Computation of natural frequencies and forced vibration amplitudes by FE considering different loading and service conditions

Excitations from engines, propellers, slamming etc. can be considered (e.g. main slow running engine is modelled for realistic mass and excitation representation)

The predicted levels are compared to the target values and it is assessed whether design modifications are advisable.

Stringent automation of the analysis process enables to investigate the effect of design variants in very short time.

Customers benefit from

- reduced risk of vibration damage and related repair cost and downtime of the vessel
- Minimised risk of exceeding contractual N&V limits
- increased vibration comfort for crew and passengers

References of typical calculation models for Global Vibration Analysis

MA services and benefit cases
Benefit Case - Global Vibration Analysis: 4,500 TEU CV

SITUATION AND CRITICAL ISSUE
Global Vibration Analysis: 4,500 TEU CV
A shipyard received an order for a series of 4,500 TEU CV
On behalf of the shipyard DNV GL conducted a global vibration analysis

DNV GL SOLUTION
- Free and forced FEA vibration analysis of the entire ship
- High longitudinal deckhouse vibrations were predicted excited by 2nd order mass moment of the main engine
- The effectiveness of different active compensator configurations were investigated
- DNV GL’s recommendation to prepare a foundation for a compensator was followed by the shipyard
- Sea trial measurements were conducted to validate the simulation results

VALUE DELIVERED
- The sea trial confirmed the simulation results
- The Shipyard installed the compensator on the already prepared foundation
- Ship delivery was not delayed because of additional steel work in the fully outfitted ship
- The 2nd sea trial demonstrated the effectiveness of the compensator: all levels were below the limits

For more information please contact: Stian.Andreassen@dnvgl.com

MA services and benefit cases
Global vibration analysis: 2,500 TEU CV

A shipyard received an order for a series of 2500TEU CV

On behalf of the shipyard DNV GL conducted a global vibration analysis

**SITUATION AND CRITICAL ISSUE**

**DNV GL SOLUTION**

- Free and forced FEA vibration analysis of the entire ship was performed
- High longitudinal deckhouse vibrations were predicted excited by 7th order ignition frequency excitation
- The effectiveness of different variants of deckhouse structure reinforcements was investigated
- DNV GL’s recommendations were followed by the shipyard

**VALUE DELIVERED**

- The sea trial confirmed the simulation results
- Ship delivery was not delayed because of additional steel work in the fully outfitted ship

For more information please contact: Stian.Andreassen@dnvgl.com
Global vibration analysis: Cruise Ship
Cruise ships have high demands for crew and passenger comfort.
Structure is complex with large overhangs and pillar rows.
Too high vibration means complaints from passengers – ship owner may claim the yard.

DNV GL SOLUTION
- Free and forced Finite Element Analysis of the complete vessel.
- Excessive vibration levels calculated in several areas, due to engine forces.
- DNV GL presented structural modification proposals to avoid resonance conditions.
- Sea trial measurements were carried out.

VALUE DELIVERED
- No excessive vibration levels detected during the sea trial.
- Vibration levels within contractual limits.
- No reported complaints from passengers after ship has been in service.

For more information please contact: Stian.Andreassen@dnvgl.com
Benefit Case - Global Vibration Analysis
Trouble-shooting for hydrodynamically excited vibrations

SITUATION AND CRITICAL ISSUE

Vibrations in the owner cabin of a fast yacht

Frequency of vibrations ruled out common sources of vibration such as propeller, engine and seaway

DNV GL was asked to determine the source of the excitations and propose a design solution to reduce the vibrations to an acceptable level

DNV GL SOLUTION

- Time-dependent CFD analyses to identify vortex shedding with associated frequencies and magnitudes of pressure fluctuations on hull and appendages
- Identification of relevant structural members subject to hydrodynamic excitation by FE analysis and measurements
- Re-design of relevant appendages utilizing FEA and CFD simulations until acceptable vibration level was attained
- Performance of sea trials and measurements to validate effectiveness of measures

VALUE DELIVERED

- The source of the vibrations was determined. The insight in the flow physics guided effectively design modifications
- The counter-measures were effective and the vibrations levels brought to an acceptable level

For more information please contact: Stian.Andreassen@dnvgl.com