AVEVA Hull Structural Design

For structural design with analysis, cost estimates and transition to detailed design

A major challenge for a shipyard is to be able to manage the early design of a ship’s structure in a timely manner, without losing touch with a wide range of parameters. Among many other tasks, the shipyard’s design office, or their specialised design agents, needs to define a hull structure that complies with classification society rules, to use Finite Element calculation methods to check the overall strength of the ship, and to estimate weight and material list. And all of this in a setting where change is the rule rather than the exception.

AVEVA Hull Structural Design™ is an integrated suite of ship design tools developed for naval architects and design engineers who seek advanced and practical tools.

AVEVA Hull Structural Design is used for the preliminary definition and arrangement of the ship’s structures. The application helps in making important decisions regarding naval architectural characteristics, the preliminary geometry definition and the arrangement of principal structural members.

Classification drawings, steel material estimates, weld lengths, and Weights and Centre of Gravity reports are produced with AVEVA Hull Structural Design.

Business Benefits

- Time saved in the project. Flexible modelling and drafting tools allow the creation, in only a few hours, of the structural model for classification documents. The same structural model can be used at an early stage in outfitting design.
- Project elapsed time and design man-hours are saved through the option of maintaining automatically synchronisable parallel views of the structural design and the detailed design. In this way, detailed design can start before the structural design is approved and can be continuously updated in a controlled manner.
- Save time and expense in the creation of classification documents by reusing earlier production designs. These can easily be converted to a structural design with the removal of block seams and other production details.
- Optimise production costs by easily investigating the costs for different design alternatives and block divisions for the project.

An example of ship's steel structure in AVEVA Hull Structural Design

www.aveva.com
Integration with other AVEVA Marine products

AVEVA Hull Structural Design is a tool for rapid definition and analysis during the structural design phases of a project. Hull Structural Design’s close integration with other AVEVA Marine applications ensures smooth and rapid design development. The preliminary structural definition and topological dependencies developed by AVEVA Hull Structural Design can be used in other AVEVA applications for detailed design and the preparation of production information. This is made possible by the advanced block splitting function, which transforms the basic design structure into production blocks.

Seamless transition between structural and detailed design

There is often a requirement to start cutting steel at an early stage in a shipbuilding project, sometimes even before final approval has been obtained from the classification societies. The structural engineers must work with the overall classification view of the ship, while in parallel the detailed designers are responsible for individual hull blocks. AVEVA has a solution to this problem.

The AVEVA Hull Structural Design and AVEVA Hull Detailed Design™ applications maintain two parallel views of the design in the model database: a design view for the structural engineers and a production view for the detailed designers. The structural engineers create and maintain the design panels, while the detail designers work with the production panels. The production panels are created from the design panels using the automatic block-splitting facilities.

After block splitting, the two views of the steel structural model are kept synchronised so that any change to a design panel will automatically affect the corresponding production panel.

Fast parametric modelling of hull steel structures

Hull Structural Design has parametric modelling functions for hull structures containing plating, holes and stiffeners. The modelling is carried out by adding information to surfaces defined in the database. This information is in the form of parameters that form a ‘recipe’ for how steel panels will be automatically generated on the surfaces.

Different alternatives for modelling of internal surfaces

Surfaces can be created in three different ways. Firstly, as a major compartment boundary in AVEVA Initial Design™, secondly, by direct input in AVEVA Hull Structural Design, and thirdly, as an imported 2D drawing view placed in 3D space in the model.

Imported 2D drawing views placed in the 3D database as surfaces

2D views in a drawing can be converted into surfaces and thus oriented in 3D space. The elements of the drawing view can then be used as backdrop references in the surface for the modelling of 3D steel structures, the placing of equipment, the routing of pipes, and so on. In this way, a General Arrangement drawing can be imported from any 2D-based drafting system using DXF, converted into a drawing view, and then used as a backdrop for modelling.
Calculation of section modulus
Once the main longitudinal elements have been modelled, the section modulus can be calculated at any transverse section of the ship.

Analysis of alternative designs
A preliminary steel structure for a ship can be generated from parameter values in a matter of few hours, and several different alternative design and dimensioning approaches can be analysed for details such as steel weights, surface areas or section modulus.

Links to classification societies’ software and programs for FEM-based strength calculations
AVEVA Hull Structural Design has powerful interfaces to classification societies’ software programs for rule checking and strength calculations.

Classification Drawings
The built-in drafting features of the system provide a highly productive way of creating the classification drawings. The drawings can be made in parallel with the modelling of the 3D steel structure through the close integration between modelling and drafting tasks.

Efficient analysis tools
AVEVA Hull Structural Design has two major features for early estimations of work content and costs. Weld lengths for blocks or assemblies can easily be calculated, based on a preliminary steel model, and all individual weld lengths can be reported. Preliminary block weights, painting areas and centres of gravity can also be quickly obtained for any selected part of the model. This allows alternative block divisions to be analysed quickly, thereby determining optimal final block divisions.

Flexibility to choose production worksite
Large shipyards with parallel production lines, and shipyards that outsource the manufacturing of the hull need to be flexible in terms of a late choice of production facilities. Panel line restrictions, lifting and transportation capacities determine the maximum size of blocks and assemblies that a shipyard can accommodate. It is vital to consider these details when creating the parts manufacturing and assembly information, as the costs of moving a design between production sites can be high.

With AVEVA Marine, it is possible to create alternative block and assembly definitions from the same design, using the block-splitting function. The options can be analysed, and the choice of production facility can be postponed until late in the process. In this way, work involved in creating the manufacturing information is minimised.

Reuse of existing model databases
An existing production model (a model database containing production panels) can be reused by 'reverse engineering' it so that design panels can be created through an intelligent merging of production panels. The newly-obtained design panels can then be split to satisfy alternative production sites. This process can also be applied to old Tribon model databases converted to AVEVA Hull Structural Design.
Key Features (continued)

Summary of Process Coverage
AVEVA Initial Design and AVEVA Hull Detailed Design are separate products from Hull Structural Design, but are shown here in order to provide a complete picture of the basic early design process with the AVEVA Marine Solution.

<table>
<thead>
<tr>
<th>Process</th>
<th>Initial Design</th>
<th>Hull Structural Design</th>
<th>Hull Detailed Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract design</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statutory compliance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hull form and performance</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural design for classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost-related information, including weight, bill of materials, welding lengths and painting area</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production planning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smooth transition to detailed design, allowing for concurrent work</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation of drawings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic export to analysis systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic export of DXF for general CAD systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detailed design</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Production design</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AVEVA Hull Structural Design is one of AVEVA’s Design products, which create 3D models for detailed design and produce all associated deliverables.