

Høgskolen I Ålesund

Ship Design Lab

Modular Vessel Parameterized Design

MONTEIRO Thiago Gabriel

Ålesund, Norway

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1 Introduction

A ship is a complex system, with several subsystems. Some of these subsystems are essential to the operation of any vessel, such as the machinery and propulsion subsystems. Others subsystems are responsible for a certain level of specialization of the vessel and are not necessarily present at any ship. For an AHTS (Anchor Handling Tug Supply), for example, it is essential to have a crane system capable of dealing with the anchor handling operation, but it is not necessary to have a drilling tower structure.

Even for those essential subsystems, it is possible to identify relevant differences according to the vessels' functions. For example, a PSV (platform supply vessel) needs a propulsion system which enables the vessel to reach high service speed while a tug boat needs a propulsion system which enables the vessel to reach high thrust values (at bollard pull condition).

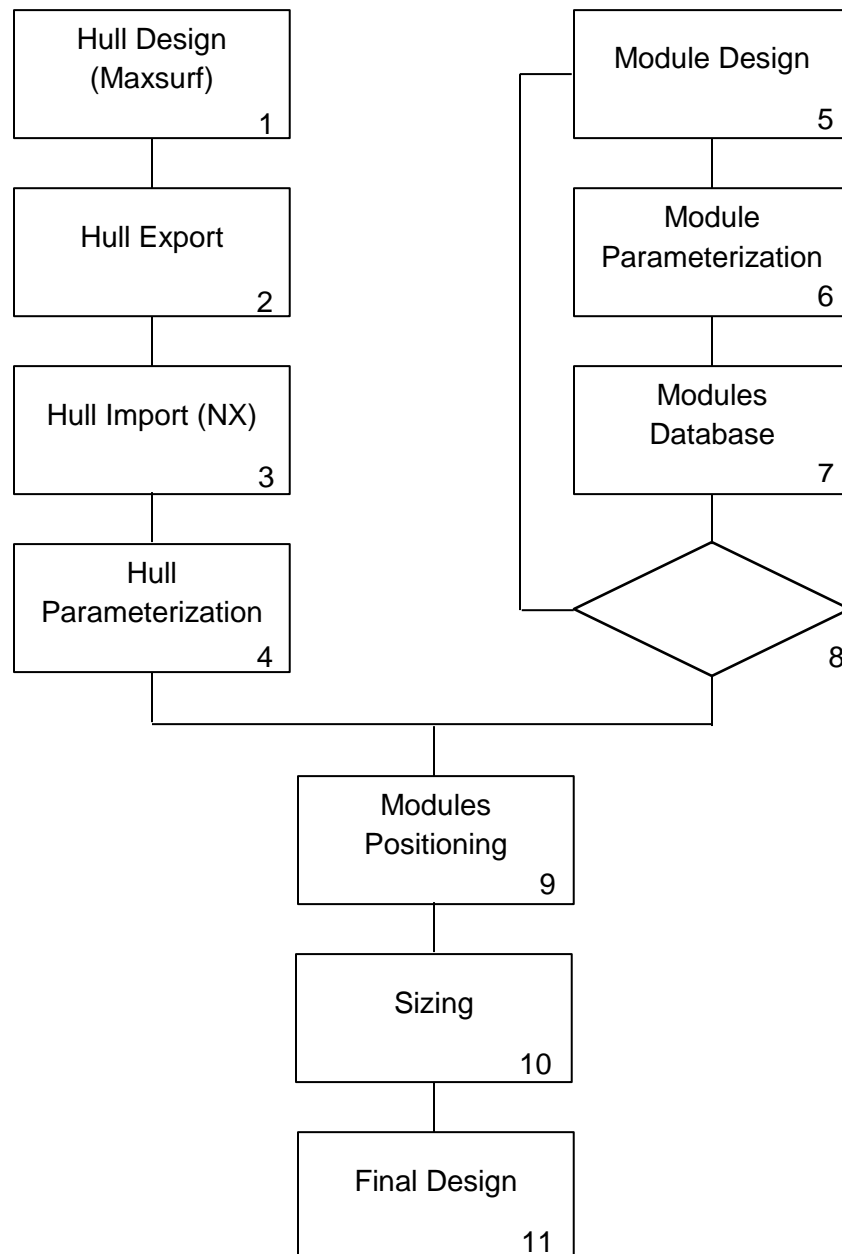
Based on the subsystems division, it is possible to make the ship design process faster by using the idea of modularization of these subsystems. The idea of modularization consists of dividing the vessel in several modules, which includes one or more subsystems. Having a database of modules containing several kinds of subsystems, it is possible to fast reach a design solution for a vessel with a specific function, by adding the required modules to fulfill the vessel's mission requirements.

This report aims to present a methodology to create and integrate parameterized computer aided designs of hulls and modules in order to have them working as a whole in the vessel's final design.

2 Methodology

In order to state the methodology which should be adopted to conduct the parameterized design process, at this chapter will be presented the flowchart which should be followed by the designer. Then, it will be presented a study case to exemplify the stated methodology.

2.1 Process Flowchart



The stages present at the flowchart can be described as follow:

1. At this phase, the vessel's hull should be modeled at the software Maxsurf.
2. At this phase, the vessel's hull should be exported from the software Maxsurf, in a format which the software Siemens NX is capable of importing.
3. At this phase, the hull modeled at the process 1 should be imported to the software Siemens NX.
4. At this phase, the imported hull should be parameterized according to the vessel's main dimension variables.
5. At this phase, a design of a module (subsystem(s)) is created.
6. At this phase, the module previously created should be parameterized according to the vessel's main dimension variables.
7. At this phase, the module previously parameterized should be included at the Modules Database.
8. At this phase, all the needed modules should be check. If there is any missing module, the process should be repeated from process 6, till there are no missing modules.
9. At this phase, the hull should be loaded and the modules positioned at the right places.
10. At this phase, the vessel should be sized to the final dimensions through the use of the parameterized main variables.
11. At this phase, the final design is obtained.

3 Study Case

To beginning with the design of the modularized vessel, it is necessary to have the ship's hull already modeled. This modeling could be done at any computer aided design software, but it is better to use one which provides tools that make the hull lines design easier. In this case the chosen software was Maxsurf.

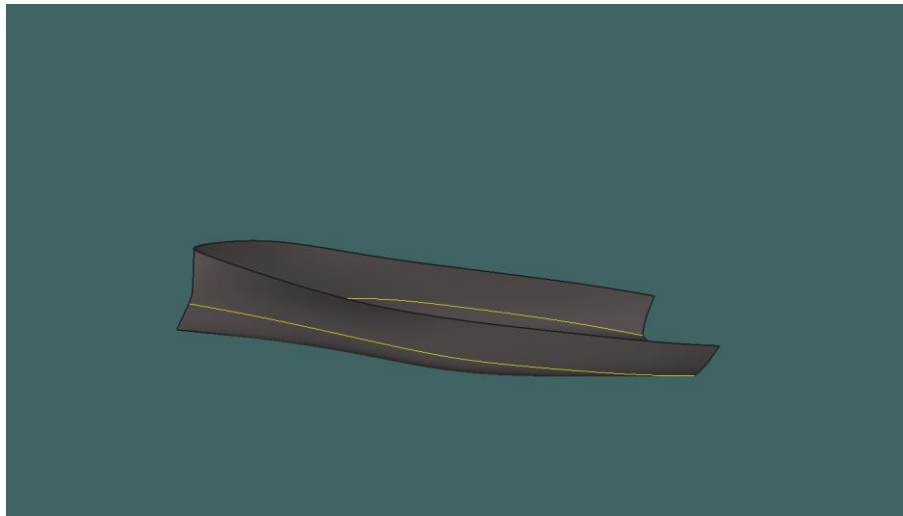


Figure 1 Modeled Hull At Maxsurf

With the hull design done, the exportation process to Siemens NX can be started. The only exportation format from Maxsurf supported by NX is IGES. It is important to be sure that you are exporting 3D NURBS surfaces.

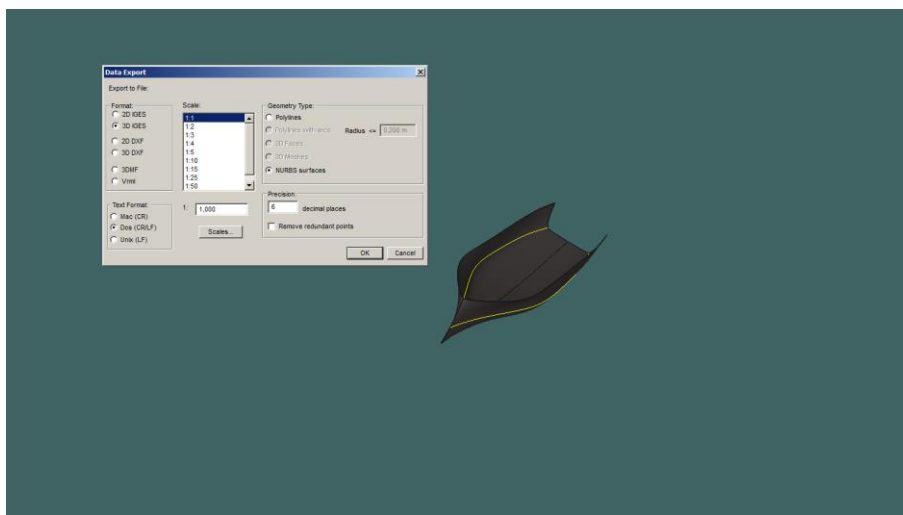


Figure 2 IGES Export Menu At Maxsurf

So, the hull should be imported at NX in order to be parameterized.

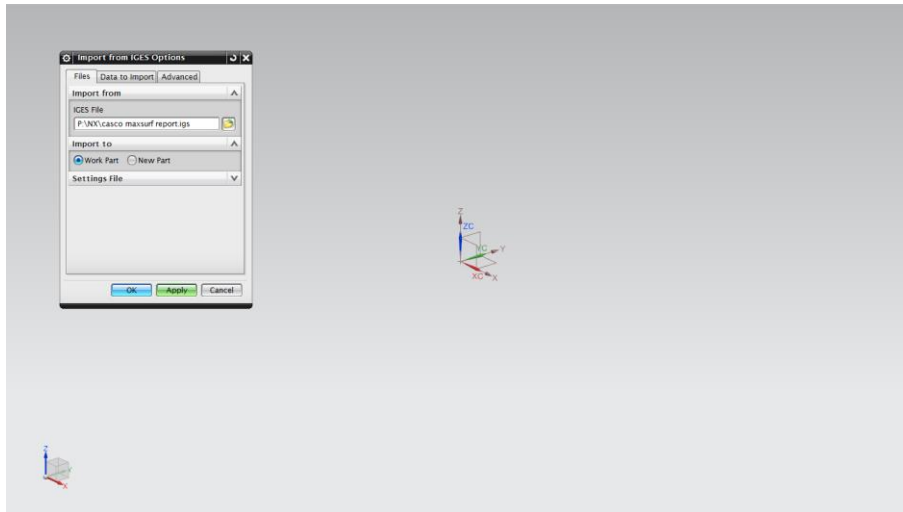


Figure 3 IGES Import Menu At Siemens NX

With the hull loaded, it is possible to use the expressions window to create variables which represent the main dimensions of the vessel. These expressions should be shared with all modules, so all the design will be updated when one parameter is changed.

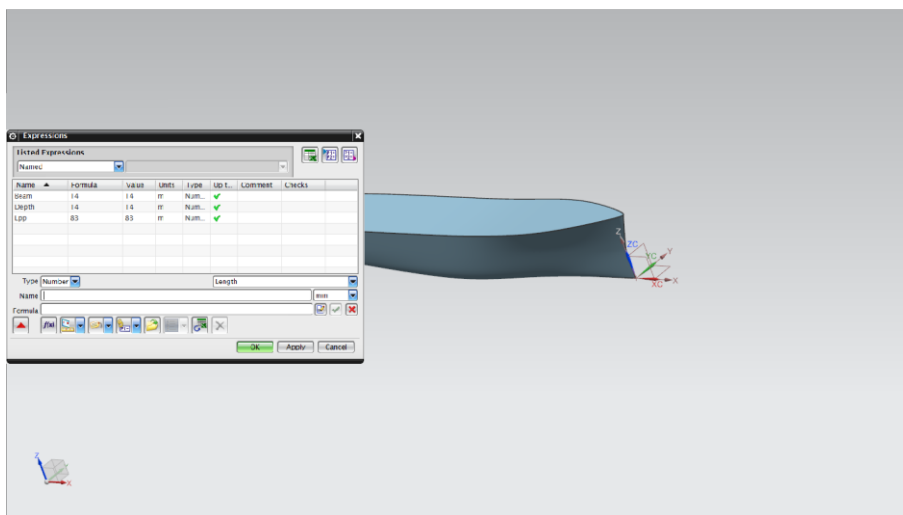


Figure 4 Expressions Control Menu At Siemens NX

All modules should be designed at Siemens NX. After the designs are completed (or even during the process) the parameters created at the vessel's hull should be used to parameterize modules' geometries.

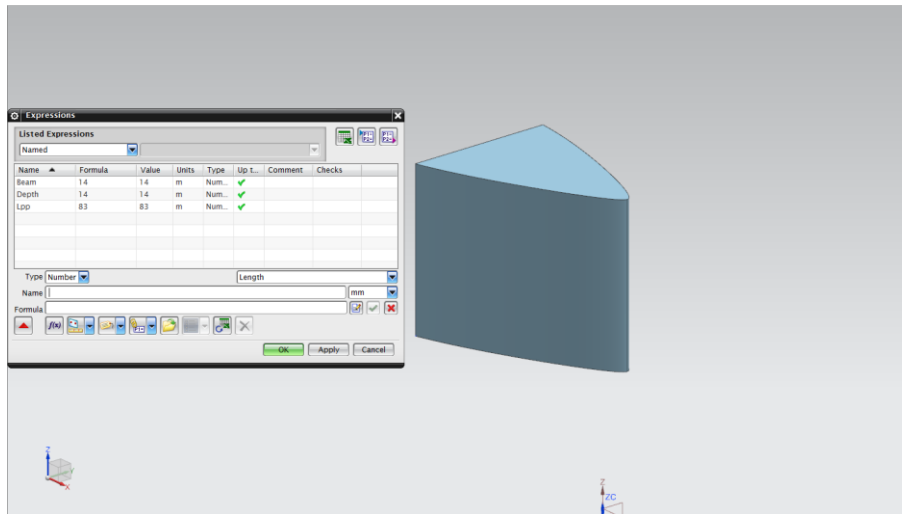


Figure 5 Super Structure Module Been Parameterized

After all the needed modules are ready, they can be positioned at the right place, relatively to the vessel's hull.

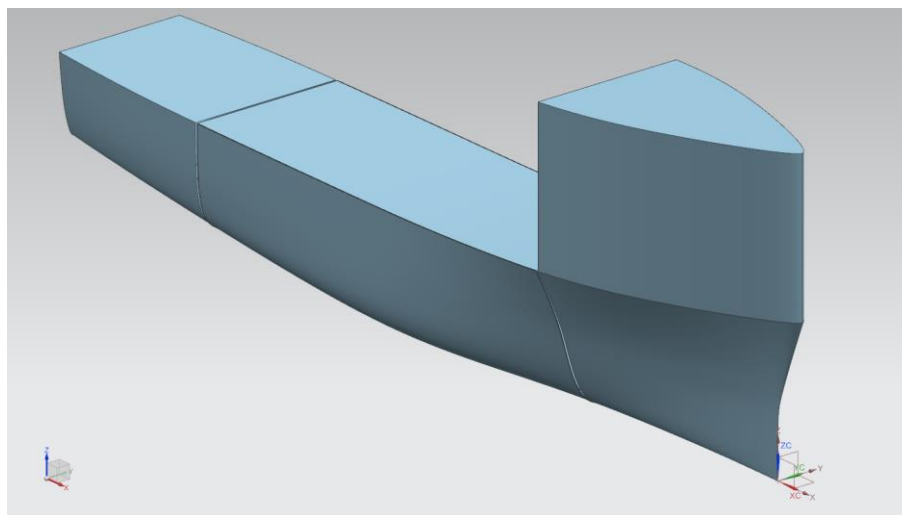


Figure 6 Designed Modules Positioned At The Correct Positions

After all the modules are in place, the final design can be dimensioned to the final size.

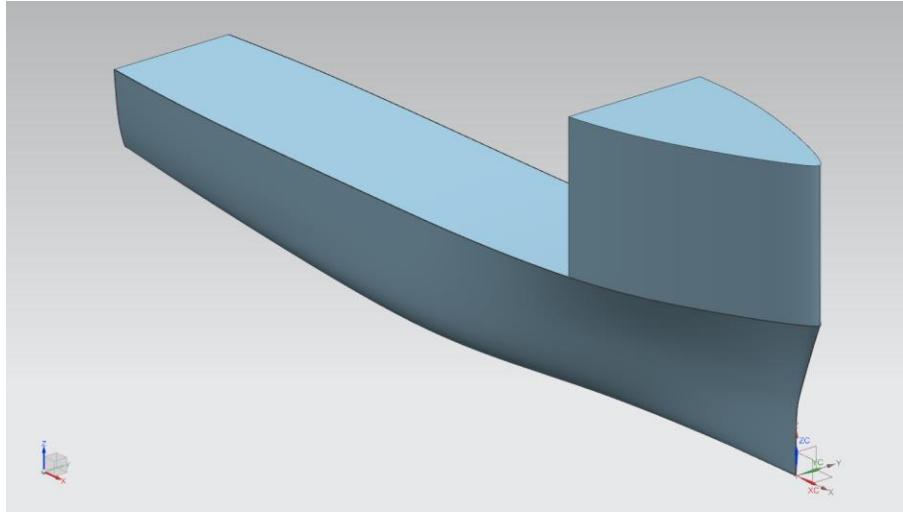


Figure 7 Final Design With Modules And Hull

4 Partial Results

At this chapter will be presented the results obtained so far.

The hull modeling present here is way simpler than the one presented at Chapter 3. The reason for that is that the more complex the vessel's hull gets, more difficult the parameterization becomes. For illustration of how the methodology can be used, the hull modeled here is from a simple barge. The hull was parameterized using variables which represent the main dimensions of the ship.

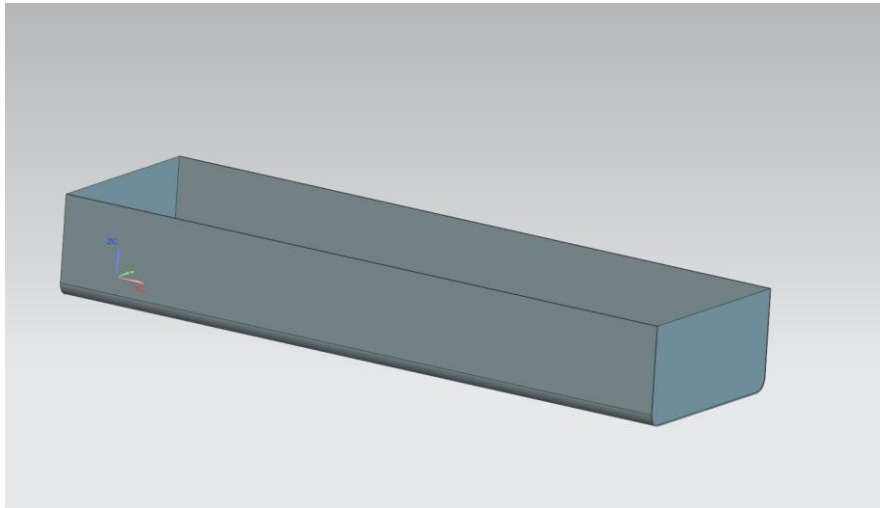


Figure 8 Simple hull

After the hull parameterization is done, it is time to design the modules which will be added at the final design. Each module present here was dimensioned using the variables defined at the hull modeling.

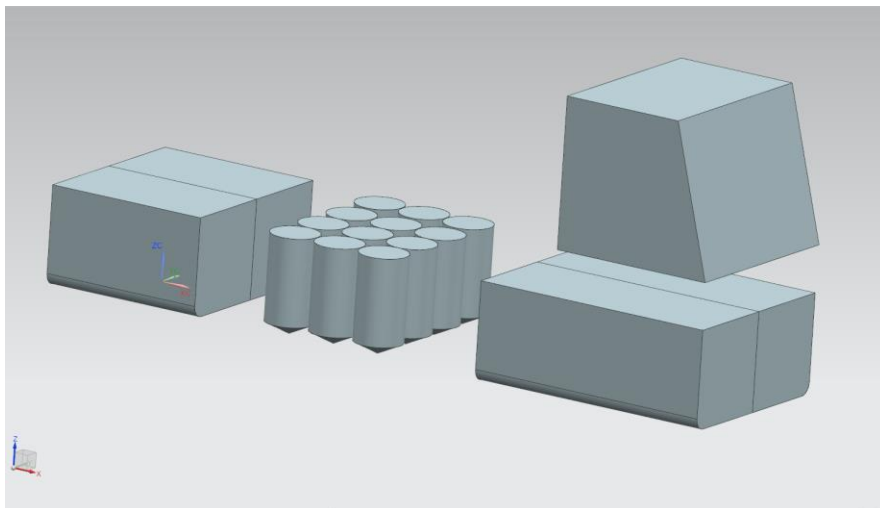


Figure 9 Modules designed

With all modules parameterized, it is possible to define the correct location for each one at the final design. This positioning task should also be done using the defined main dimension variables.

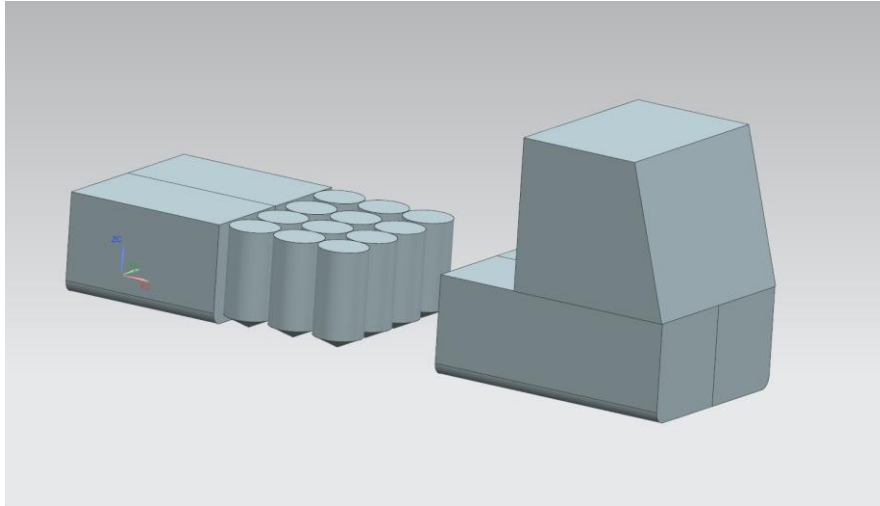


Figure 10 Modules positioned

When all the modules are correctly positioned at the vessel's hull, the final design is complete. Now, it is possible to resize the vessel varying the main dimension, without being necessary to change every part individually.

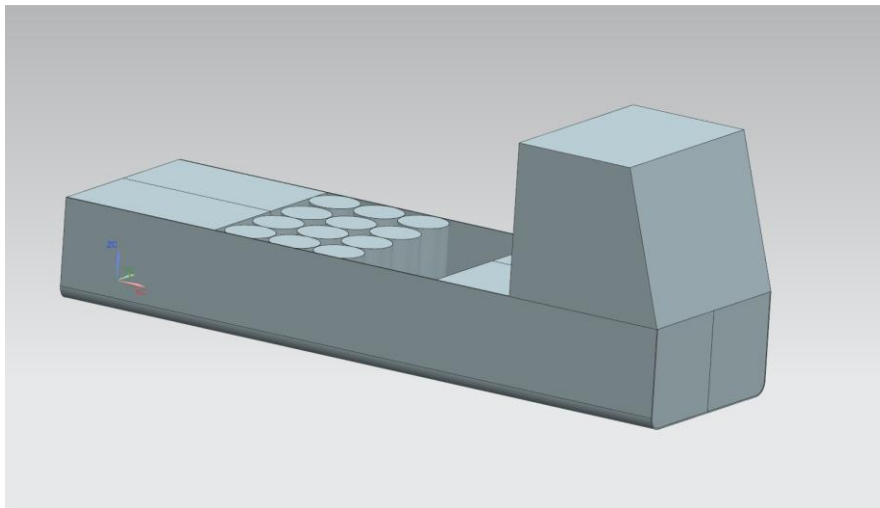


Figure 11 Final design