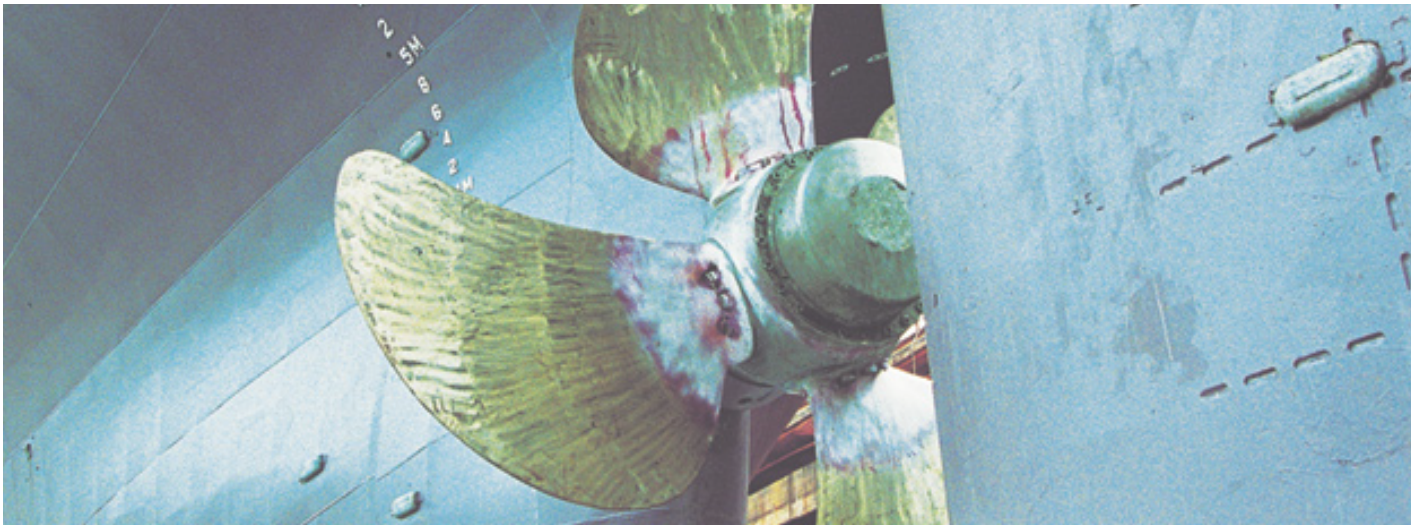
NAUTICUS™ MACHINERY

Shaft Alignment

Troublefree and flexible modelling of the shaft line



Shaft alignment has in recent years become more of a challenge, especially on the after stern tube bearing lubrication problems, due to increased power, lower shaft speeds and heavier propellers in combination with a shorter propulsion shaft. In Nauticus Machinery Shaft Alignment these effects can be carefully considered when designing an optimal shaft line in order to avoid problems in operation.

Nauticus Machinery – Shaft Alignment is an advanced and flexible software tool for calculation of the optimal shaft alignment and natural frequencies for whirling and axial vibrations.

One user interface – three types of analysis

Control of vibration levels and optimum shaft alignment are necessary on all ships in order to have machinery that operates with the required safety and reliability. Shaft alignment, whirling and axial vibration calculations are traditionally regarded as three separated mathematical problems. The Shaft Alignment tool in Nauticus Machinery simplifies your analysis process by integrating the three mentioned calculation methods into one common user interface and reporting tool.

Applications

The software has a rich menu of modelling elements, making it applicable to any kind of marine shafting systems. However, the tool is tailored for analysing marine direct driven or geared propulsion plants.

Benefits:

- Based on DNV's extensive knowledge in shaft alignment
- Efficient modelling by drag-and-drop or import from files
- Rich component menu providing relevant shaft alignment elements
- Proven solution that has been in use for decades
- Tailor-made results for onboard shaft alignment verification and measurements
- Stern tube bearing lubrication calculation to ensure the
- hydrodynamic lubrication and sufficient lubrication film
- stiffness in the aft stern tube bearing
- Advanced bearing offset optimization
- Alignment, whirling and axial vibration analysis in the same interface
- Flexible report generator with export to Microsoft Office

Modelling the shaft line

There are several ways to build your shaft line model. The main objective is to make a mathematically correct representation of the shaft "beam" with shaft elements, bearings and external loads. Some users prefer to work with standard drag-and-drop while others may prefer to import model data from text files or spreadsheets. Nauticus Machinery – Shaft Alignment offers several modelling methods:

- Pick model elements from a menu and use drag-and-drop functions
- Make geometry definition in a spreadsheet and import it or use copy/paste
- Create model by script function
- Reuse the engine model by Export/Import crankshaft function

In addition, helpful functionalities such as Undo/Redo, multiple update and selection-filter will make the modelling process effortless.

Modelling elements

- Shaft elements (cylindrical, conical, hollow)
- Flanges
- Bearings with or without flexible pedestals
- Concentrated or distributed masses
- Propeller
- Couplings (shrink fits or elastic)
- Jacks and temporary supports
- Horizontal and vertical forces or bending moments
- Vertical distribution load

Features

- Fast and flexible modelling
- Engine library where you can save sub-models for later use
- After stern tube lubrication analysis
- Verification condition calculation such as jacking and flange/shrink-fit open
- Set densities for steel in water, oil or air
- Advanced optimization functions (optimize bearing offsets) Flexible report generator
- Export results to Microsoft Office
- Calculation of several operating conditions in one batch

Making the optimum shaft alignment

Some of the components in the shaft line may have limitations or boundary conditions which should be taken into account. It can be rather time-consuming to figure out the combination of bearing offsets that fulfils all limitations. In Nauticus Machinery – Shaft Alignment the problem is effectively solved by an advanced optimization algorithm.

The user can set the following boundaries on the system:

- Fixed or free offsets for bearings
- Tilted bearings
- Allowable range for bearing reactions and pressures

Reduce the risk of after stern tube bearing damage

DNV has observed an increasing trend in reported incidents involving aft propeller shaft bearing damages. Most of the damage is related either to fatigue or wiping due to poor lubrication in the stern tube. DNV has also revised the main class shaft alignment rules to minimize the risk of such failures. The Shaft Alignment tool in Nauticus Machinery provides a tailored function to design a robust after stern tube bearing regarding the lubrication problem from two aspects:

- Required minimum rotational speed calculation to ensure the hydrodynamic lubrication according to DNV rules
- Oil film analysis calculation to get the pressure and thickness distribution inside the after stern tube bearing

Calculation results

- Natural frequencies of whirling and axial vibrations
- Campbell diagram and mode shapes of whirling vibration
- Deflections, stresses and moments of the shaft line
- Bearing influence numbers and reaction forces
- Flange diagram of bending moments and share forces
- Open shaft calculations
- Gap and sag values for flanges/shrink-fit
- Jacking sequence diagrams and jack influence numbers
- Required minimum rotational shaft speed to ensure sufficient lubricant on the after stern tube bearing
- Oil film pressure and thickness distribution inside the after stern tube bearing