MAXSURF

Naval Architecture Software for all Types of Vessels

The MAXSURF suites of software offer a comprehensive range of capabilities for the design of all types of marine vessels. The technology has been used for more than 20 years on thousands of vessels worldwide, providing naval architects with a complete range of software tools for all phases of the design process.

MAXSURF includes tools for hull modeling, stability, motions and resistance prediction, structural modeling, structural analysis, and export to vessel detailing. MAXSURF software applications operate from a single parametric 3D model that facilitates smooth communication and coordination between different team members and design activities.

MAXSURF's three suites of software provide a solution for every design team. All suites feature data interchange, both import and export, with other industry standard file formats including offsets, CFD, CAD, and surface data.

MAXSURF Advanced

Designed for professional naval architecture teams, the MAXSURF Advanced suite offers a full range of functions for designing power, sail, commercial, or naval vessels made from steel, aluminum, or composite material.

MAXSURF Advanced features an unlimited number of dynamically trimmed 3D NURB (non-uniform rational B-spline) surfaces for modeling the hull, appendages, and superstructure. MAXSURF Advanced includes interactive and numerical controls that enable systematic manipulation of the vessel's hull shape to achieve a fair and optimized hullform.

A range of analysis methods support intact and damage stability, hydrostatics, longitudinal strength, limiting KG, floodable length, and tank calibrations. Each analysis can be performed in flat water or in a user-defined waveform. Grounding can also be considered.

MAXSURF Advanced includes a comprehensive library of stability criteria, as well as the ability for users to define their own criteria. To assist with creating stability booklets, a unique templating system allows you to define the report format using a Microsoft Word template document. Tables, graphs, and images are then automatically sent to the report.

The MAXSURF Advanced suite's Motions module predicts the motion of vessels in a range of sea states and at varying headings and speeds. The calculation of RAOs (response amplitude operators), accelerations, and motion sickness incidence helps optimize vessels for comfort and a wide range of operating conditions.

MAXSURF Enterprise

The MAXSURF Enterprise suite is Bentley's most comprehensive marine product. The suite includes the capabilities of MAXSURF Advanced with additional features including probabilistic

Key Capabilities

Modeling
- Trimmed NURB surfaces
- Dynamic trimming
- Fast, intuitive modeling

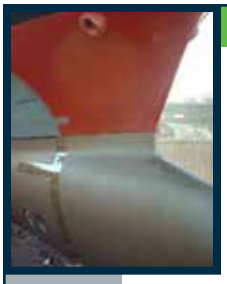
Stability
- Intact and damaged
- Integrated weight editor
- Integrated compartment editor
- Comprehensive stability criteria
- Probabilistic damage

Resistance
- Planing, displacement, and sailing
- Slender body CFD
- Wake prediction

Motions
- Monohull and multihulls
- RAOs and accelerations

Structure
- Shell plates
- Shell stringers
- Frames, decks, bulkheads
- Beam and plate FEA

Data Interoperability with
- MicroStation
- Rhino
- AutoCAD



damage stability, advanced motions prediction, and dynamic structural analysis. For passenger vessels and larger ships, the probabilistic damage stability in the Stability Enterprise module provides easy-to-use graphical tools for defining and managing hundreds of damage conditions. To facilitate compliance with the IMO (International Maritime Organization) stability criteria, MAXSURF Enterprise includes a built-in criteria library and graphical tools for defining and viewing damage zones. For motions prediction, the panel-based radiation-diffraction solver can accurately predict vessel motions, including vessels with a broad beam or unusual hull shapes like SWATHs (small waterplane area twin hull). The dynamic structural analysis capabilities in the MAXSURF Enterprise suite can predict natural modes of vibration of vessel structure as well as supporting time-based dynamic loads from machinery, impact, or other sources.

MAXSURF

Bentley's entry-level MAXSURF suite is ideal for designing smaller craft or for naval architects on a limited budget. The Modeler module allows the use of up to 20 NURB surfaces, and, like the other suites, has round-trip interoperability with Rhino, MicroStation, and other NURB modeling tools. This suite also includes the Resistance module for predicting power requirements of planing or displacement vessels. MAXSURF also predicts wavemaking, complete with graphical visualization of the generated wave train. For sailing vessels, the VPP (velocity performance prediction) module can predict yacht speed in a range of wind strengths and headings.

		Suites		
Module	**Function**	**MAXSURF**	**MAXSURF Advanced**	**MAXSURF Enterprise**
Modeler	NURB hull modeling, up to 20 surfaces	✓		
Modeler Advanced	NURB hull modeling, unlimited surfaces		✓	✓
Stability	Intact stability	✓		
Stability Advanced	Intact and damage stability, stability criteria, tank calibrations, and longitudinal strength		✓	
Stability Enterprise	Intact, damage, and probabilistic stability, tanks, and strength			✓
Motions	Motions prediction strip theory		✓	
Motions Advanced	Motions prediction strip theory and 3D panel method			✓
Resistance	Power and resistance prediction	✓	✓	✓
Structure	Plate development	✓		
Structure Advanced	Plate development, stringer, frame, and deck definition		✓	✓
Multiframe	Static beam and plate structural analysis		✓	
Multiframe Advanced	Static and dynamic beam and plate structural analysis			✓
Fitting	Fitting of existing designs from offsets	✓	✓	✓
Link	Data exchange with analysis systems	✓	✓	✓
VPP	Sailing yacht performance prediction	✓	✓	✓

MAXSURF KEY ADVANTAGES

SINGLE 3D HULL MODEL

MAXSURF applications work from a single design file, streamlining the design process by removing the need to create geometry files in different formats for downstream analysis programs. Changes in the hull surface flow through parametrically to compartmentation, resistance and motions hull meshes, and structural part definition.

INTUITIVE INTERFACE

MAXSURF is renowned for its consistent, graphical interface that is easy to learn and use. Each module shares a common intuitive interface with high-quality rendering and animation to visualize analysis results.

HIGH-QUALITY SURFACING

MAXSURF is optimized to help naval architects create very high-quality hull surfaces that are fair and can be used for all other analysis and CAD/CAM functions.

COMPREHENSIVE ANALYSIS

The MAXSURF suites include a full range of analysis capabilities including intact and damage stability, longitudinal strength, structural analysis and design, resistance prediction, wake calculation, motions prediction, and a sailing VPP (velocity prediction program).

DYNAMIC TRIMMING

Surface trimming in MAXSURF is a simple point-and-click process. Most important, MAXSURF's trimming is fully dynamic, allowing you to modify trimmed surfaces and have the trimmed portions automatically update.

INTEROPERABILITY WITH RHINO, MICROSTATION, AND EXCEL

MAXSURF is based on industry standard NURB surface modeling. It reads and writes Rhino, IGES, and DXF files, which facilitates smooth data transfer with Rhino, MicroStation, AutoCAD, ShipConstructor, and SolidWorks. It also features copy and paste to and from Microsoft Excel, and a full automation interface, compatible with Microsoft Excel and Microsoft Word, that allows macros to be used to control MAXSURF for optimization studies or customized calculation and reporting.

MAXSURF Modeler

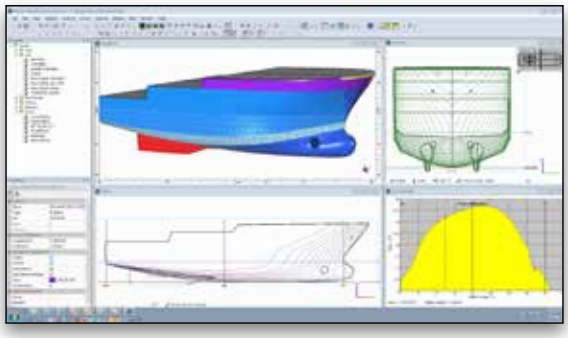
NURB Hull Modeling

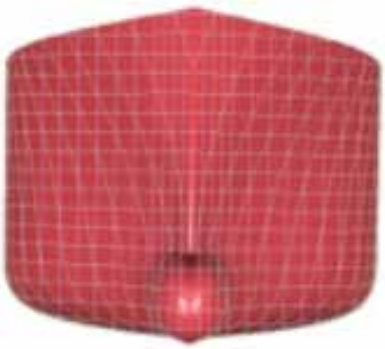
MAXSURF Modeler provides fast, flexible, and intuitive modeling of all types of hulls, superstructures, and appendages. An unlimited number of trimmed NURB surfaces can be used to model any vessel from yachts to workboats to the largest ships.

The Modeler design module, the core of the MAXSURF range, provides naval architects with the design tools necessary to create optimized hull forms quickly, accurately, and with minimal training. Any number of NURB surfaces can be joined, trimmed, and manipulated to create a complete model ready for hydrostatic and performance analysis or construction detailing.

A range of commands provide direct interactive manipulation of the surface shape by mouse or keyboard. Control points can be dragged with the mouse, adjusted numerically, or manipulated with a range of fairing commands. Modeler also provides capabilities to automatically transform hull shapes to match desired dimensions and hydrostatic properties.

Fair and accurate surfaces are critical for optimal vessel performance and ease of construction. Modeler provides a comprehensive range of tools for evaluating curvature of the entire surface, as well as curvature along a particular surface contour, such as a waterline or diagonal. Curvature displays are automatically and interactively updated as the surface is modified.





The MAXSURF Modeler module facilitates modeling of all types of hulls and appendages.

MAXSURF designs are stored in a common 3D design file that all modules use for analysis, construction, and performance prediction. Changes made in Modeler are automatically available when the design is opened in other modules. The design database files are extremely compact, making them ideal for transmission to designers or builders via email.

Modeler's interactive graphical environment allows you to quickly learn and master the many design tools provided. Multiple windows can be used to view and change the model and provide a tabular view of design data. Other windows provide on-the-fly checks of curve of areas, upright hydrostatic calculations, and tables of offsets.

Data exchange is a key requirement in the modern design office and Modeler supports a wide range of industry standard formats. You can copy and paste numerical tables to and from Microsoft Excel for custom calculations and formatting. Graphical views can be copied and pasted to other applications to help create presentation materials and reports. You can also import and export industry standard DXF and IGES files, as well as read and write Rhino files to seamlessly exchange point, line, or surface data with other systems.

Modeler's unique surface trimming capabilities allow you to model complex surface edges while maintaining fairness throughout the rest of the hull. An interactive display of surface-to-surface intersections lets you create the shapes you require even with complex configurations such as curved transoms, stepped sheerlines, and appendages or bow thrusters. Surface trimming is automatically updated as the surfaces in the design are adjusted. Modeler provides all the required modeling capabilities for hull, appendage, and superstructure. The Modeler Advanced module allows for the modeling of an unlimited number of surfaces, while the Modeler module allows for modeling up to 20 surfaces.

Modeler Advantages

- Model complex hull geometry with trimmed surfaces
- Visualize hull shape changes with dynamic updating of all views
- Match required hull parameters using parametric transformation
- Extract key design data via hull lines, tables of offsets, hydrostatic properties or curve of areas

MAXSURF Stability

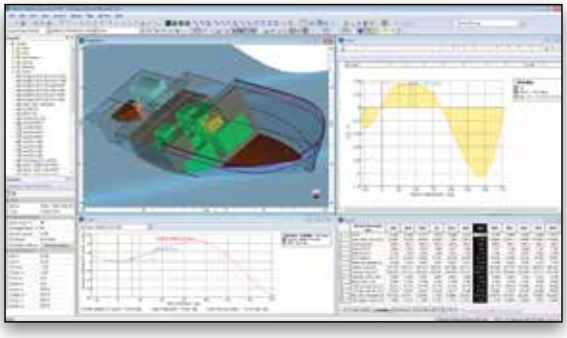
Intact and Damaged Hydrostatics and Stability

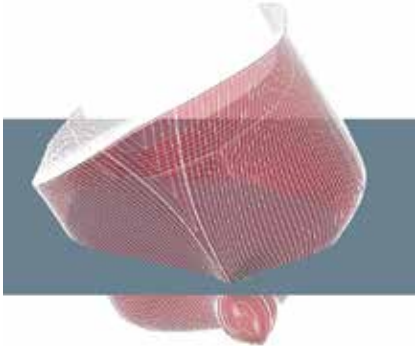
The MAXSURF Stability module provides fast, graphical, and interactive calculation of intact and damaged stability and strength for all types of MAXSURF designs.

Once a design has been created using Modeler, its stability and strength characteristics can be assessed using the Stability analysis module. The Stability analysis module provides a range of powerful analysis capabilities to handle all types of stability and strength calculations. Precise calculations are performed directly from the trimmed MAXSURF NURB surface model without the need for offsets or batch file preparation.

All functions within Stability are performed using a graphical multi-window environment consistent with all other MAXSURF modules. Data is displayed simultaneously in graphical and tabular form and is automatically updated when changes are made and as the analysis progresses. An integrated load case editor makes setting up any number of loading conditions simple and error free. Copying and pasting data to and from spreadsheets also makes it easy to prepare complex loading schedules in other programs and run them in Stability. Load cases can also be saved and reused with various design configurations.

Tank and compartment modeling are integrated within Stability, allowing you to quickly and easily define the vessel's tank and compartment layout. More complex compartments can be defined using surfaces created in MAXSURF Modeler. Tanks are automatically included in the weight schedule and as parametric objects they are automatically updated if the hull shape is changed as the design progresses.

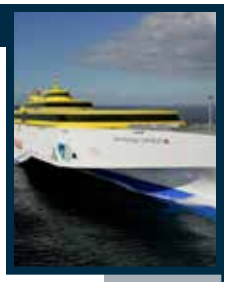




The MAXSURF Stability module includes integrated compartment and load case editors.

A tank calibration option is provided to give detailed volume and CG characteristics of all tanks.

The Stability module includes intact and damaged options for a range of analysis methods including upright hydrostatics, large angle stability, equilibrium analysis, KN tables, cross curves, limiting KG, and longitudinal strength analysis. For each analysis method, Stability automatically highlights the required data to be entered and provides data entry dialogs to ensure data is entered correctly.



Stability provides a wide range of criteria, including the most commonly used standard criteria, that can be used to ensure compliance with class requirements. The software also allows you to define your own custom criteria for special requirements. When used in conjunction with the table of downflooding points, it provides a complete range of options for satisfying class.

After an analysis is completed, all results are presented in either tabular or graphical form. You can click on any graph and move the cursor to obtain precise values at any location. You can also choose how tables are displayed, which columns are visible, and sort results by any column.

An automatically formatted on-screen report window accumulates the results of analysis to help prepare a stability book for your vessel. Descriptions, tables, graphics, and graphs are automatically inserted and can be re-formatted or deleted at any time. You can also enter notes into the report and cut and paste graphics from the Stability module, other MAXSURF modules, or any other program. The entire report can be generated using a Microsoft Word template document, if desired.

The wide range of analysis, data entry, and data display options within Stability make it an indispensable tool for designers of all types of vessels. For designers with a limited budget, the basic Stability module contains only the intact hydrostatics and large angle stability analysis methods. Stability Advanced adds tank definitions and calibration, stability criteria, damage stability, longitudinal strength, limiting KG, floodable length, and MARPOL oil outflow, while Stability Enterprise adds probabilistic damage stability.

Stability Advantages

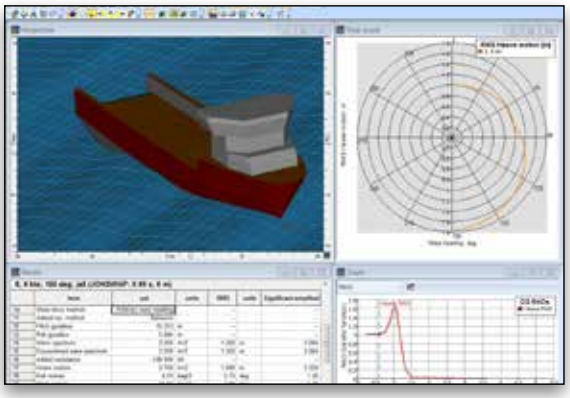
- Save time and reduce input errors using direct surface integration
- Visualize hydrostatic behavior while analysis runs
- Ensure accurate load cases with automatically linked tanks
- Check standard or custom stability criteria from the criteria library
- Analyze any hydrostatic condition with comprehensive analysis capabilities

MAXSURF Motions

Vessel Motions Prediction

The MAXSURF Motions module for hydrodynamic and seakeeping analysis provides fast, reliable calculation of vessel response and seakeeping characteristics in a variety of sea states for many types of designs created with MAXSURF Modeler.

The Motions module provides designers with the tools necessary to quickly predict the seakeeping performance of MAXSURF designs. The hull geometry required for the analysis is read directly from the trimmed MAXSURF NURB surface model. This eliminates the need to prepare input or offsets files.



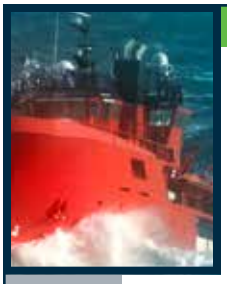
The MAXSURF Motions module calculates RAOs and accelerations at a range of headings and sea states.

Data is displayed simultaneously in graphical and tabular form and is automatically updated when changes are made, and as the analysis progresses. Data can be copied to spreadsheets and other applications for presentation purposes or further analysis, for example, to calculate the probability of slamming, propeller emergence, and more.

In the Motions module, you can specify the wave spectrum and heading, vessel speed, and several other analysis parameters. RAOs are computed, as well as the added resistance, significant absolute and relative motions, velocities, and accelerations of the vessel in the specified sea spectrum. Motion, velocity, and acceleration and motion sickness incidence (MSI) may also be computed for any position on the vessel.

Both strip theory and 3D radiation-diffraction panel methods are available. The Motions Advanced module is required for the panel method. Strip theory provides fast calculation of heave, pitch, and roll response for hull shapes with L/B (length-beam ratio) greater than 4. The panel method can be used for any vessel shape and provides full six degrees of freedom response calculations.

The software has been validated against a variety of data from various independent sources including model tests, full scale trials, and other numerical methods.



Motions Advantages

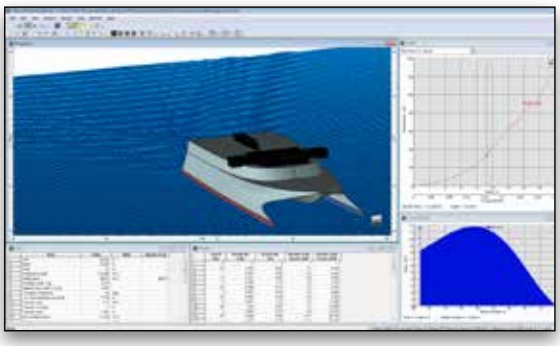
- Save time and reduce errors using direct geometry input from any MAXSURF design
- Quickly calculate response amplitude operators, added resistance, and MSI
- Determine response at vessel center of gravity or at remote locations
- View results in both graphical and numerical displays
- Animate seakeeping response in various sea states
- View display of response to head seas or user-specified heading

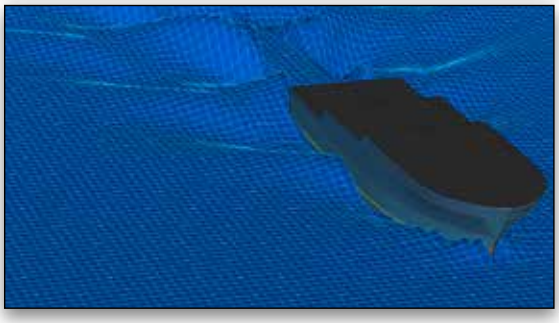
MAXSURF Resistance
Resistance and Power Prediction

The MAXSURF Resistance module estimates the resistance and power requirements for any MAXSURF design using industry standard prediction techniques. MAXSURF Resistance can also compute the resistance and wavemaking of slender vessels using an integrated potential flow solver.

When designing a vessel using MAXSURF, the Resistance module provides a wide range of calculation methods to help you estimate the resistance and powering requirements of the hull. MAXSURF Resistance module includes a range of industry-standard algorithms, allowing you to select the methods most appropriate for your hull shape.

Calculation methods include Savitsky pre-planing and planing, Lahtiharju for planing vessels, Blount & Fox for planing vessels, Holtrop and Compton for fast displacement hulls, Fung and Series 60 for ships, van Oortmerssen for full form hulls such as tugs and trawlers, and Delft systematic yacht series for sailing yachts. It is also possible to directly analyze the resistance of a MAXSURF hull using a slender-body method, which uses a potential flow approach.





The MAXSURF Resistance module can compute the wavemaking of slender hull shapes.

The Resistance module can automatically read any MAXSURF design file and measure the required input parameters. You can override these automatically calculated values to fine tune the calculations to match requirements.

Output from the Resistance module is provided in both tabular and graphical format and is automatically recalculated as changes are made to input parameters.

Resistance Advantages

- Directly measure the 3D model
- Predict vessel performance in minutes
- Override measured parameters to test design variants
- Compare analytical resistance with tank test methods
- Add wind and appendage resistance

MAXSURF Structure
Structural Definition and Plate Development

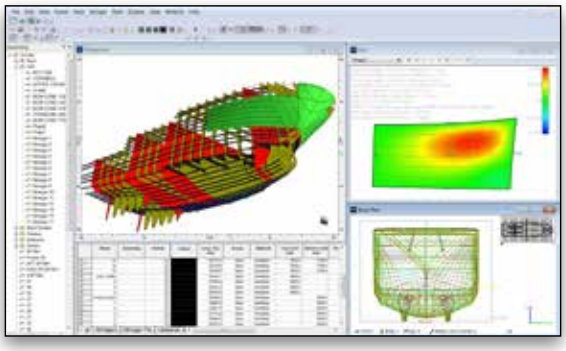
The MAXSURF Structure module provides initial definition of structural parts including hull plates, stringers, transverse frames, decks, and longitudinal structure for all types of MAXSURF designs.

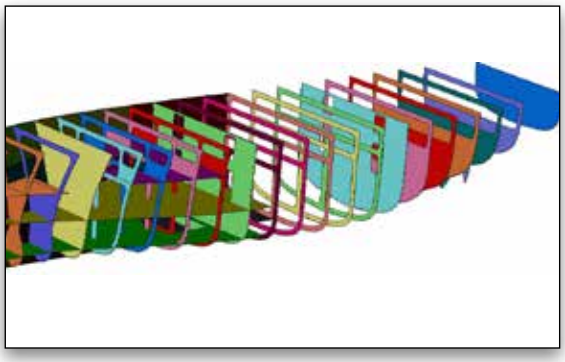
The Structure module is used to define the location of structural parts on the vessel, generate part geometry, and define parts that can be passed to other CAD systems for further detailing. The software provides a range of interactive graphical tools that are used to parametrically define parts directly from the MAXSURF NURB surface model.

With Structure's parametric part definition, parts not only match directly to the hull surface, but automatically adapt to any change in the hull definition. This enables concurrent engineering, allowing design, analysis, and construction detailing to proceed in parallel. This increases scope for weight optimization and results in time savings in the detailing process.

All the parts you define and calculate are stored in an integrated parts list within the Structure module. Quantities, areas, weights, centers of gravity, and cutting lengths are calculated and tabulated. The parts list database can be sorted by any criteria and each part can be renamed to suit your part naming conventions. All parts can also be exported to spreadsheets or databases.

The Structure module has comprehensive functions for laying out stringers, or longitudinal stiffeners, on the hull surface. Stringers can be automatically aligned with particular contours, set to specified girth spacing, or duplicated in groups on the hull. Girth positions and stringer manipulation work equally well for monohull or multihull vessels.





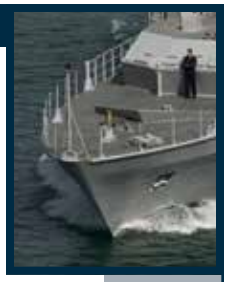
The MAXSURF Structure module provides initial definition of hull structural parts.

Both developable and doubly curved plates can be defined and expanded using the Structure module. The part window provides a range of development methods, and also displays plate-forming information. Girth differences, a color map of in-plate strain, and locations of frames and stringers can all be displayed on the developed plate.

The wide range of part creation, definition, and display options within the Structure module make it an ideal tool for preliminary layout of structure and plating. From the initial point-and-click definition of parts, through to the 3D shaded views of the complete structural model, the Structure module provides everything you need to quickly and accurately develop the major structure for vessels. The Structure module contains the plate development capabilities. Structure Advanced adds stringer, frame, and deck generation.

Structure Advantages

- Parametric model instantly responds to design changes
- Point-and-click interface lets you define parts quickly and accurately
- Integrated parts list produces accurate weight information
- Automated stringer layout lets you optimize structural weight and effectiveness
- Large numbers of frames and decks can be rapidly generated by sharing and re-using attributes
- Integrates with any downstream CAD system via industry-standard 3DM, IGES, and DXF files



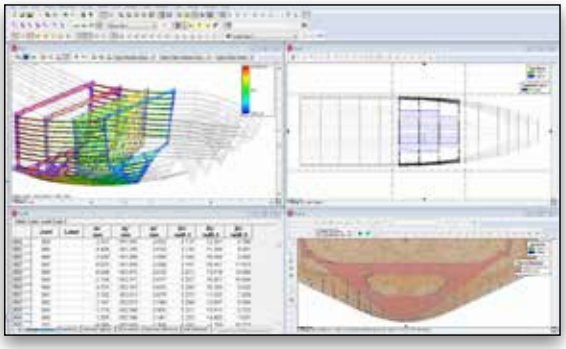
MAXSURF Multiframe
Structural Analysis and Design

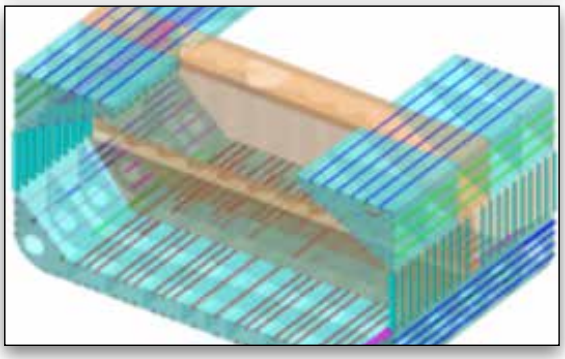
MAXSURF Multiframe helps structural experts determine the stresses in their vessel to comply with class requirements and optimize it for strength and weight.

When designing a steel or aluminium vessel, there are a range of structural analysis approaches that can be used to assess the ship's structural capacity and compliance with class requirements. Multiframe is a general-purpose beam and plate element-based system that allows you to very quickly model and analyze ship structures and carry out static or dynamic analyses of their structural behavior. Multiframe is an ideal complement to the more time-consuming full finite element analysis and less-accurate spreadsheet calculations.

With Multiframe, you can open geometry files from MAXSURF Structure or most other structural modeling systems then use a wide range of tools to apply structural properties such as restraints, materials, and section shapes. You can create a family of load cases and then perform a static or dynamic analysis and review results in terms of displays of actions, stresses, and deflections. Dynamic results include natural frequencies and mode shapes or more detailed time history results for time varying loads.

Multiframe's automation interface with Excel enables optimization of structural behavior using custom calculations, as well as built-in searching, sorting, and checking functions. Automation is particularly useful for post-processing of analysis data as well as pre-processing including generation of hydrostatic or wave loads.





The MAXSURF Multiframe module provides structural analysis of beam and plate models.

System Requirements

Processor:
Intel Core 2 or faster

Operating System:
Microsoft Windows 7 or Windows 8

Memory:
Minimum 2 GB of RAM

Disk Space:
Minimum 10 GB of free disk space

Display:
Graphics card supporting Open GL, with minimum 128 MB RAM and 1280x1024 or higher resolution

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Multiframe has a strong set of 3D tools for easily managing the complex geometry that results from a detailed structural analysis model. Rendering and animation can be combined with clipping, searching, and sorting functions. This makes it easy to narrow your focus to critical areas.

Multiframe also includes the Shape Editor, a section properties calculator, and a comprehensive library of common structural shapes.

Multiframe Advantages

- Graphically model beam and plate structures
- Automatically adjust mesh density and hot spots
- Apply loads using self weight, buoyancy, inertial and current load cases
- Check results numerically and graphically
- Animate structural response with rendering

MAXSURF Utilities

MAXSURF VPP Utility – Sailing Yacht Velocity Performance Prediction

The MAXSURF VPP utility provides sailing performance analysis for yachts in a variety of sailing conditions and produces performance polar curves to show predicted speeds.

Designers of sailing yachts who use MAXSURF can take advantage of VPP to predict the performance of their designs in a variety of sailing conditions.

Using calculation methods similar to the original IMS Velocity Performance Prediction program, VPP solves the equations for lift and drag for hull and rig and finds an equilibrium velocity and angle of heel. VPP's calculations operate through a variety of true wind angles and speed, and calculate with both spinnaker up and down.

Integrated into VPP is a hull measuring capability that automatically measures the MAXSURF design to extract the required input measurements and parameters. Alternatively, a small number of key values can be entered directly from an IMS (International Measurement System) certificate.

Output from VPP is provided in both tabular and graphical format for each wind strength and direction. Results include apparent wind strength, hull velocity, Vmg, heel angle and the various lift and drag forces involved. The family of polar performance curves produced can be selected to find key values for any setting.

MAXSURF Link Utility – Industry Standard Data Exchange

The MAXSURF Link utility provides data exchange between a range of modeling, performance prediction, and hydrostatic software programs.

The Link module provides a range of data translation options that are used to move models to and from MAXSURF and other software applications. The Modeling module provides import and export of DXF and IGES files. MAXSURF Link's data exchange options complements this with capabilities to read and write NURB surface files and to write offset files in a format compatible with a number of hydrostatic and VPP programs.

Each file format option has an associated visual dialog of any additional information to prepare a complete and consistent file without additional text editing. Validation of key parameters is provided to ensure that input values lie within the required range.

MAXSURF Link imports and exports MAXSURF, IGES, DXF, IMSA NURBS, and USNA formats. The module exports GHS, SHCP, MHCP, IMS LPP, BMT, Microship, IMSA Hull Parameters, Veres, Hydros, GHS, Wolfson, ShipFlow, and nuShallo formats.

Bentley®
Sustaining Infrastructure

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