



Ship Design & Construction: from A to Z

Integration of Maxsurf design and ShipConstructor construction detailing software.

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Introduction

Ship designers and shipbuilders around the world are under continuing pressure to deliver vessels in shorter periods of time and at lower cost. Just striving to win more business is not enough, as high turnover does not automatically translate into increased profits. With margins remaining relatively small, it is important for shipbuilders to look at improvements in efficiency to reduce cost and strengthen their competitive position in all aspects of their business.

In this environment, one of the keys to timely delivery and cost reduction is the use of design and construction tools which are well suited to the specific needs of shipbuilders, and which integrate smoothly with their existing work processes and IT infrastructure. These tools should also be smoothly integrated through the design/build process so that data is passed from the earliest stages of the design through to detailing and construction management.

This paper discusses the integration of hull design software with downstream detailing and shipbuilding production software. In particular it reviews historical approaches to this problem and explains how the combination of Maxsurf and ShipConstructor provides a new solution using existing, widely used hardware and software platforms.

History

For over thirty years, naval architects and shipbuilders have used CAD/CAM systems to design and build ships. During that time the range of tools on offer has evolved with three main types of systems being utilized. These are large standalone packages such as Tribon and Foran, general purpose CAD programs applied to shipbuilding, such as Catia and ProEngineer, and assembled suites of software from a range of suppliers such as the IMSA group.

Large Standalone Systems

The larger systems generally started out on Unix platforms and proposed to provide all the capabilities that a shipbuilder could want including hull modeling, 2D drafting, 3D modeling and production management. While these systems are certainly technically very capable, they are also characterized by a relatively closed technical architecture making them more difficult to integrate and customize. In addition, such systems require a large investment in training due to the specialist nature of the technical architecture. This is also required due to limited supply of a pre-trained and skilled workforce. Finally the size and structure of large standalone packages make them more directly tied to specialist and expensive database systems and therefore less able to take advantage of the rapid advances which are available in products based on more widely used platforms.

General Purpose CAD Systems

Many vendors of general mechanical CAD software have attempted to provide solutions for the shipbuilding market. Almost all have abandoned their efforts because of the specialized nature of the technical requirements and the fact that 3D solid modeling – as found in these systems – is not well suited to the modeling of plate structures as found in ships. Ships are essentially 3D assemblies of 2D plate parts and any attempt to model this using full 3D solids incurs a very high penalty in terms of decreased performance and increased complexity.

Multi-Vendor Alliances

In an attempt to provide a complete solution, alliances have been formed where a number of software vendors combine to offer the various modules required. While in principle this does cover a wide range of shipbuilding activities, in practice the process suffers from a number of problems. These include a range of inconsistent graphical interfaces, only limited data exchange capabilities, and increased complexity in managing support, upgrades and customization.

Current CAD/CAM Environment

Over the past 5-10 years, the shipbuilding industry has clearly standardized on a number of software platforms for general management and specialist design work.

These comprise -

- Microsoft Windows based personal computers and servers
- Microsoft Office including Excel and Word for document management
- Access and SQL Server for database activities
- AutoCAD for drawing production
- NURB surface modeling for hull definition

It is clear that an ideal solution for the industry should be based on these widely used platforms so that additional investment is minimised, training times are reduced, and startup time is kept to a minimum allowing a faster return on investment and faster vessel delivery.

Shipbuilding Requirements

Before looking in detail at new software options, it is useful to review the requirements of shipyards and engineering offices, and the drivers of change in design and construction tools and processes. Some of the driving forces include -

Decreasing Delivery Times

Vessel owners and operators are continually looking to minimize time to delivery. Consequently any software tools adopted must facilitate a minimum of down time for staff, require little training, and support processes for delivering vessels more quickly. Tools which allow rapid exploration of design parameters at the proposal stage can also help to make estimates more accurate and allow a faster start-up in the early stages of the project.

Many One-Off Vessels

A characteristic of the shipbuilding industry is that shipyards are likely to have a wide variety of vessel projects. Consequently any implementation of CAD/CAM software must allow for application to a wide variety of vessel types and construction methods, At the same time, such systems must support development and construction of new vessels which are minor variants on past deliveries.

Increased Regulatory Requirements

As concern about vessel safety increases, naval architects and shipbuilders are required to spend more time ensuring that new vessels comply with regulatory and classification society requirements. These increasing demands require more specialist tools covering intact and damaged stability, compliance with stability criteria, structural analysis, and production of documentation in a format acceptable to the relevant authority.

Companies implementing formal Quality Assurance systems can also gain relative advantages by certification and its internal effects. Implementation of standardized processes with CAD/CAM can help support this. This can include drawing standards, naming conventions, material management and project management.

The Maxsurf/ShipConstructor Combination

In the context of the general shipbuilding CAD/CAM environment described above, Formation Design Systems (FDS) and ShipConstructor Software Inc. (SSI) have joined forces to deliver a CAD/CAM software solution which addresses the issues faced by shipbuilders today. This solution is based on the Maxsurf suite of initial design software from FDS and the ShipConstructor suite of detailing and production software from SSI.

Maxsurf

Maxsurf will typically be used by naval architects and engineers. As such it is based on a suite of Windows based applications which all share a common look and feel. It also links smoothly with Microsoft Office for the development of additional calculations in Excel or the production of design documents in Word.

The Maxsurf system is used in the initial stages of design and uses 3D NURB surfaces to model hull, superstructure and appendages. Use of this modeling approach ensures a high level of surface quality and also ensures that data can be moved to other CAD programs for additional modification.

Specialist modules in the Maxsurf suite perform analyses such as damage stability, resistance prediction and calculation of seakeeping behavior. The Workshop module is used to define preliminary structure including frames, stringers, decks and plates.

ShipConstructor

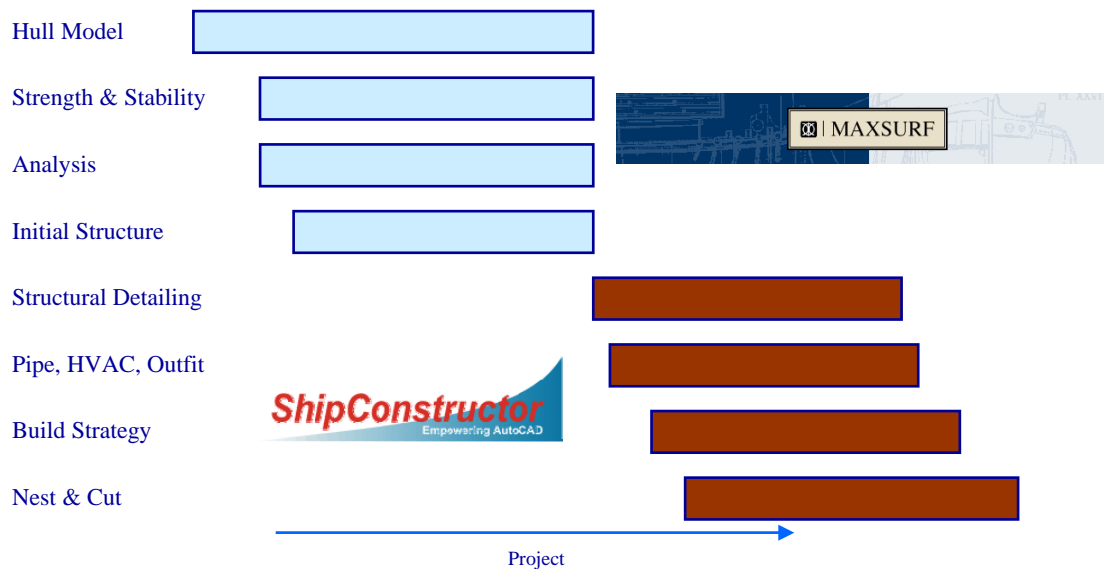
The ShipConstructor system is typically used by designers and draftsmen. Because of this, it has been developed to run inside the AutoCAD environment so that users can use their existing skills and tools without re-training. ShipConstructor has a range of modules which cover –

- Build strategy planning
- 3D assembly drawings generator
- Plate and stiffener nesting
- NC code output, for automated plate cutting
- Stock and supplier management
- Piping and outfitting
- HVAC

Together Maxsurf and ShipConstructor provide a complete solution which a shipyard may use internally, or may use in collaboration with external design and engineering offices.

Linking Maxsurf to ShipConstructor

It is clear that Maxsurf and ShipConstructor together cover the functional requirements of ship design and construction, but how is data managed and transferred during this process? Commencing with version 9.6 of Maxsurf, specialist functions have been included which directly output part data in ShipConstructor format. Unlike transfer of geometry using DXF, IGES or text files, this process uses the ShipConstructor native format so that any adjustments due to differing units, coordinate system or other issues, are eliminated.



Schematic view showing functional coverage of Maxsurf and ShipConstructor modules

After the preliminary design has been approved regarding stability, speed and seakeeping requirements, the hull form can be loaded into the Workshop module. Workshop's 3D graphical interface allows the addition of frames, decks, plates and stringers which can update automatically if the hull form changes. Initial definitions are also made of material thicknesses, plate layout and part assemblies.

Once the hull shape has been finalized, the parts are exported to ShipConstructor with no loss of data. Once in ShipConstructor, all parts including plates, frames, stiffeners, materials and drawing standards are managed through a Microsoft SQL Server database. The SQL database on the back end means that those yards who wish to add their own reporting can easily do so using Excel or one of the numerous add-on reporting utilities available.

Maxsurf/ShipConstructor Case study

The following is a hypothetical case study on the use of Maxsurf and ShipConstructor. It is based on actual usage in a number of yards and design offices.

Shipyard XYZ based in Australia builds large offshore workboats. They usually deliver to South East Asian operators with a delivery time of 32 weeks. XYZ works with engineering bureau ENG who provide hull design and engineering services. ENG start their work by scanning a similar linesplan from XYZ and digitizing the hull shape into Maxsurf. First, markers are created by loading the scanned image into the background and then a surface is manipulated to fit over the markers. The Maxsurf design is resized to match the design requirements.

The hull surfaces are then loaded into Workshop for preliminary structural modelling, while in the mean time Maxsurf's modeling tools are used to fair and finalise the design. Concurrently, the members of the team responsible for stability compliance model the tank configurations and engine room size in Hydromax. This allows them to begin a range of stability and equilibrium analyses while structural definition continues. Some adjustments to the lines have to be made, but soon after, the work in Workshop is completed. Workshop exports developed plates, stringers and frames, so that an estimate on material requirements can be made for the shipyard.

ENG then exports the Workshop parts into ShipConstructor format and emails them to the XYZ yard office. There they are imported into ShipConstructor and additional parts are defined. A preliminary build strategy is created in ShipConstructor to ensure there will be no conflicts regarding the yard and machinery usage which ensures a short delivery time.

Construction is started before detailing is complete and yard workers are provided with the 3D assembly drawings automatically generated by ShipConstructor. When the 3D structural model is near final, a table of weights and centres is exported to Excel and then to Hydromax for a final check for the stability booklet.

The combination of Maxsurf and ShipConstructor allows both the design and construction teams to have access to a consistent set of data via a set of tools that are well suited to their current and future business and IT environments.

Further Information

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