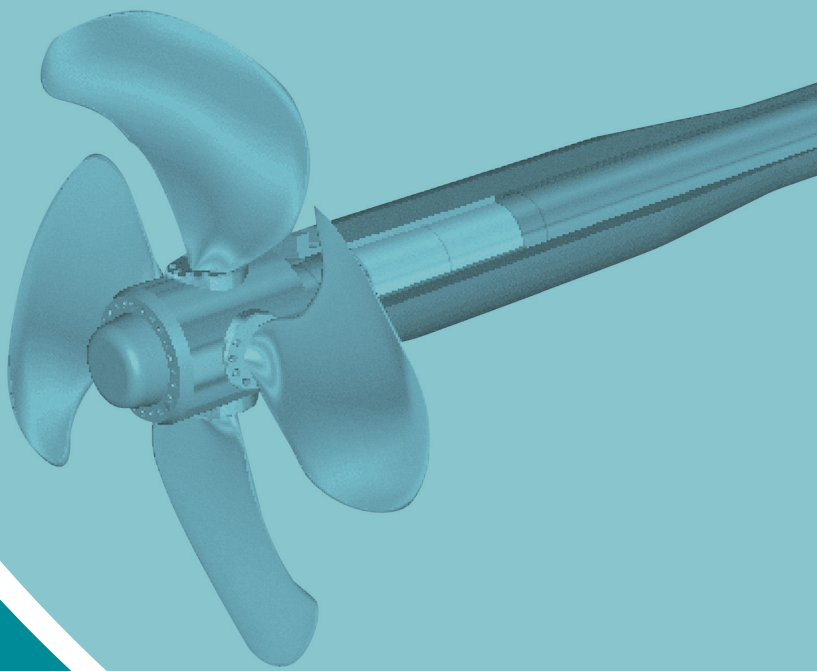
ShaftDesigner

The Shaft Calculation Software

- **Shaft alignment**
- **Vibration calculations**
- **Drag and drop modelling**
- **3D graphical environment**
- **Base model for quick recalculation**
- **Customizable reports with export options**

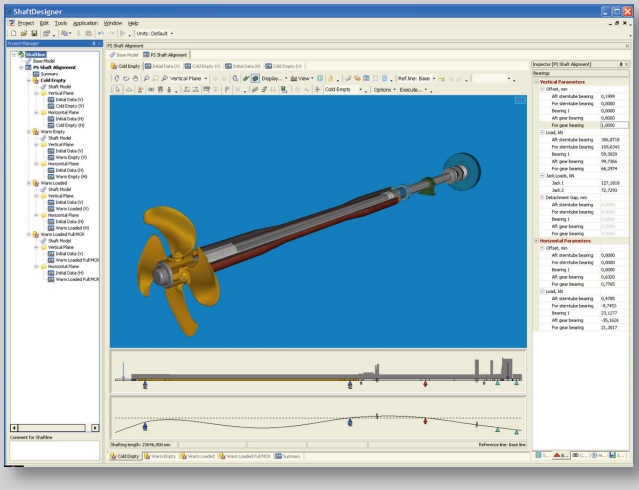


ShaftDesigner – The Shaft Calculation Software

ShaftDesigner is a multi-project, multi-shaft and multi-state 3d Computer Aided Engineering system for ship propulsion train calculations.
The ShaftDesigner software uses a base model to calculate shaft alignment, whirling vibration, bending (lateral) vibration, axial vibration and torsional vibration.

The software's main features are:

- 3D graphical environment for easy visual checks
- Base model for quick recalculations
- Multiple modelling possibilities for different purposes
- Various shaft alignment calculation methods
- Calculations for various types of vibrations
- Customizable reports with export options



The multi-shaft system provides the possibility to handle anything from a single shaft line to complete propulsion trains with multiple shaft lines, engines and other components. Each application can hold a number of propulsion train states.
Another big strength of ShaftDesigner is that all calculations are performed from a single base model. Once this base model has been created, any changes at any time are automatically incorporated in all applications and can be checked visually with the 3D representation, minimizing the chance of human entry errors.

ShaftDesigner contains three main techniques of modelling. These are free drag and drop modelling with subsequent correction of object position, drag and drop modelling using snapping to prior created object positions and group placing by distance from an assigned origin position. Any modelling error can be easily corrected using the undo/redo function or the History Window.

Shaft Alignment Calculations

The goal of the shaft alignment calculation is to determine the location of shaft line bearings at the time of alignment, or to optimize the bearing load of shaft lines. Both of which provide safe operation of the vessel's propulsion train under all specified operating conditions.

The location of the shaft line bearing axis is defined by vertical and horizontal offsets of the bearing bush centre point, and by the angles between the base reference line and the bearing bush axis. Shaft line deflections are calculated automatically when the application is run. The application model is automatically constructed from the base model. Any changes in the base model update the shaft line's deflections immediately.

Shaft alignment techniques supported by ShaftDesigner are direct calculation, offset exploration, geometric alignment, catenary alignment and strain gauge alignment. Thanks to the reversed engineering capabilities of the software it is also possible to calculate alignments based on measured bending loads, bearing stress, jack loads, sag&gap and shaft deflections.

The application model can be further developed to meet specific application requirements. The user

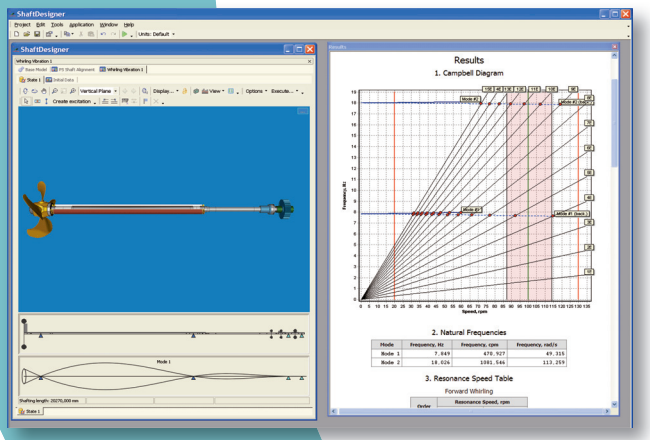
can add additional objects such as concentrated forces, temporary supports and jacks in order to verify theoretical alignments in practice. Placing additional supports and forces starts an immediate automatic shaft line deflection recalculation.

Vibration Calculations

All vibration calculations are performed automatically from the base model when the specific vibration module is available. There are five types of vibration calculation modules available for ShaftDesigner:

Whirling vibration

The main result of the whirling vibration calculation is the list of critical speeds for forward and backward whirling. Excitation of a first order corresponds to synchronous whirling. The results are presented in a resonance table and graphically as a Campbell diagram.



Bending vibration

The bending vibration application calculates free vibration characteristics such as natural frequencies, mode shapes as well as resonance speeds. The results are given in the form of a Campbell diagram and a resonance table.

Axial vibration

The axial vibration module includes free vibration as well as forced vibration calculation possibilities. There are a lot of options to set excitation and damping parameters in forced vibration calculations. The results are presented in a resonance table and as a graph showing the vibrations at various RPM.

Torsional vibration

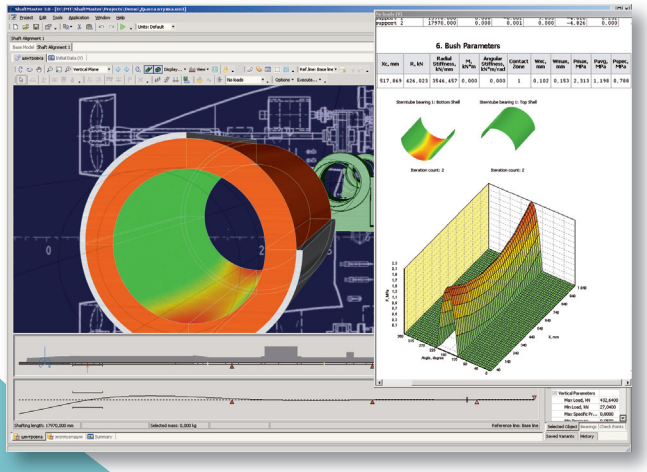
Torsional vibration calculations are performed from the mass-elastic model created with the graphical editor and also includes both free and forced vibrations. The results are presented as a graph showing the vibrations at various RPM and in a resonance table. Note: For torsional vibration it is more efficient to manually enter values instead of relying on the base model, as specific data is required for torsional vibrations.

Coupled torsional and axial vibration

The coupled vibration application calculates the axial-torsional vibration parameters for the installations with directly coupled diesel engines.

Reporting

The results of the various ShaftDesigner calculations are represented in detailed, but easily customizable reports, containing all information needed by the end user. To facilitate easy analysis of the reports the software automatically generates graphical outputs to support the findings. Also, certain results can immediately be seen in the base model, making it easy to make preliminary conclusions at a single glance. All reports are created as a XML document so they can easily be exported to various formats, such as html, Microsoft Word™ or Windows Web Archive™ (.mht).



ShaftDesigner was created by Dr. Yuriy Batrak of Intellectual Maritime Technologies (IMT) in the Ukraine for Machine Support B.V in the Netherlands as part of their service division in shaft alignment. It was created as a bridge between IMT's theoretical expertise with Machine Support's practical experience in the field of shaft alignment and mounting. Thanks to the software's capabilities to perform reversed calculation, the theory and practical findings could be cross-validated, guaranteeing accurate results. In the development of ShaftDesigner there was also a close cooperation with leading OEM's of various components of the propulsion train in order to meet their needs.

ShaftDesigner Phase Benefits

ShaftDesigner is a useful application in all phases of a ship's life cycle, from design and construction, to maintenance and repair. Because of the scope of the software, all phases have their specific benefits.

Design Phase

- Accurate representation of all components of propulsion train (engine, gearbox, bearings, propellers, etc.).
- Easy drag and drop function for quick modelling possibilities.
- Functional offset functions for optimizing propulsion train component positions.
- Optimal placement of components at design phase can save a lot of time and money due to unnecessary re-alignment.
- Possibility to calculate in design phase if harmful vibrations are present.

Construction Phase

- Precise detail input possible to create realistic representation of the to be constructed propulsion train.
- Bearing offset calculations for optimal shaft alignment.
- Model automatically updated with every entry.
- Theoretically calculated shaft alignments can be verified using jack-loads, laser alignment or strain gauge techniques.

Maintenance and Repair Phase

- Precise detail input possible to create realistic representation of the to be maintained/ repaired propulsion train.
- Shaft alignment and vibration calculations can help predict which bearings have the biggest chance of malfunctioning and thus should be checked on board.
- ShaftDesigner is an easy tool for checking alignment changes and hull deflections in the case of ships being grounded or other incidents.

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MS FOL SHAFTD Rev.01 d.d.05-2009