NEW FOUNDATION FOR PIAS' CALCULATION MODULES

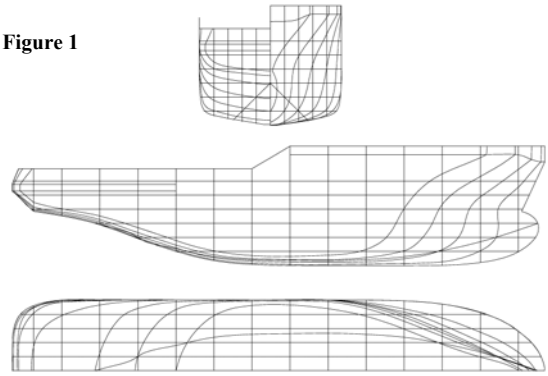
September 29, 2003

Background

Since the initial development of PIAS, in the mid 80's, the functioning is based on a model of frames or other cross sections. Volumetric and hydrostatic calculations are executed by determining the sectional areas, and subsequently integrating those areas in longitudinal direction (by means of an adapted version of Simpson's rule). Also compartment calculations and damage stability calculations are fundamentaly based on this scheme. By the way, in this respect PIAS is no exception, the majority of naval artchitectural software suits have adopted this method.

Although this calculation scheme always has been performing well, and will do so for years, the improved hardware and software techniques give an opportunity for an alternative approach based on a solid model of the shp and its compartments. This newsletter aims to sketch roughly the features of this new technique.

Figure 1



Volumetric and hydrostatic calculations

For long and slender hull shapes the representation with cross-sections is a natural one, in principle the sections can be distributed evenly over the vessel's length. The more parallel the shell is to the cross-section plane, in fore ship and aft ship, the more support needs to be given by the placement of additional sections.

The tug of figure 1 can be given as an example. The PIAS model which has been based exclusively on the design ordinates already present is shown in figure 2, and it may be clear that for accurate hydrostatical calculations and tank volume calculations additional cross-sections in the aft ship will be necessary. Placing additional cross-sections poses no substantial problems, but it requires special consideration and therefore additional time. This tug, however, is only a moderate example. With inland waterway vessels with blunt stems, or with (buoyant parts of) semi-submersibles a considerable number of local cross-sections is required for adequate shape modelling.

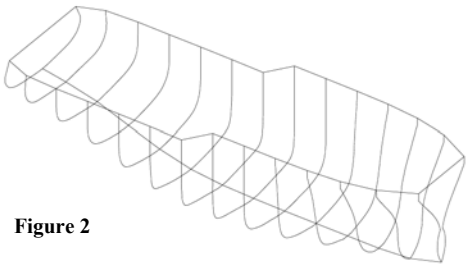


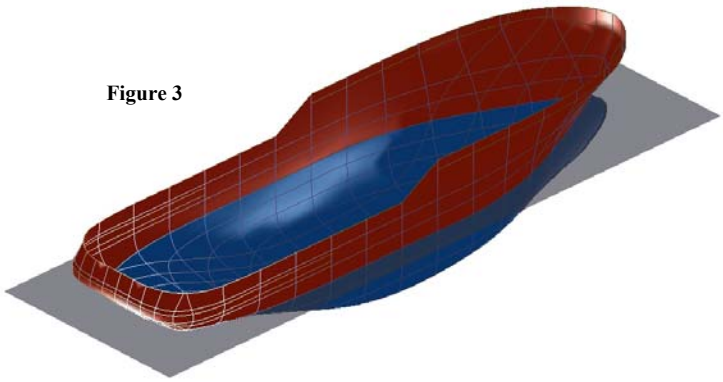
Figure 2

If a ship has been defined in Fairway then a surface model of the whole shell is available. This model can be used to generate the PIAS calculation sections, but it still is a waste to 'decompose' such a coherent surface in frames. Therefore, as an alternative, PIAS has recently been provided with the possibility to use Fairway's surface model. Volumetric and hydrostatic calculations are performed by calculating the buoyant forces of a magnitude of small planes, and to add these over the submerged part of the vessel. Because all local details are represented by surfaces, they are all included in the calculation. An example of the surface model of the tug from figure 1 and 2 is given in figure 3.

Spaces and compartments

Other aspects are defining the compartments and calculating compartment volumes. On the basis of the cross-sectional model PIAS has always performed satisfactorily, but whereas SARC always has opted for convenience with regard to the input, the compartments unfortunately could only be visualized by approximation. The reason for this is the fact that the space between the defined cross-sections is empty. PIAS can calculate tank volumes there based on interpolation and extrapolation, but the shape of the compartment itself cannot be determined at every desired location because of a lack of coherence in cross-sections. This phenomenon becomes more striking when using so-called negative subcompartments, which are not added to a main compartment but are subtracted. While visualizing a compartment these parts are simply drawn and the user must realize that the negative parts are deemed to be subtracted instead of added.

Figure 3



With the aid of solid modelling techniques which are also applied in Fairway, it is possible to combine parts of a compartment explicitly. The closed resulting shape will serve as the basis for calculations, but can also be visualized.

As an illustration images of a virtual arrangement are included. The model contains three compartments:

- A fore peak, minus chain locker;
- a U-shaped tank, with a recess in a part of the wing;
- an engine room with stepped bottom level, from which a U-shaped fuel oil tank (with oblique inner bulkhead) and a supply tank are subtracted as ‘negative subcompartments’.

Figures 4 to 6 show the conventional PIAS drawings of these compartments, whereas figure 7 shows several sections of the whole vessel, on the basis of that conventional PIAS model. Figures 8 to 10 show the rendered plots of the compartments which have been composed with the solid modelling technique. Figure 11 shows a wire frame model of the composed engine room from figure 10, while figure 12 shows sections on the same locations as figure 7, but determined with the new technique.

Figure 4

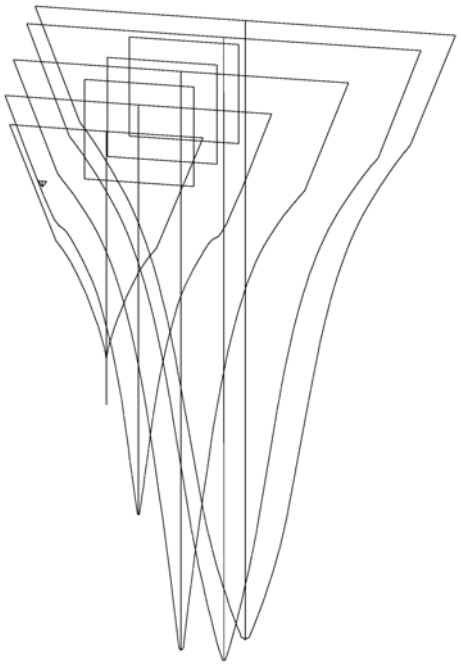
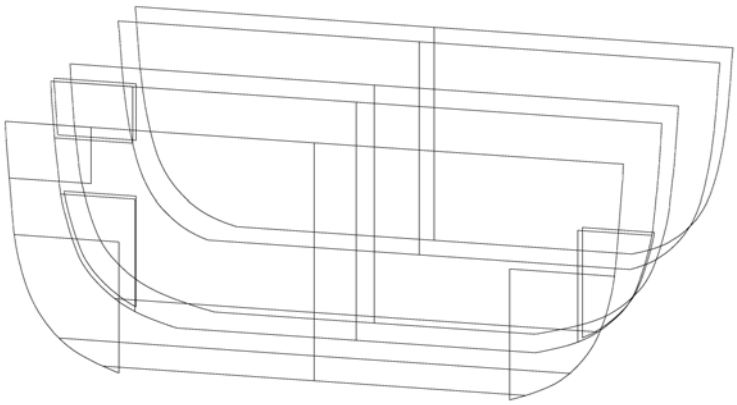


Figure 5



Conventional PIAS drawings compartments

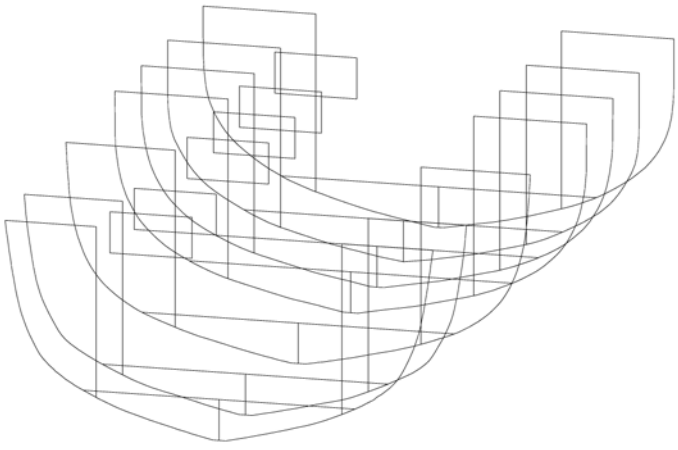


Figure 6

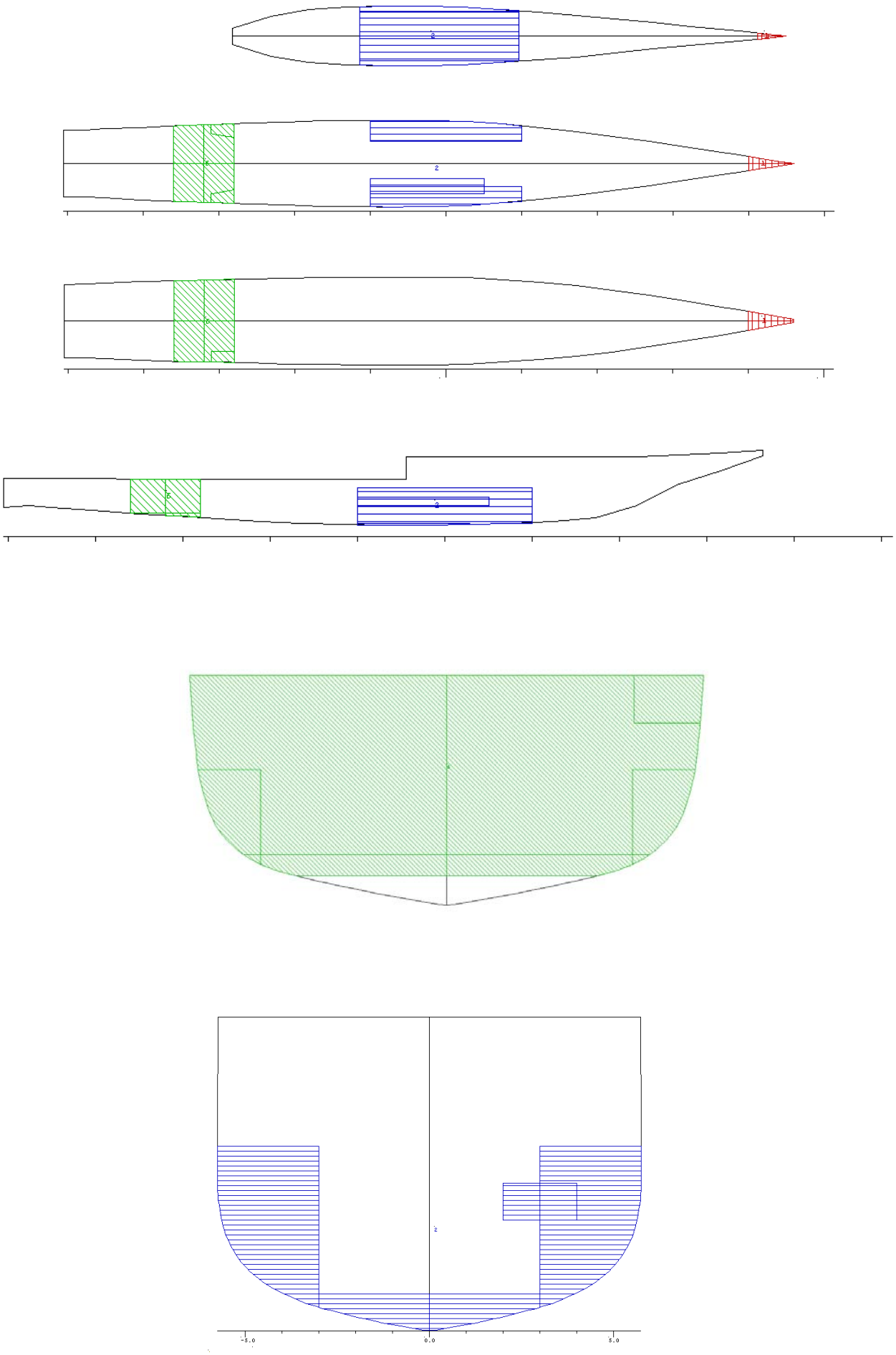


Figure 7 *several sections of the whole vessel, on the basis of that conventional PIAS model*

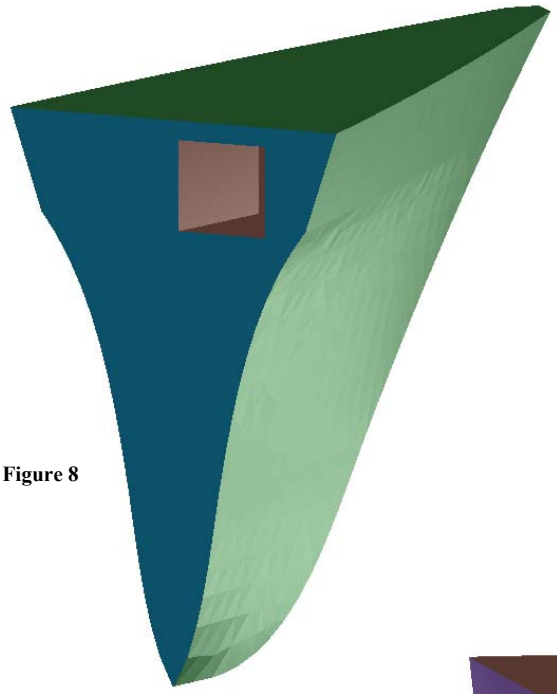


Figure 8

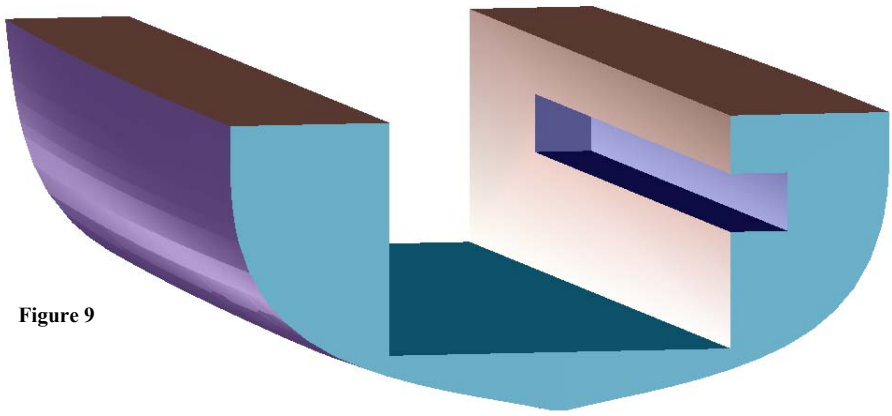


Figure 9

Rendered plots of the compartments which have been composed with solid modelling technique

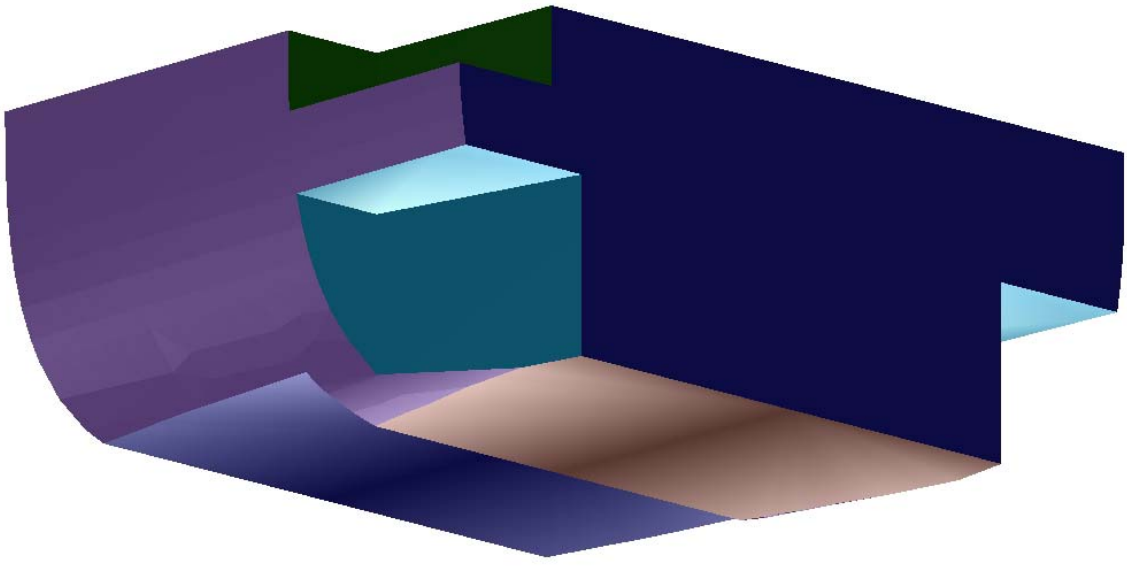


Figure 10

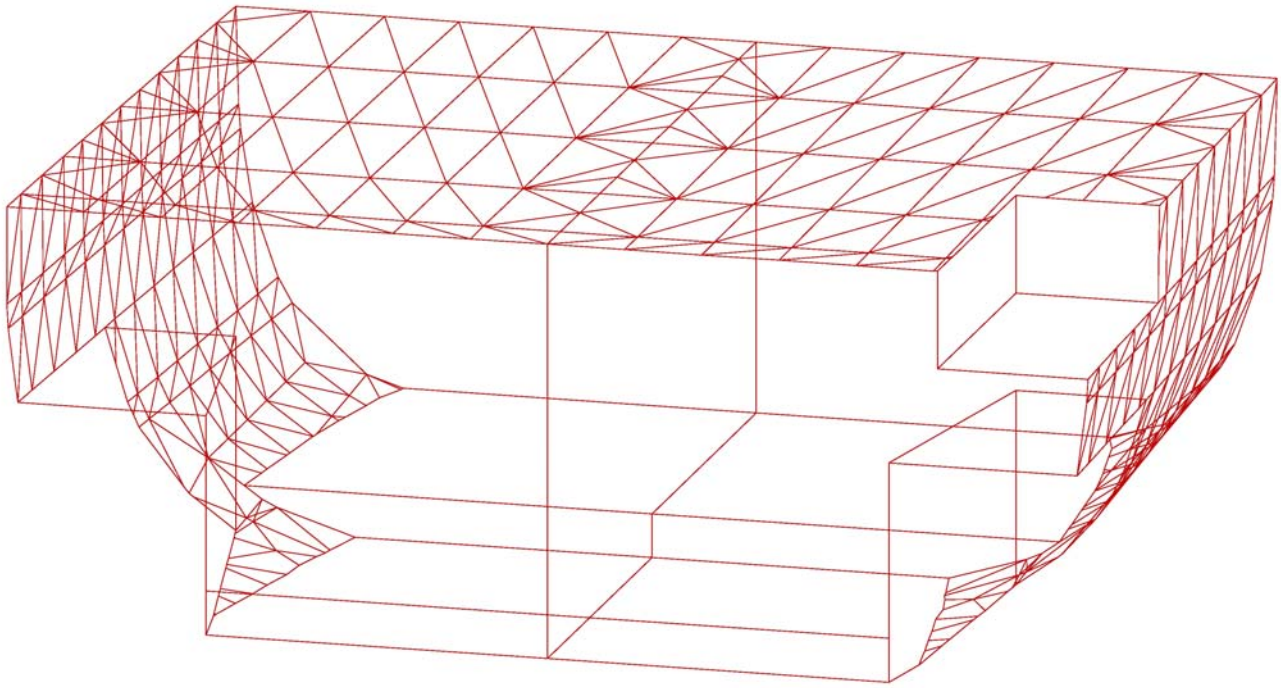


Figure 11 *Wire frame model of the composed engine room composed with solid modelling technique*

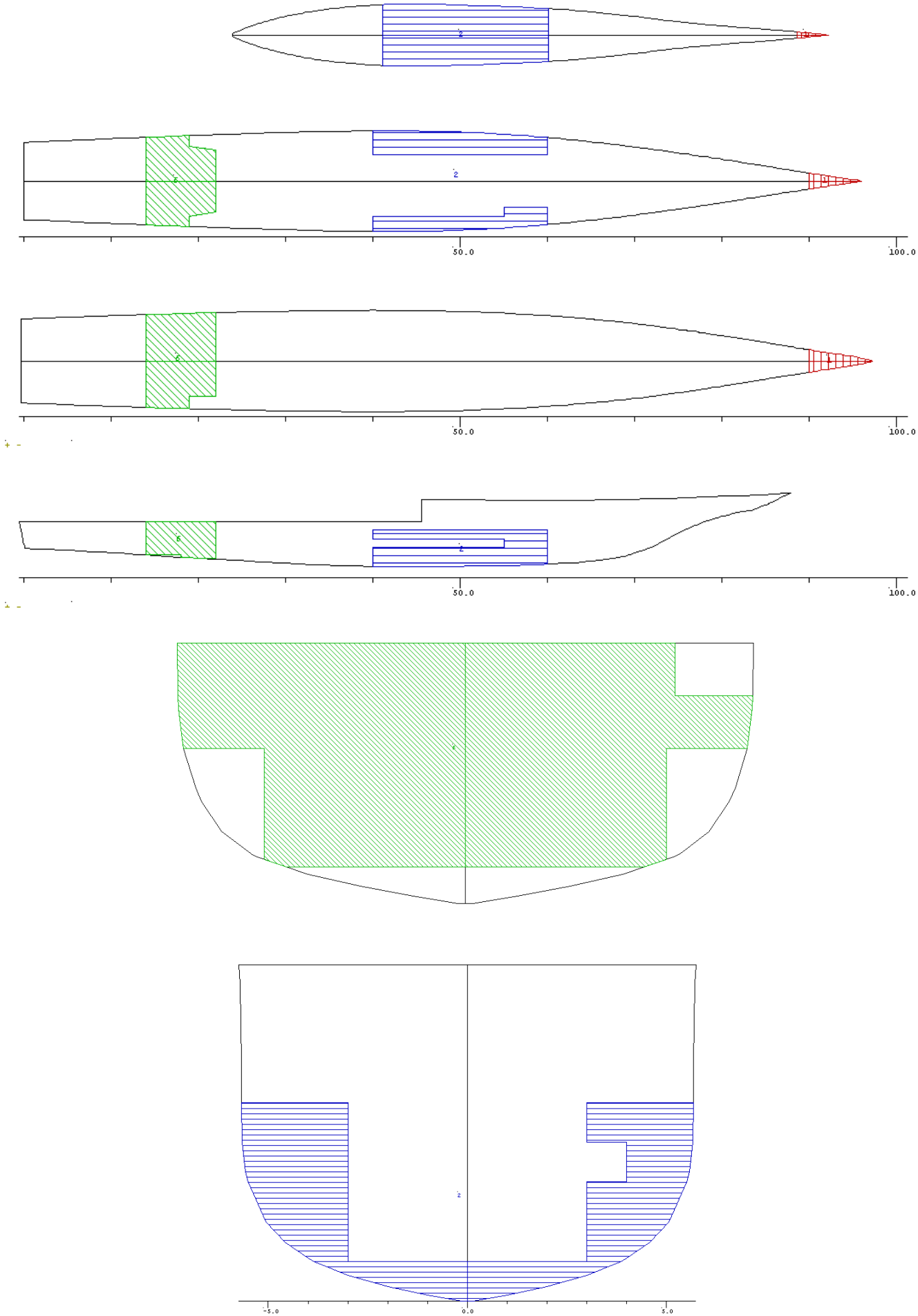


Figure 12 several sections of the whole vessel *composed with solid modelling technique*

Future operation of PIAS

First we would like to notice that it is not our intention to dispose PIAS of its classic procedure, the traditional PIAS model of cross-sections will be supported for a long time. It is to be expected, however, that the new functionalities only will be available if a Fairway solid model is used. The following new functions are among others considered:

- Additional visualization of existing calculations and modelling actions with PIAS.
- Extension of the existing 'reference planes' concept which already exists to support the definition of compartments. Reference planes themselves will be equipped with dimensions and as a consequence coincide with bulkheads and decks.
- Representation of the levels of flooded water in damaged compartments.
- Development of a 'space configuration module' where hull shape, compartments, schematic main equipment as well as loading such as general cargo and containers are modelled and visualized, and possible collisions are being signaled.

Availability

The software presented is still in an experimental stage, many details still have to be finished, and of coursee SARC itself has to test the new procedure in practice. At this moment we expect that the new functionality will be mature enough to be distributed to others after a couple of months.

In due course the new functionality will become available as an additional PIAS module, which can be acquired or not. As soon as this module is available, we will inform you.

We invite anyone interested for a demonstration of this new functionality at our stand at the Europort exhibition 18-22 November 2003, RAI Amsterdam.