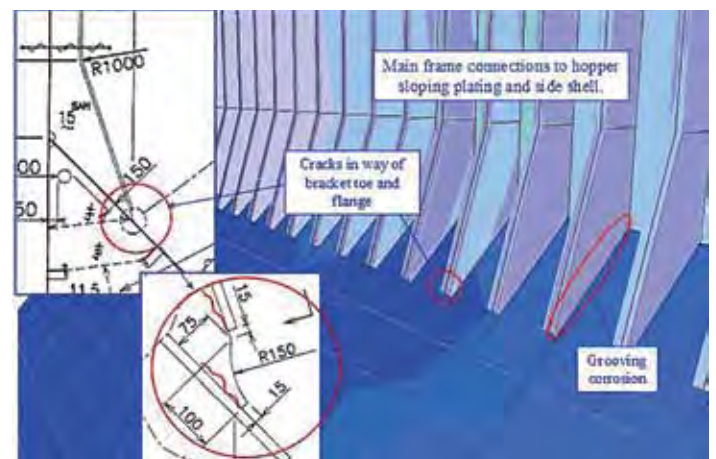
- Design assistance
  - Concept development and evaluation
  - Feasibility analysis and risk-based assessment
  - Assessment of lightweight and composite structures
  - Design assessment and verification
- Finite Element Analysis
  - Global ship analysis and local fine-mesh analysis
  - Linear and non-linear analysis
  - Static and dynamic analysis
- Hull strength assessment
  - Yield strength assessment
  - Buckling strength analysis
  - Ultimate hull girder strength analysis
- Fatigue assessment
  - Simplified rule-based fatigue analysis
  - Advanced fatigue calculations (spectral analysis)
  - Crack propagation analysis
- Advanced structural analysis
  - Ice load and response calculations
  - Collision, grounding, explosions, falling objects, etc.
  - Sloshing analysis and assessment
  - Hull monitoring and evaluation of measurement data

## Hull Advisory Services

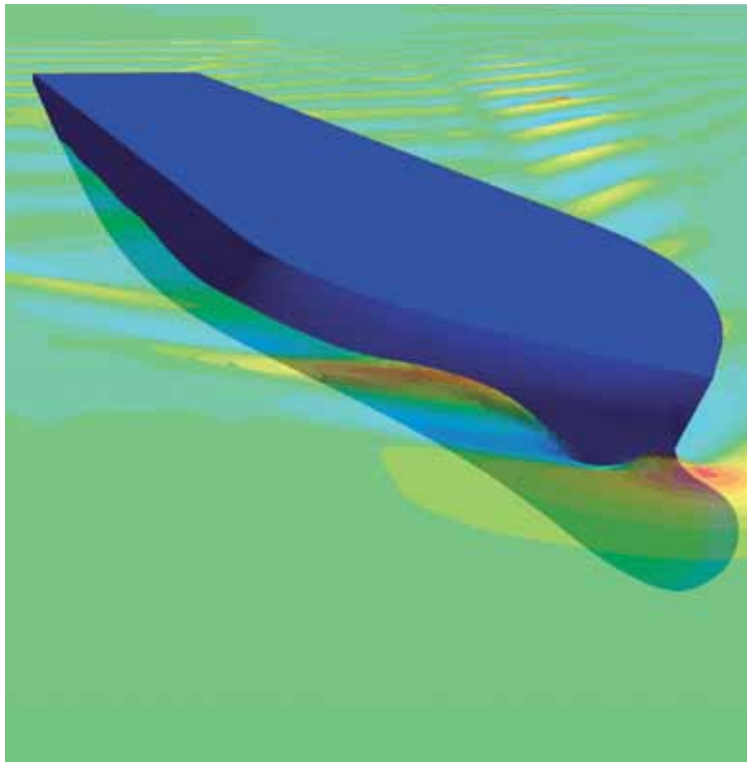
Increasing use of new technology, growing fleet and new regulations has put more and more pressure on the technical department of companies. For our customers to have better control of the fleet, in cost, quality and availability, DNV is offering to the market a range of services to help ship owners gain control of the operational hull-related technical matters.

Our services include:

- Hull integrity management system and hull competence training
- Hull maintenance and inspection scheme including critical areas of inspection on board
- Vessel life extension program, repair forecast and other decision support services
- Docking and related planning, docking specification review
- Hull damage analysis
- Fleet performance benchmarking
- Vessel lay-up, mooring arrangement, preservation and re-commissioning
- Emergency towing, bollard strength calculations
- Cargo securing and lashing, route-tailored securing of special vessels
- Volatile Organic Compounds (VOC) Management Plan
- Nauticus Construction and associated advisory services
- Survey finding benchmarking and root cause analysis



Cargo holds – lower bracket connections



## Ship Motions and Wave Loads

To ensure adequate fatigue life and ultimate strength of new ship designs, direct calculation of hydrodynamic hull girder loads is becoming the industry standard.

DNV has broad and multi-disciplinary competence within different types of advanced hydrodynamic problems, many of which require the use of specialised applications such as Wasim, HydroD (Wadam) and several other in-house solutions as well as Computational Fluid Dynamic (CFD) tools.

The nonlinear three-dimensional potential flow forward speed solver Wasim and associated tools facilitate efficient and accurate calculations of wave-induced motions and loads. The expert group working with advisory projects is also involved in Wasim maintenance and development.

Efficient procedures and analysis programs, mixed with long experience and a practical engineering approach, ensure high-quality services within this field. A continuous focus on program and method development utilising the DNV high-performance computing centre ensures efficiency and accuracy.

Our services include:

- Sea-keeping
  - Transfer functions for motions (RAOs)
  - Operability studies, e.g. for a given location or trade route
  - Weather-dependent cargo securing
  - Dynamic stability
  - Sea-sickness evaluation
  - Side-by-side analysis
- Wave loads
  - Accelerations, hull girder loads and hull pressures
  - Sloshing loads using model tests as well as CFD analysis
  - Slamming and whipping
  - Green seas
- Model test advice
  - Model test specification
  - Numerical analysis to complement model test results
  - Review of model test results

## Resistance and Propulsion

Increased awareness to reduce the environmental impact from shipping by aggressively lowering its emissions to air combined with uncertainties in volatile fuel costs, has resulted in the need for highly optimised hull forms and propulsion systems.

DNV can assist the maritime industry in designing and operating fuel efficient ships without compromising on safety, by combining our hydrodynamic expertise on hull and propeller flow with advanced CFD tools.

Our services include:

- Ship resistance calculations
- Hull form and propeller optimisation
- Trim and draft optimisation
- Nominal and effective wake estimates
- Added resistance in waves prediction
- Sea trial and model tests witnessing
- Energy Efficiency Design Index (EEDI) technical files

## Stability Services

If a ship is converted after newbuilding, or there is a change in the operational conditions, it is essential to verify the stability of the ship in order to ensure a safe and efficient operation. DNV offers a wide range of stability services for ships, offshore units and leisure craft. DNV has an extensive database of calculation models that may reduce both cost and time of the calculations. We have easy access to relevant drawings for DNV-classed ships for preparation of the calculation models.

Our services include:

- Stability Analyses of ships and offshore units including third-party verification, documentation for approval, wind moment calculations, emergency studies, geometry and stability analyses
- Ballast Water Management Plan in order to ensure safe exchange of ballast in open sea
- Accidental Oil Outflow Performance according to MARPOL requirements
- Verification of sounding and ullage tables in order to issue a "Calibration Certificate"



## Noise and Vibration Services

Prevention and control of noise and vibration onboard ships and offshore constructions have over the years received increasing attention. This may be due to vibrations that have caused hazards to machinery and personnel, as well as possible operational problems. High noise levels may cause human fatigue and increase the risk of miscommunication and human errors.

DNV offers advisory services in order to prevent possible vibration and noise problems and meet today's criteria to ships and offshore structures. DNV has wide experience of noise and vibration, trouble-shooting and verification measurement, including underwater noise, pressure, temperature and stress.

Focus on noise and vibration in the design stage may help avoid costly re-designs later on. Noise and vibration analyses may involve many technical disciplines. DNV benefits from a huge knowledge database including all technical disciplines relevant for noise and vibration analyses. DNV has a pool of people working with noise and vibration, who may assist customers globally.

Several noise and vibration class notations are available and broadly implemented;

- The DNV Comfort Class ensures a favourable environmental condition on noise, vibration and inner climate. Today more than 500 ships have included this class notation, ensuring improved living and working conditions and a general better safety, health and environment situation.
- The DNV Vibration Class defines vibration limits to machinery and equipment, ensuring less operational disruption caused by vibration problems.
- On underwater noise, the DNV Silent Class will alleviate environmental impact and ensure satisfactory operational performance for various types of ships.

Our services include:

- Preparation of noise and vibration specifications
- Analysis of noise and vibration levels
- Proposals for measures to meet specified limits
- Verification and trouble-shooting measurements

## Rotating Machinery Services

Malfunctioning machinery results in poor performance, low operability and hazard to humans. Responsible operators, manufacturers and designers are aware of costly consequences caused by inappropriate component designs, poor component interactions and limited system functionality. DNV offers world-leading multi-disciplinary expertise on engineering and technology for rotating machinery to explore their possibilities and limitations for safe and reliable operation. Our insight into valid design criteria ensures that proper requirements are considered. In operation the most effective trouble-shooting and damage investigation on rotating machinery is supported.

Our services include

- Trouble-shooting: Multi-disciplinary service for components and systems, and on site assessment combined with analyses, on-site measurements and laboratory investigations.
- Analysis: Theoretical and physical approach using state-of-the-art technology for analysing shaft alignment, vibrations in shafting systems, and component and system design.
- Verification: Conformity with Rules, Regulations and Standards through analyses and measurements.

The services cover propulsion and power-generating machinery, as well as pump and compressor systems. DNV assists ship owners and operators of machinery including yards, manufacturers and designers, providing expertise on engineering in the complete life span of rotating machinery based on technologies such as:

- Vibrations (torsional, lateral, axial), linear and non-linear analyses
- Shaft alignment, bearing loads and tribology
- Measurements (vibrations/stresses/deflections and emissions)
- Finite elements analyses and other specialised tools and methodologies

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