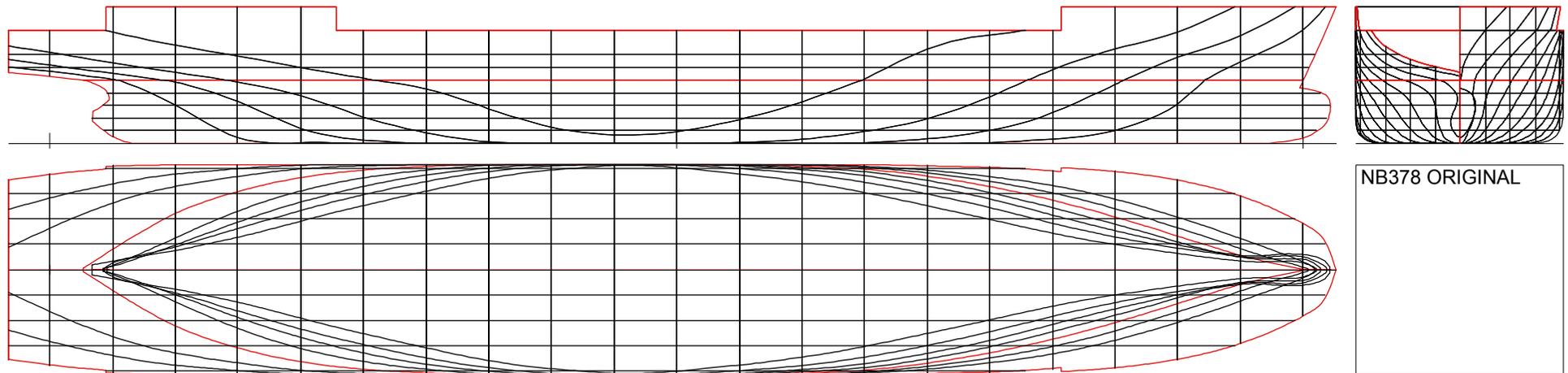

HYSS Manual



Version 2.2 Part 1 - Functions

Installation

The full application Hyss.xls - in the following referred to as the program - consists of one Excel Workbook. The Workbook may be duplicated and placed in any directory. It is run without any installation under the condition that Excel-97 or a later version is installed with macro functionality.

Rights

All rights to the program Hyss, independent of version, inclusive of source code, methods, user interface and documentation is hold by M Huss Naval Architect. Licensed user has the right to make copies of the Hyss.xls Workbook on the computer or workstation to which licence has been agreed. No user has the right to make copies or in any other way distribute the program outside of his terms of licence. Neither has any user the right to decode, read or change the source code of the application.

Disclaim of liability against user or third parties

Every user has the right to, and carries the full responsibility of results obtained by using Hyss.xls. Under no circumstances is any responsibility assumed by the developer or distributor of the program regarding results obtained from it or regarding references to the program or its documentation. This disclaim of liability covers all conditions also including possible errors irrespective of whether they are the result of inaccurate input to the program, inaccurate usage of the program or its documentation, or errors within the program or its documentation, or incompatibility of the computer environment under which the program is run. All usage in whatever possible form is performed under the exclusive responsibility of the user. The user also is obligated to inform any involved third parties of this disclaim of liability.

About the Manual

This manual describes the basic functionality of the program Hyss.xls (Ver.2.2) in its full, **Pro**, edition. Some of the functions are not available in the **Intact** or **Basic** editions. Also dependent on which version of the program and under which operating system or version of Excel it is used, some functions may be different, added or not present compared to this manual. However, in general it should be clear from the context how these possible deviations are to be handled.

Most screen shots in this manual are obtained from Mac OS X. When the program is run under other operating systems, the program buttons and possibly also the screen fonts appear somewhat different but the functionality is not affected by the interface appearance. At present the program calculations are significantly faster when run on a PC under Windows compared to MacOS. This is presumably due to a better integration of Microsoft VBA and operating system. As far as the program has been tested this difference in performance does not affect the precision of results.

All written text as well as all programs may include inaccuracies or errors. This manual and the program Hyss is probably no exception. In the ongoing work of improving and further developing the program and its documentation, it is of great importance to have feed-back from users. All contributions, suggestions or found problems that are reported will be considered in future updates. Please also check the web site for possible bug fixes or upgrades.

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Part 1 - Functions

General

Hyss is an Excel application for calculation of ships hydrostatics and stability. The calculation methods and principles are based on previous versions from 1983 (written for the early home computers in the Basic programming language), from 1985 (for HP workstations written in HP-Basic), and from 1992 (for Macintosh computers written as a Claris Resolve macro). In the totally revised Excel version, every procedure has been rewritten and modernised and completely new extensive procedures for creation, modification and plotting of hull geometries have been added.

All program modules are in this version developed in Microsoft Excel Visual Basic for Application (VBA) and make use of the built-in Excel functionality. By using Excel Sheets both for input and for presentation of results, the user may utilise all standard methods such as Cut/Paste/Copy data, post-processing results, plot diagrams, adjust printouts, save and print just like in any spreadsheet independent of the local computer environment. While this open architecture offers large possibilities, it also is a potential risk. The program procedures require that all positions for input and output cells in the Workbook Hyss.xls remain unchanged but the positions are not locked. Only the subroutines in the VBA macro modules are prohibited from changes. Therefore, before any changes are made in the Hyss.xls Workbook, it is recommended to save it under a new name (which may be chosen by the user). There are no restrictions in how many copies that may be made on the same workstation. The licence restricts, however, the number of permitted users.

Workbooks and Sheets for input, calculations and results

The program modules are assembled in one Workbook with two Sheets to control calculations and an additional number of Sheets to facilitate the work and to define output templates. Besides this main Workbook, at least one additional Workbook is needed containing the geometry description for the ship to be analysed. Results in the form of plot diagrams or results from calculations are placed in new Sheets in an output Workbook. While performing creation, modification or plotting of geometries and calculations these new Sheets may be chosen to be placed within the existing geometry Workbook or may be placed in separate open Workbooks.

All Workbooks and Sheets may be named, saved and moved without restrictions. The file name (including extension .xls) to the used geometry Workbook, is directly referred to from the program Sheet. When several geometry Sheets are to be used (i.e. when analysing damage stability) in one calculation, all these Sheets must be placed in the same Workbook.

Geometry Sheets

The ship geometry is defined with coordinates in a geometry Sheet. There are three different kind of geometry Sheets, Lines, Sections and Calc. All three types have the same general data format but contain different levels of information. The Lines format is primarily used for free modelling of the hull geometry while the Sections format either is used to describe an existing geometry or is created from Lines. Calc is a calculation format which contains essentially the same information as the Sections but in a less compressed form.

Lines

Lines is the most general format for geometry description. In a Lines Sheet, an unlimited number of straight or curved lines are defined by giving x,y,z-coordinates together with information regarding the curvature of the line at the specific coordinate position. The curvature at a point is defined by spline functions which accounts for the surrounding coordinate points and is guided by four local curvature parameters, tangent length backward, tangent length forward, direction backward and direction forward. With the tangent lengths =1 and the directions =0, a smoothly adjusted curvature is achieved relative to the surrounding points; with the tangent lengths =0 the point will be a knuckle (directions are not applicable); with the tangent lengths = 1 and the directions = 1, the tangent at the point will be directed towards the forward (next) point; with the directions = -1, the tangent will be directed toward the backward (previous) point. Both length and direction may be given as decimal numbers allowing for local adjustments of the curvature along the line. If the direction forward differs from the direction backward, the line will be knuckled at the point but may still continue as curved on both side.

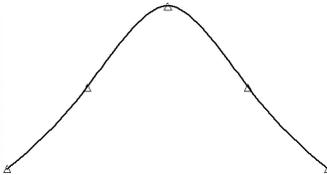
Since the mathematical description of lines is parametric, there are basically no restrictions regarding closed or self-crossing lines. The user may in HyssLines chose between ordinary parametric cubic B-spline functions to model the line curvature, or more advanced parametric trigonometric spline functions, here called H-splines, developed uniquely for this program. The latter gives somewhat more smooth curves and may represent perfectly circular forms with only a very limited number of coordinate points.

Curvature parameters

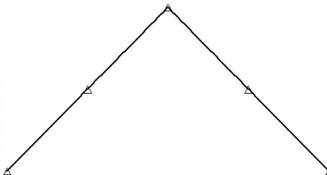
The form of a curved line at a specific point is guided by the point coordinates and curvature parameters together with the coordinates and parameters of the four closest surrounding points (two on each side). The examples below illustrate the influence from the local curve parameters. In all examples, the coordinates for all five points are the same, only the third points tangent length and directions are adjusted.

Variation of tangent length:

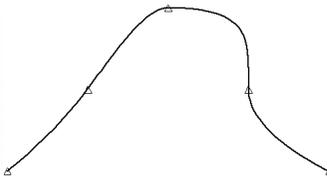
x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	1	1	0	0
9	3	0	1	1	0	0
12	0	0	0	0	0	0



x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	0	0	0	0
9	3	0	1	1	0	0
12	0	0	0	0	0	0

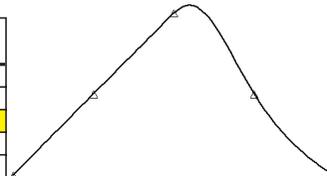


x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	1	4	0	0
9	3	0	1	1	0	0
12	0	0	0	0	0	0

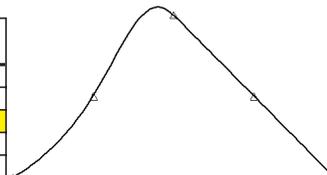


Variation of tangent direction:

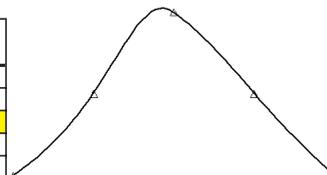
x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	1	1	-1	-1
9	3	0	1	1	0	0
12	0	0	0	0	0	0



x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	1	1	1	1
9	3	0	1	1	0	0
12	0	0	0	0	0	0



x	y	z	tan length backw	tan length fwd	tan direct. bwd	tan direct. fwd
0	0	0	0	0	0	0
3	3	0	1	1	0	0
6	6	0	1	1	0.5	0.5
9	3	0	1	1	0	0
12	0	0	0	0	0	0



Sections

Sections is a geometry description which may be seen as a limited Lines description consisting of curved or straight lines (sections) in the y,z-plane, i.e. lines with constant x-coordinate. A Sections Sheet may be created from a Lines Sheet by cutting through all the lines at specified x-coordinates. The cross-points will then be the coordinate points for the created section. To make it possible to create Sections from Lines in a consistent way, all Lines have to be given in the order that follows the contour of the section. Furthermore, the curvature parameters that shall be given to the sections coordinate point must be defined, and all lines must be uniquely defined at the x-coordinate in question. For this reason each line must be defined with increasing x-coordinate within the length for which they

shall be valid for section cutting. Each line must also be addressed specific curvature parameters (tangent length and direction) that are applied to the sections created at the cross-point.

Calc

Calc is a subform of Sections geometry description used for calculations of hydrostatics and stability. The sections in a Calc Sheet are defined in the same way as the sections in a Sections Sheet but the line segments between coordinate points are straight (no curvature). A Calc section equals thus a Sections section with knuckles at every point. Since Calc line segments always are straight, no curvature parameters are needed (or used) in a Calc Sheet. A Calc Sheet may be created from a Sections Sheet by dividing all curved lines in a specified number of straight segments.

Usage of the different geometry descriptions

To illustrate the purpose and differences between the different geometry Sheets, let us assume a realistic case when a ship hull form is to be modelled based on an offset-table, with half-breadth values (y-coordinates) given for different sections (x-coordinates) and waterlines (z-coordinates), together with an ordinary lines drawing.

If a complete geometric model is the goal, we will start by making a new Lines Sheet in which coordinates for a number of longitudinal characteristic lines are entered. These lines may represent the centerline with stern and stem contours, diagonal lines in the order from bottom and upwards along the side of the hull (alternatively waterlines), the deck knuckle, watertight superstructure and the centerline at deck. By plotting these lines from different perspectives we may check smoothness and if necessary adjust the curvature parameters. When the first lines are acceptable smooth, we may mirror them

by the centerline plane and thus create a complete hull description in this first step.

The next step will be to cut out sections from the Lines description and put them in a new Sections Sheet. This can be automatically done by one single command from the HyssLines program module, just by specifying the number of sections and the x-coordinate at which they shall be created. With further plotting these sections may be checked with regard to their smoothness and if necessary the curvature for the cross-points with the lines may be modified by changes in the lines type definition. When the sections form is found to be correct, one or several final Sections Sheets may easily be created representing the main hull and various compartments and integrated tanks. At this stage it is also possible to adjust the distance between sections locally in order to optimize the representation of changes in the hull form along the ships length. Closely spaced sections should be used in parts where the form changes rapidly such as the aft and fore body while a more spares division may be used around amidships.

The final step in the process of making a geometry description that is to be used for hydrostatic calculations, is to transfer the curved sections into Calc sections consisting of straight line segments. This is easily done from HyssLines just by specifying the number of segments each curve shall be divided into. It is also at this stage possible to limit the geometry by bulkheads and decks, and thereby creating small compartments. Every new file created will be stored in an own Sheet of the Calc type.

A basically more simple geometry description may be made by directly enter the offset coordinates in a Sections Sheet and adjusting the curve parameters for these, section by section. These sections give a less complete form description since they cannot be placed or spaced individually according to the hull form variation. However, if necessary they may be supplemented by a few

extra sections directly taken from the lines drawing. This input Sections Sheet may be used in the same way as above to create Calc Sheets for calculations.

The most simplified alternative would be to directly input offset data into the Calc Sheet. The hull geometry would then be represented by straight lines between all offset points. Reasonable accuracy with this approach can only be achieved if the offset table is very detailed, i.e. there are a large number of waterline coordinates specified in the offset table. Still the drawback would be that by this method, the precision may not be increased and the smoothness cannot be checked or adjusted.

All three kind of geometry Sheets, Lines, Sections and Calc, use the same principal input format and can thus be treated in the same way regarding input and plotting. It is even possible to change the Sheet type just by changing the denomination. (However, obviously no extra information will be available just by changing the type). The difference is that part of the information is not available or used in the more simple geometry Sheets; e.g. in Sections is not the variation of x-coordinate along a line used, and in Calc is furthermore no curvature parameters used (even in the case when they are given). The input format is described in detail in a separate Sheet named **Lines_template** in the program Workbook. A few example of different geometry Sheets are given in the examples in a separate part of this manual.

Program Sheets

The user interface in the program Sheets **HyssLines** and **HyssCalc** consists of coloured cells and buttons to control plotting, modifications of geometry and calculations. Red cells are used to give names of Workbooks and Sheets to be used in the calculations. Blue cells are used to give general data, often concerning all other activities initiated from the program Sheet. Green cells are used for information text input such as Titles. Yellow cells are used for more specific data concerning a single operation. Yellow cells are usually connected to one single program button placed in the vicinity of the input cell.

HyssLines

The left part of **HyssLines** contains general data used by all geometry procedures.

HyssLines	Pro
Geom. Workbook:	NB378.xls
Output Workbook:	Revision 2
Plot Workbook:	Revision 2
SplineType H/B:	H
General Plotdata:	
rotx (deg):	105
roty (deg):	0
rotz (deg):	30
Range update? (Y/N):	Y
xmin (m):	-4.982
xmax (m):	153.877
ymin (m):	-12.500
ymax (m):	12.500
zmin (m):	0.000
zmax (m):	16.216
Plot xscale:	1
yscale:	1
zscale:	1
No of segments:	6
Points size:	0
Line Weight (pt):	0.4
1/View distance:	0.6
Plot Title:	Hold No 4
Mean draught (m):	
trim (m):	
heel (deg):	
Plot coord? (Y/N):	N
Bounding box? (Y/N):	N
Print Plotdata? (Y/N):	N

Geom. Workbook: (string)

specifies the name of the Workbook in which all used geometry Sheets shall be stored.

Output Workbook: (string)

specifies the name of the Workbook into which new created geometry Sheets shall be stored (if no input is given, results are stored in the Geom. Workbook).

Plot Workbook: (string)

specifies the name of the Workbook into which new created plot Sheets shall be stored (if no input is given, plots are stored in the Geom. Workbook)..

SplineType H/B: (string)

H (default) specifies that H-splines are used for curve generation, B specifies that B-splines are used.

rotx (deg): (number)

...

specify the rotation in degrees around the x-, y- and z-axis for plotting in different perspectives.

Range update? (Y/N): (string)

specify if the plot range is to be updated automatically based on the range of the first Sheet.

xmin (m): (number)

...

specify limitations of part of the geometry to be plotted. When no input is given the first Sheet is used for defining the appropriate min and max values.

Plot xscale: (number), ...

specify plot scaling factors for the three main coordinate directions.

No of segments: (integer)

specifies the number of segments in which curved lines are divided between coordinate points. Straight lines are always represented by one single segment.

Point size: (integer)

specifies the size of marks (in points) to be used when plotting specific coordinate points (if the given size is below 3pt, no marks will be plotted).

Line Weight (pt): (number)

specifies the thickness of plotted lines (in points), supporting lines are plotted with half the specified thickness.

1/View distance: (number)

specifies the amount of perspective distortion. A value of 0 will give no distortion at all and the maximum value 1.5 will give a fish-eye perspective.

Plot Title: (string)

specifies a single text row that will be placed at the top of plot Sheets.

Mean draught (m): (number)

trim (m): (number)

heel (deg): (number)

is only to be specified if marking lines are to be plotted at the intersection between geometry lines and the waterline.

Plot coord? (Y/N): (string)
 Bounding box? (Y/N): (string)
 Print Plotdata? (Y/N): (string)

specify additional information to be plotted; system of coordinates, a box that shows the plot range and print-out in the plot of the used general plot data.

Plot 1st Sheet

1st Sheet:

No of Lines:

From LineNo:

LineNo 01:

LineNo 02:

LineNo 03:

Plot 1st Sheet: This button is used for plotting all kind of geometry Sheets (Lines, Sections and Calc). The button creates a new Sheet (in the Plot Workbook) with a plot of the specified geometry (1st Sheet: (string)). If only a limited number of the lines are to be plotted, the number can be specified (No of Lines: (integer)) together with either the first line in a sequence (From Line No: (integer)) or by separately specified line numbers to be plotted (LineNo 01: (integer) ...).

Note that the lines specified to be plotted by the **Plot 1st Sheet** button also will be plotted together with other lines or sections initiated by other buttons in the HyssLines interface. In this way it is possible to plot sections together with e.g. specified contour lines for stern, keel, stem and deck. If the lines specified for the first Sheet is not to be added to other plots, No of Lines: shall be specified to 0.

Also note that it is the line coordinates in this first Sheet that will be decisive for the general min and max values if no specified values are given in the blue cells.

This 1st Sheet is finally used for specifying the complete Lines Sheet from which Sections (or waterlines/buttocks) is cut. In this function no other specified limitation of the number of lines is used.

Add from 1st to EditLines

Clear EditLines

Add from 1st to EditLines / Clear EditLines: The first button copy one or several lines from 1st Sheet and add it to the Hyss Sheet **EditLines** where the geometry can be analysed (or modified). The second button removes all previous lines from **EditLines**. See more about the use of **EditLines** below.

Add from 1st to Target

Target Sheet:

Add from 1st to Target: The button enables to build a geometry Sheet by adding one or more lines from the above given 1st Sheet to another existing or new Target Sheet: (string). The lines to be added are specified in the same way as when plotting lines from 1st Sheet. Added lines are placed at the end of the target Sheet. As long as all lines are of the same type (Lines, Sections or Calc) the target Sheet is assigned the same type, if lines of a different type are added, the target Sheet will automatically be assigned the Lines format. If no Target Sheet: is specified, a new Sheet will be created of the same type as the 1st Sheet.

When lines are added, their coordinates will automatically be transformed to a coordinate system with (xAP, yCL and zKL) placed in (0, 0, 0). The function may therefore also be used for moving a full geometry or a single line within a geometry.

Mirror in CL; Double

Mirror in CL; Switch

Sheet:

Mirror in CL; Double / Switch: The **Double** button mirrors all lines in the specified Sheet in the CL-plane (y-z-plane) and creates a new Sheet with the original and the mirrored lines together. The mirroring method is automatically adjusted to suit the Sheet format. When a Lines Sheet is mirror-doubled then the number of lines will be doubled, when a Sections or Calc Sheet is mirrored-doubled, the number of sections will not change but the sections are extended from a half body to the full body.

When a Sheet is mirrored-switched then the geometry switch sides so that port side becomes starboard and v.v. This function is convenient for e.g. creating symmetric tanks. A starboard tank can be used to create an identical port side tank by just one click on the button.

Cut Sections, WLs, Btks & Plot Full Drawing from 1st

Cut Sections, WLs, Btks Plot Full Drawing from 1st: With this button, a number of different procedures (buttons) are executed. Input data to all these must first have been entered according to below. The button is a shortcut to get a first quick check of how well a Lines model is faired by plotting a traditional lines drawing. After the plot has been created the user is asked if the different temporary Sheets may be deleted. Note that this function is only working if the Output Workbook is assigned the same as the Geometry Workbook.

Plot Full Drawing (+1st)

Section Sheet:	Sections 21
WL Sheet:	WL 08
Btk Sheet:	BTK 04

Plot Full Drawing (+1st): The button creates a traditional lines drawing with profile, waterlines and sections drawings in a common scale. If a 1st Sheet is specified, it will be included in all three views. (If this is not desired, No of Lines: 0 are to be specified). The plot rotations and view distance given under general plot data are not used in conjunction with this procedure.

Plot Entire Sheets (+1st)

No of Sheets:	2
Sheet 01:	Hold03Calc
Sheet 02:	T03PCalc

Plot Entire Sheets (+1st): This button is used for plotting several geometry Sheets together in the same plot with the same perspective and scale. No of Sheets: (integer) specifies the number of geometry Sheets to be plotted together with the 1st Sheet specified below the **Plot 1st Sheet** button. Sheet 01: (string), Sheet 02: (string), ... specify the names of the Sheets to be plotted.

Cut Sections from 1st Sheet

No of sections:	86
xmin (m):	-6
xstep (m):	2
Add to Sheet:	
Add after sectNo:	

Cut Sections from 1st Sheet: This button creates Sections from a Lines Sheet by cutting the lines at the specified x-coordinates. (The Lines Sheet to be used shall be specified in the 1st Sheet: field below the **Plot 1st Sheet** button).

No of sections: (integer)

specifies the number of sections to be created

xmin (m): (number)

specifies the x-coordinate for the first new section

xstep (m): (number)

specifies the distance between new created sections

Add to Sheet: (string)

specifies the name of an existing Sections Sheet to which the created sections are to be added. The new sections will be placed after the existing and must therefore have larger x-coordinates. (If no name is specified, the new sections will be placed in a new Sections Sheet).

Add after sections: (integer)

specifies the section number in an existing Sections Sheet after which the new sections shall be inserted. (Is only relevant if sections are to be added to an existing Sheet)

Cut WL from Sections + 1st**Cut Btks from Sections + 1st****Plot Sections Drawing (+1st)**

Section Sheet:	Sections 86
x amidships (m):	68
No of Waterlines:	8
WL min (m):	1.2
WL step (m):	1.2
No of Buttocks:	5
Btk step (m):	2.4

Cut WLines from Sections + 1st: This button creates a Lines Sheet from a Sections or Calc Sheet by cutting through the sections at equally spaced z-coordinates. If the sections are created from a Lines definition of the hull, the original Lines Sheet may be given as 1st Sheet and the cross-points with these lines will also be added.

Note that this function does not guarantee the correct curvature at the cross-points along the created waterlines. Thus, to achieve well faired waterlines they may have to be supplemented with curvature parameters and possibly also with extra points. The waterline points are picked from the first cross-point with the section which means that only waterlines for a half hull is created. For multi-hulls or hulls with skegs this function is generally not fully applicable.

Cut Btks from Sections + 1st: This button creates buttocks in the same way as waterlines and with the same restrictions

Plot Sections Drawing + 1st: The button creates a standard sections drawing with the possibility to include a grid of waterlines and buttocks. Aft sections are plotted to the left side of the CL and sections forward of amidships to the right. (If No of Lines: has not

been specified to 0 below the **Plot 1st Sheet** button, also these lines will be plotted but not separated to aft and fore side).

Common input to all three buttons are:

Sections Sheet: (string)

specifies the name of the Sections or Calc Sheet to be plotted

x amidships (m): (number)

specifies the x-coordinate that divides aft body from fore body in the sections drawing. Default value is $L_{pp}/2$, (only used for sections drawing).

No of Waterlines: (integer)

specifies the number of waterlines to be plotted or created.

WL min (m): (number)

specifies the z-coordinate for the lowest waterline

WL step (m): (number)

specifies the distance between waterlines

No of Buttocks: (integer)

specifies the number of buttocks to be plotted or created (in addition to the centerline).

Btk step (m): (number)

specifies the distance between buttocks from the centerline.

Stretch & Scale Sheet Coordinates	
Sheet:	ContourLines
original xfull, m0 (m):	
new xfull, m1 (m):	
fullness stretch, s2:	
xscale:	
yscale:	
zscale:	1.023

Stretch & Scale Sheet Coordinates: This button creates a copy of an existing geometry Sheet but with stretched and/or scaled coordinates. Stretching can be applied for changing the fullness (slenderness) and/or the longitudinal center of buoyancy without changing the main dimensions. Scaling, on the other hand, changes the main dimensions without changing the form coefficients. Stretching is performed by moving x-coordinates according to functions that, as far as possible, maintain a smooth hull form. The stretching parameters necessary to obtain a specific displacement and LCB may be calculated from HyssCalc and is then automatically transferred to HyssLines.

Stretching or scaling may be applied to any kind of geometry Sheet, Lines, Sections or Calc. However, if a geometry is originally created from Lines, it is preferable to stretch or scale the original Lines Sheet rather than its derivatives in terms of Sections or Calc. In this way the full 3D information is kept within the scaled geometry.

Sheet: (string)

specifies the name of the geometry Sheet to be stretched or scaled.

original xfull, m0 (m): (number)

specifies the original longitudinal position of the full section.

new xfull, m1 (m): (number)

specifies the new longitudinal position of the full section (after stretching and/or scaling).

fullness stretch, s2: (number)

specifies the amount of increased fullness. It is recommended to calculate the parameter s2 from HyssCalc, but as a guideline for trial and error, the maximum stretch, if m1 is kept equal to m0, at any position will be in the order of 25% of s2.

xscale: (number)

yscale: (number)

zscale: (number)

specifies the factors for scaling. If no value is given for any of the x,y or z direction, the factor is default taken as 1.

Create Calc from Sections

Section/Calc Sheet:	Hold03Sec
No of segments:	4
Plane limits:	
xmin (m):	
xmax (m):	
Plane limits at xmin:	
yplmin (m):	
yplmax (m):	
zplmin (m):	1.5
zplmax (m):	13.4290541
Plane limits at xmax:	
yplmin (m):	
yplmax (m):	
zplmin (m):	1.5
zplmax (m):	13.4290541

Create Calc from Sections: The button transforms a Sections (or Calc) Sheet to a new Calc Sheet by dividing all curved lines into straight line segments.

While transforming Sections into Calc it is possible to include transverse and vertical limitations (y- and z-limitations) as in decks and longitudinal bulkheads. Note that it is not possible at this stage to introduce transverse bulkheads (x-limitations), these should be introduced already when creating the original Sections Sheet.

Sections Sheet: (string)

specifies the name of the original Sections Sheet to be transformed.

No of segments: (integer)

specifies the number of straight segments that each curved line segment shall be divided into.

In the case when geometrical limitations are introduced, the following additional data are given:

xmin (m): (number)

specifies the aftmost x-coordinates where y and/or z limitations are to start.

xmax (m): (number)

specifies the foremost x-coordinate where limitations are to end. (If no values are given for xmin and xmax, the limitations act from the first section to the last).

Plane limits at xmin:

yplmin (m): (number)

specifies the lower y-limitation at xmin (i.e. limitation to starboard since positive y-direction is portwise).

yplmax (m): (number)

specifies the higher (to port side) y-limitation at xmin. Similar input are given for z-limitations at xmin and for y- and z-limitations at xmax. (If no values are given, no limitations are introduced).

Since Sections and Calc Sheets use the same general format, different limitations may be introduced to different parts of the geometry by repeating the operation. In this way it is possible to introduce several steps in decks and bulkheads.

EditLines

The Sheet **EditLines** is a very simple tool for check and modification of geometry coordinate input. From **HyssLines**, any line (including sections from Sheet of type Sections or Calc) or number of lines may be transferred (added) to the Sheet **EditLines**. The three Excel diagrams then present these lines in the three main orthogonal projection planes; y-x, z-y and z-x.

After clicking on a point on a line in any of the three projections, its coordinates will be visible and the point may be dragged to a new position in that diagram. The source coordinates which are presented at the side will be updated consequently and the other diagrams will instantly reflect the change.

In order to avoid mistakes, there are no automatic way of transferring the changes back to the original Sheet. However, the adjusted coordinates may be Copied and Pasted back manually.

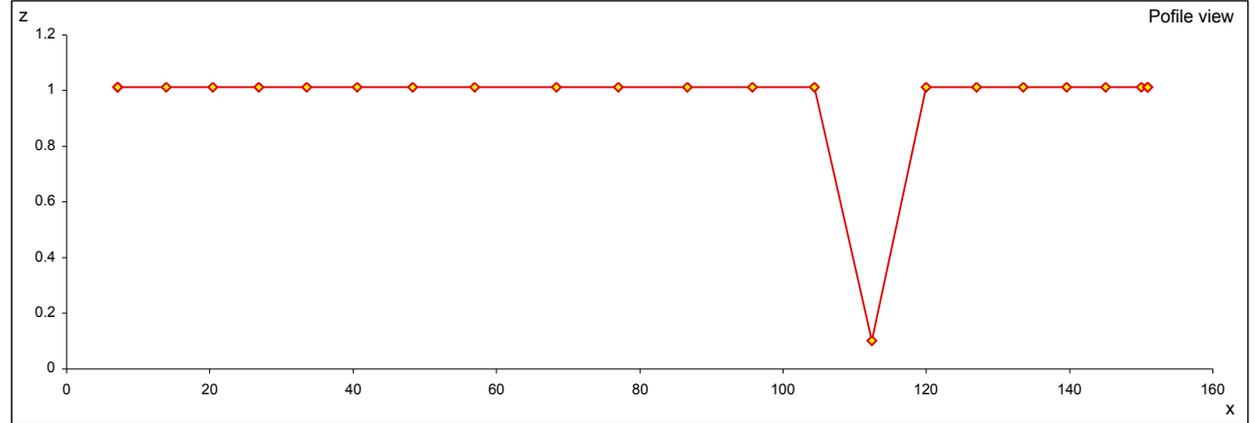
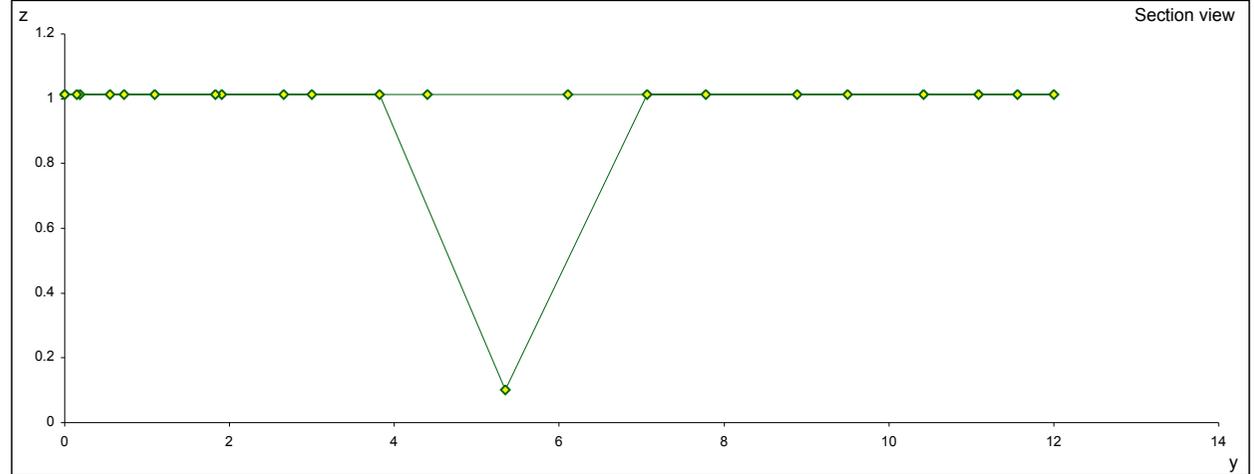
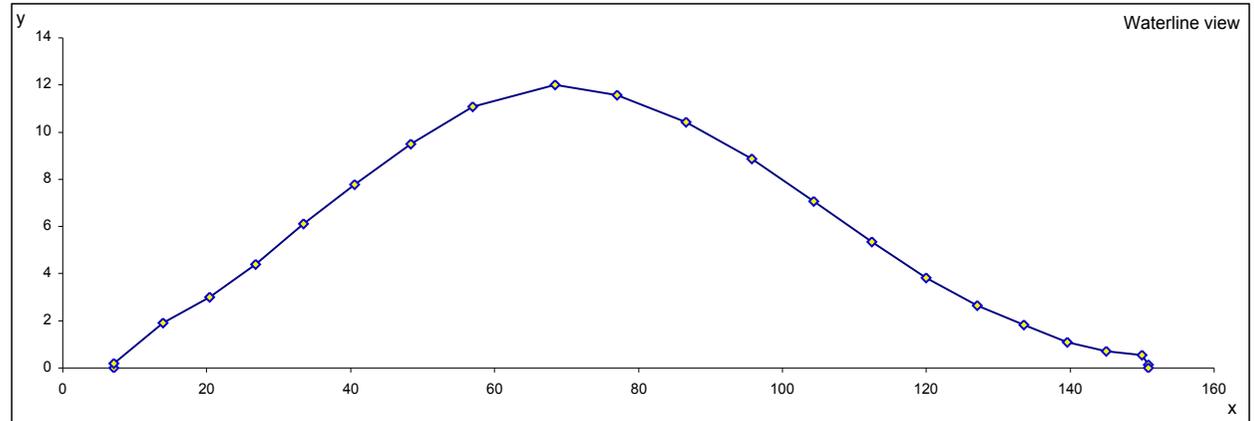
The figure at side here shows an example of a waterline which have been entered with one misprint of decimal in one z-coordinate. The error is not visible in the ordinary waterline view (y-z projection) but is very obvious in the two other projections. The most easy way to correct this error is to go back to the original Sheet and enter the correct z-coordinate.

When the check is done, a click on the **Clear EditLine** button will remove the coordinates.

1st Sheet:	Lines
No of Lines:	1
From LineNo:	
LineNo 01:	7
LineNo 02:	
LineNo 03:	
LineNo 04:	
LineNo 05:	
LineNo 06:	
LineNo 07:	
LineNo 08:	
LineNo 09:	
LineNo 10:	

Add from 1st to EditLines

Clear EditLines



HyssCalc

General data for calculations

HyssCalc		Pro	
Geom. Workbook:	NB378.xls	(Title 1):	
Output Workbook:	PrelStab03.xls	(Title 2):	Preliminary
Hull & Compartments:			
No of Calc Sheets:	3	PermVol:	(Name:)
(Main)Sheet 01:	HullCalc	1	Hull
Sheet 02:	RudderCalc	1	Rudder
Sheet 03:	BowTCalc	-0.88	BowThruster
Sheet 04:			
Sheet 05:			
Sheet 06:			
Sheet 07:			
Sheet 08:			
Sheet 09:			
Sheet 10:			
Sheet 11:			
Sheet 12:			

Output Workbook: (string)

specifies the name of the Workbook in which all result Sheets will be assembled. The Output Workbook must be an open Workbook.

Dens SW:	1.025
itermax:	20
eps:	0.001

(Title 1): (string)

specifies the main title to be printed in the header of all output Sheets. If no Title 1 is given, the geometry name and Lpp will be printed as Title 1.

(Title 2): (string)

specifies an optional second title to be printed.

Dens SW: (number)

specifies the density of sea water in ton/m³ and is used for all calculations of weight.

itermax: (integer)

specifies the maximum number of iterations to be used for calculation of load conditions with free trim and/or heel.

eps: (number)

specifies the precision in calculations and iterations

itermax may be adjusted if convergence problems occur while the parameter eps normally shall be kept to its default value 0.001.

No of Calc Sheets: (integer)

specifies the number of geometry (Calc) Sheets to be used in calculations (at least 1).

(Main)Sheet 01: (string)

specifies the name of the first Calc Sheet (usually the main hull geometry). The definition of Lpp is taken from this first Sheet.

Sheet 02: (string), ...

specify additional Calc Sheets (e.g. different compartments for damage stability calculations or hull appendices).

PermVol: (number)

specifies the volume permeability for the related geometry Sheet. If PermVol:>0 the geometry will add to the displacement, if PermVol:<0 the geometry will subtract from the displacement (flooded geometry). Note that if two geometries intersect, their permeability (displacement or amount of flooding) will be added in the overlapped part.

(Name:): (string)

specify a name for each geometry Sheet. This name will be used when printing compartment displacements in the output Sheets

Geom. Workbook: (string)

specifies the name of the Workbook in which all geometry Sheets used in calculations must be assembled

Setting Buttons

Edit Crit No:	1
Save as No:	Criteria Set
	2
Edit LC No:	1
Save as No:	Load Cond.
	19
Edit WD No:	12
Save as No:	W/ Distr.
	12
Edit TC No:	2
Save as No:	Tank Cond.
	19

The column of setting buttons consists of buttons in pairs which enables to define an unlimited number of preset input for calculations. If a new set is to be defined, the button **Edit ...** is pressed without giving any number in the yellow edit field. The input format for that setting will then appear to the right and new data may be added. By default the input format will consist of the last given input. If an existing set is to be edited, the number of that set is given to the right of the **Edit ...** button.

After the complete input has been entered or changed, an integer number is given in the yellow set field, the adjacent **Save as No:** button is pressed and the data will be saved in the **CalcSettings** Sheet within the Hyss Workbook.

The content of different settings are presented in the following.

Calculation Buttons

Hyd.table	Exec
Hyd.loadcase	Exec
Hyd.special	Exec
Stab.KN-table	Exec
Stab.loadcase	Exec
Stab.special	Exec
Tank capacity	Exec
Stretch Geom.	Exec
Power	Exec

The column of calculation buttons consists also of buttons in pairs. The left button fetches the relevant input format for the calculation and the right **Exec** button executes the calculations with the given input. The **Exec** button does only work after the correct input format has been activated. Each time a new input format is chosen (with the left button) the previous given input is stored locally within the **CalcSettings** Sheet in order to facilitate to repeat calculations or adjust previous calculation input.

CalcSettings Sheet

The **CalcSettings** Sheet consists of all the settings and the last input for all calculations. If previous input is to be stored to another session the **CalcSettings** Sheet may be copied to the geometry Workbook and copied back to the Hyss Workbook at the beginning of the new session, replacing the default **CalcSettings** Sheet. There must always be one **CalcSettings** Sheet present within the Hyss Workbook and no other name except **CalcSettings** is accepted for that Sheet.

Output formatting

The following pages show examples of input and output for the different settings and calculation alternatives. The format of result tables is defined by templates in the Hyss.xls Workbook. These templates may be reformatted by the user by changing the text font, type and size, justification and number format in the output cells. Note that the printouts from these result Sheets may appear different depending on the platform and the printer settings.

The position of the various output items must not be changed in the templates since the program uses fixed cell addresses for results. However, when a result Sheet has been created after a calculation it may be further formatted and the cells, columns and rows may be copied or repositioned for further postprocessing in Excel.

All results are stored with the highest precision even if the standard number format only shows a limited decimal number.

Formatting is further discussed under the section **Customize Hyss.xls**.

Criteria settings

Edit Crit No:

Save as No:

One set of Criteria includes definitions of critical points, margin lines and stability criteria. When all relevant data has been entered, the set is saved by entering a set number to the right of the **Save as No:** button and then press the button. Additional criteria settings may be entered and saved under other numbers or edited and resaved under the same number. Note that there will be no warning if a new set is saved under a number that already exist.

The input fields should be self explanatory. The yellow fields to the right of the stability criteria are used for specifying which criteria will be analysed and in which order they will be printed. A maximum of 12 criteria may be analysed and printed in one calculation.

Criteria sets may be referred to from calculations of the following types:

Hyd.loadcase (critical points)

Hyd.special (critical points)

Stab.KN-tables (critical points and criteria)

Stab.loadcase (critical points and criteria)

Critical Points and Stability Criteria

Crit No: 1 Critical Points: No of Cr.Pts: <input type="text" value="7"/>				Stability Criteria: Note: range of heel: 0°-70° Mark up to 12 criteria to be evaluated:			
Name: x: (+) y: z:				Intact Stability Code Standard criteria: Crit No:			
Pilot dr	22	12.5	13.45	3.1.2.1: $GZa(0^\circ-30^\circ) > 0.055$ mrad	<input type="text" value="40"/>	<input type="text" value="1"/>	
Hatch 3a	36	10.5	14.7	$GZa(0^\circ-30^\circ) > 0.090$ mrad	<input type="text" value="40"/>	<input type="text" value="2"/>	
Hatch 3f	59	10.5	14.7	$GZa(30^\circ-70^\circ) > 0.030$ mrad	<input type="text" value="40"/>	<input type="text" value="3"/>	
Hatch 2a	63	10.5	14.7	3.1.2.2: $GZ(\theta > 30^\circ) > 0.20$ m		<input type="text" value="4"/>	
Hatch 2f	86	10.5	14.7	3.1.2.3: $a(GZ_{max}) > 30^\circ$		<input type="text" value="5"/>	
Hatch 1a	90	10.5	14.7	$a(GZ_{max}) > 25^\circ$		<input type="text" value="6"/>	
Hatch 1f	113	10.5	14.7	3.1.2.4: $GMo > 0.15$ m		<input type="text" value="7"/>	
Cr.Pt 08				3.1.2.5: Equil. angle $< 10^\circ$ at Pass. Moment:			
Cr.Pt 09				Upright max moment: <input type="text"/> (tonm)			
Cr.Pt 10				3.1.2.6: Equil. angle $< 10^\circ$ at Turning Moment:			
				Const max moment: <input type="text"/> (tonm)			
				3.2.2.1: Severe wind and rolling criteria:			
				P (Pa): <input type="text" value="504"/> z A(m): <input type="text" value="13"/> (abv KLI)			
				A (m ²): <input type="text" value="1500"/> Ak (m ²): <input type="text" value="70"/>			
				Limit flood. angle, af: <input type="text" value="50"/> (deg)		<input type="text" value="9"/>	
				4.5.6.2: Equiv. criteria Supply Vessels:			
				Limit flood. angle, af: <input type="text" value="40"/> (deg)			
Note: Critical Points are not automatically accounted for in stability criteria ! Positive (+) y for the down-heeling side							
Margin Line Points: No of M.Line Pts: <input type="text" value="14"/>				Additional user defined criteria:			
Name: x: (+) y: z:				$GMo > u$ (m): <input type="text"/> u (m): <input type="text"/>			
ML.Pt 01	-4.98	10.68	13.35	$GZ(u^\circ) > v$ (m):	<input type="text"/>	<input type="text"/>	
ML.Pt 02	6.66	12.01	13.35	<input type="text"/>	<input type="text"/>	<input type="text"/>	
ML.Pt 03	6.66	12.31	16.14	$GZ(\theta > u^\circ) > v$ (m):	<input type="text"/>	<input type="text"/>	
ML.Pt 04	34.25	12.5	16.14	<input type="text"/>	<input type="text"/>	<input type="text"/>	
ML.Pt 05	34.25	12.5	13.35	$a(GZ_{max}) > u^\circ$	<input type="text"/>	<input type="text"/>	
ML.Pt 06	94.98	12.5	13.35	<input type="text"/>	<input type="text"/>	<input type="text"/>	
ML.Pt 07	104.32	12.39	13.35	$GZa(u^\circ-v^\circ) > w$ (mrad):	<input type="text"/>	<input type="text"/>	
ML.Pt 08	113.06	12.18	13.35	u (°): v (°): w (mrad):	<input type="text"/>	<input type="text"/>	
ML.Pt 09	120.97	11.69	13.35	Equilibrium angle $< v^\circ$:	<input type="text"/>	<input type="text"/>	
ML.Pt 10	120.97	12.16	16.14	Upright Moment u	<input type="text"/>	<input type="text"/>	
ML.Pt 11	131.06	11.27	16.14	(actual moment =	<input type="text"/>	<input type="text"/>	
ML.Pt 12	141.88	8.98	16.14	Upr.Moment*cos(a))	<input type="text"/>	<input type="text"/>	
ML.Pt 13	147.56	6.73	16.14	Constant Moment u	<input type="text"/>	<input type="text"/>	
ML.Pt 14	153.88	0	16.14	<input type="text"/>	<input type="text"/>	<input type="text"/>	
ML.Pt 15							
ML.Pt 16							
ML.Pt 17							
ML.Pt 18				Critical Pts subm.angle $> u^\circ$:	<input type="text"/>	<input type="text"/>	
ML.Pt 19					<input type="text"/>	<input type="text"/>	
ML.Pt 20				Freeboard at equilibrium $> v$ (m):	<input type="text"/>	<input type="text"/>	
					<input type="text"/>	<input type="text"/>	
Note: Margin Line Points are only used in conjunction with Margin Line criteria				Critical Pts.: <input type="text"/>			
				Margin Line: <input type="text"/>			

Load Condition settings

One Load Condition set includes definitions of Fixed Weights with reference to Weight Distributions and reference to a Tank Condition.

The LC set is edited and saved in the same way as Criteria sets

If no reference to a Weight distribution is given, then the given LCG will be used directly for calculations and a default weight distribution (with constant weight around the given LCG $\pm Lpp/20$) will be used for hull girder loading calculations. If a reference to a Weight Distribution exists, then the LCG from this distribution will be used irrespectively of the input of LCG in the load condition table.

The summary below the Fixed Weight table is thus just for information and the condition may be corrected during calculations. due to Weight Distribution data and Tank Conditions.

Load Condition sets may be referred to from calculations of the following types:

Hyd.loadcase

Stab.loadcase

Stab.special

Load Condition		Detailed Specified Load Condition				
LC No: 1		(Title 3): Full Load Arrival Condition				
Fixed Positioned Weights:					dens*lx	Weight
Name:	W (ton):	LCG:	TCG:	KG:	(tonm):	Distribution No:
W01:	Hold 01	800	128		11	W01: 11
W02:	Hold 02	2500	104.25		8.5	W02: 12
W03:	Hold 03	2500	74.5		8.5	W03: 13
W04:	Hold 04	2500	47.625		8.5	W04: 14
W05:	Hold 05	400	1		12	W05: 15
W06:	Stores	80	19.5		6	W06: 4
W07:	Cons.	42	19.5		4.3	W07: 4
W08:						W08:
W09:						W09:
W10:						W10:
W11:						W11:
W12:						W12:
W13:						W13:
W14:						W14:
W15:						W15:
W16:						W16:
W17:						W17:
W18:						W18:
W19:						W19:
W20:						W20:
W21:						W21:
W22:						W22:
W23:						W23:
W24:						W24:
W25:						W25:
W26:						W26:
W27:						W27:
W28:						W28:
W29:						W29:
W30:						W30:
W31:						W31:
W32:						W32:
W33:						W33:
W34:						W34:
Light Ship:	5430	65.732		7.12		Light Ship: 1
Fixed W Summary:	W (ton): 14252.0	LCG: 72.021	TCG: 0.000	KG: 8.186	KG': 8.186	

Include Tank Condition No:

Note: Tank Conditions are only available in Hyss Pro

Weight Distribution settings

Edit WD No:

Save as No:

A Weight Distribution set is used to describe the longitudinal distribution of a Fixed Weight. The distribution may include steps (by entering different aft and fwd values at the same x-position) and sloping distributions (by entering different fwd and aft values for two subsequent x-positions). The WD set is edited and saved in the same way as Criteria and Load Condition sets.

The given Weight per m value is relative for the individual set. The actual weight distribution will be scaled to fit the given fixed weight in the Load Condition set.

The calculated values of Total Weight and LCG is for information only and will be recalculated during processing of the load condition. Only the exact No of Positions given here will be used during calculations.

Weight Distribution sets are only necessary to define if distributions of shear force and bending moment is to be calculated.

Weight Distribution

WD No: 1
Name: Light Ship

No of Positions: 7

Note: x must be increasing

Pos	x:	Weight per m at the Pos.		For information only ...	
		aft:	fwd:	Calculated segment weight:	moment:
Pos 01:	-5		1	11.7	9.7
Pos 02:	6.66	1	2.4	66.2	1354.4
Pos 03:	34.25	2.4	1.1	95.4	7407.4
Pos 04:	121	1.1	1.2	10.8	1355.4
Pos 05:	130	1.2	1.2	11.8	1585.8
Pos 06:	140	1.15	1.15	14.4	2105.4
Pos 07:	154	0.9		0.0	0.0
Pos 08:				0.0	0.0
Pos 09:				0.0	0.0
Pos 10:				0.0	0.0
Pos 11:				0.0	0.0
Pos 12:				0.0	0.0
Pos 13:				0.0	0.0
Pos 14:				0.0	0.0
Pos 15:				0.0	0.0
Pos 16:				0.0	0.0
Pos 17:				0.0	0.0
Pos 18:				0.0	0.0
Pos 19:				0.0	0.0
Pos 20:				0.0	0.0
Pos 21:				0.0	0.0
Pos 22:				0.0	0.0
Pos 23:				0.0	0.0
Pos 24:				0.0	0.0
Pos 25:				0.0	0.0
Pos 26:				0.0	0.0
Pos 27:				0.0	0.0
Pos 28:				0.0	0.0
Pos 29:				0.0	0.0
Pos 30:				0.0	0.0
Pos 31:				0.0	0.0
Pos 32:				0.0	0.0
Pos 33:				0.0	0.0
Pos 34:				0.0	0.0
Pos 35:				0.0	0.0
Pos 36:				0.0	0.0
Pos 37:				0.0	0.0
Pos 38:				0.0	0.0
Pos 39:				0.0	0.0
Pos 40:				0.0	0.0
				Total Weight:	LCG:
				210.2	65.738

Note: Weight Distr. will be scaled to fit Fixed Weight, but Fixed Weight LCG will be changed to fit the Distribution!

Tank Condition settings

A Tank Condition set is used to describe a tank filling condition which is to be included in a Load Condition set. The effect of filling rate, liquid density, permeability and liquid movements in the tank (free surface effects) is directly calculated without any approximations. All directly calculated tanks geometries which are referred to from the set are to be defined as separate Calc Sheets in the Geometry Workbook.

If Weights are given in % then the actual weights are calculated during processing of the Load Condition. If the Weights are given in ton, a preliminary summary will be calculated directly during input (but will be recalculated during processing). If a specified weight exceeds the maximum of the tank, then the tank will be assumed 100% full and the weight will, during processing of the Tank Condition, be adjusted.

A large number of direct iteratively calculated tank weights and centre of gravity will significantly increase the calculation time. If a tank is 100% full or if its liquid movements have insignificant influence on the stability, it could be treated as a fixed weight (with free surface effect).

(Direct calculated tanks are not available in the limited **Intact** and **Basic** versions of the program).

Tank Condition		Detailed Specified Tank Condition						
TC No: 2		Weight in %? (Y/N): <input type="text" value="Y"/>						
		(upright LCG):	(upright TCG):	(upright KG):	liq.dens (ton/m ³)	Calc Sht: (+)PermVol:		
Tanks:	Name:	W(ton/%):						
Tank 01:	FP WVB	100			1.025	FP Calc	1	
Tank 02:	DeepT WVB	20			1.025	DeepT Calc	1	
Tank 03:	T02S HFO	15			0.92	T02S Calc	1	
Tank 04:	T02P HFO	15			0.92	T02P Calc	1	
Tank 05:	T03S HFO	0			0.92	T03S Calc	1	
Tank 06:	T03P HFO	0			0.92	T03P Calc	1	
Tank 07:	T04S HFO	15			0.92	T04S Calc	1	
Tank 08:	T04P HFO	15			0.92	T04P Calc	1	
Tank 09:	T14S GO	85			0.86	T14S Calc	1	
Tank 10:	DayTP HFO	85			0.92	DTP Calc	1	
Tank 11:	AP WVB	0			1.025	AP Calc	1	
Tank 12:							1	
Tank 13:							1	
Tank 14:							1	
Tank 15:							1	
Tank 16:							1	
Tank 17:							1	
Tank 18:							1	
Tank 19:							1	
Tank 20:							1	
Tank 21:							1	
Tank 22:							1	
Tank 23:							1	
Tank 24:							1	
Tank 25:							1	
Tank 26:							1	
Tank 27:							1	
Tank 28:							1	
Tank 29:							1	
Tank 30:							1	
Tank 31:							1	
Tank 32:							1	
Tank 33:							1	
Tank 34:							1	
Tank 35:							1	

Prel. Tank Summary:	W(ton):	(LCG):	(TCG):	(KG):
	--	--	--	--

Note: preliminary LCG, TCG, VCG are only available if Tank Weight is given in ton

Comments:

Hyd.table

Hyd.table

Exec

The pair of buttons initiate calculations for a standard hydrostatic table.

Up to 255 different draughts in sequence, each with a maximum number of 12 different trim, in addition to even keel, may be calculated and stored in the same output Sheet which may be printed within the height of an A4 paper size. All coordinates refer to the origo defined by xAP, yCL and zKL as given in the first Calc Sheet. Trim is defined as the difference between draught at AP, x=0, and draught at FP, x=L, i.e. positive stern down.

The figures below and to the right show an example of input format and results from a **Hyd.table** calculation.

Definitions are discussed in more detail in a separate section of this manual.

The page head and foot are automatically set to reflect the time of calculation, the user and the calculation type. The second and third row at the head may be set by the user as Title 1 and Title 2 among the general input.

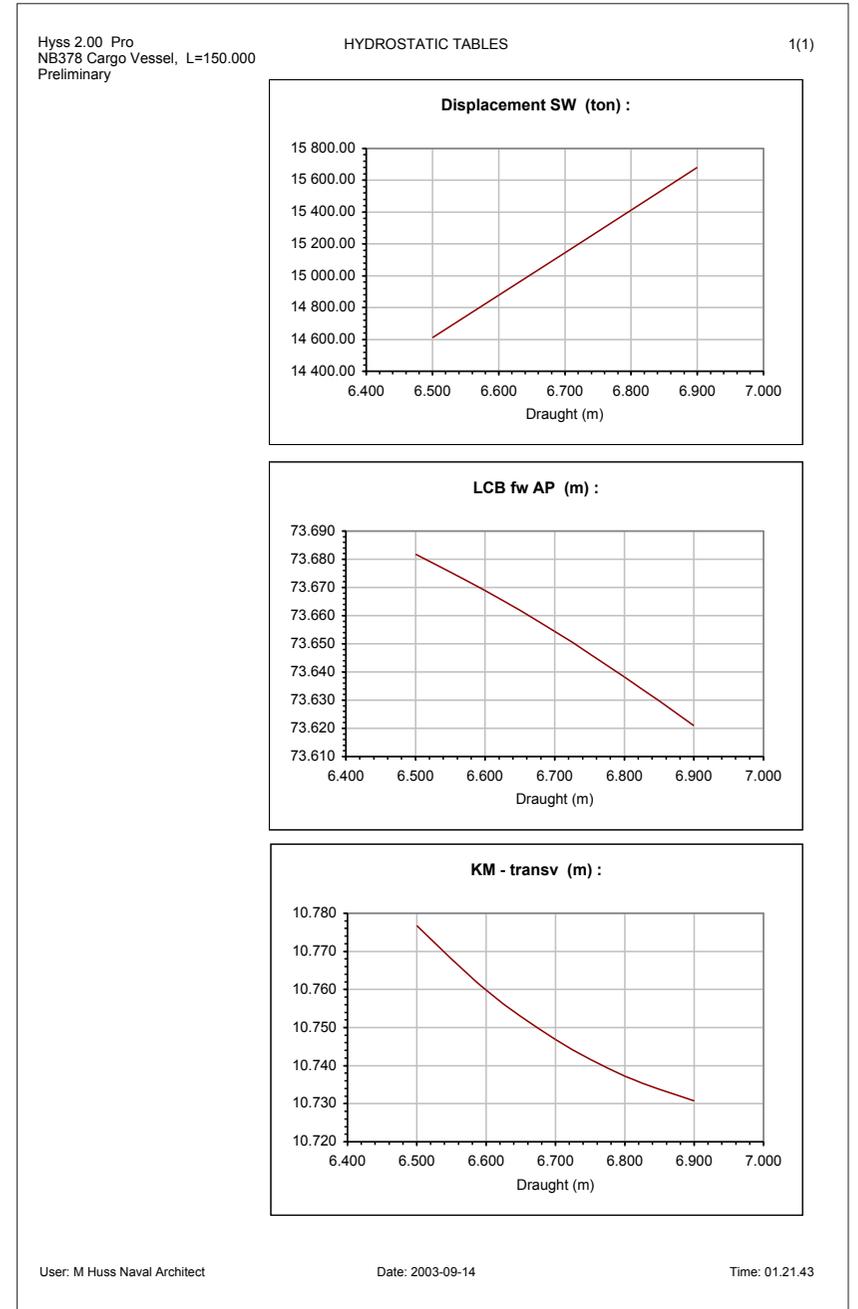
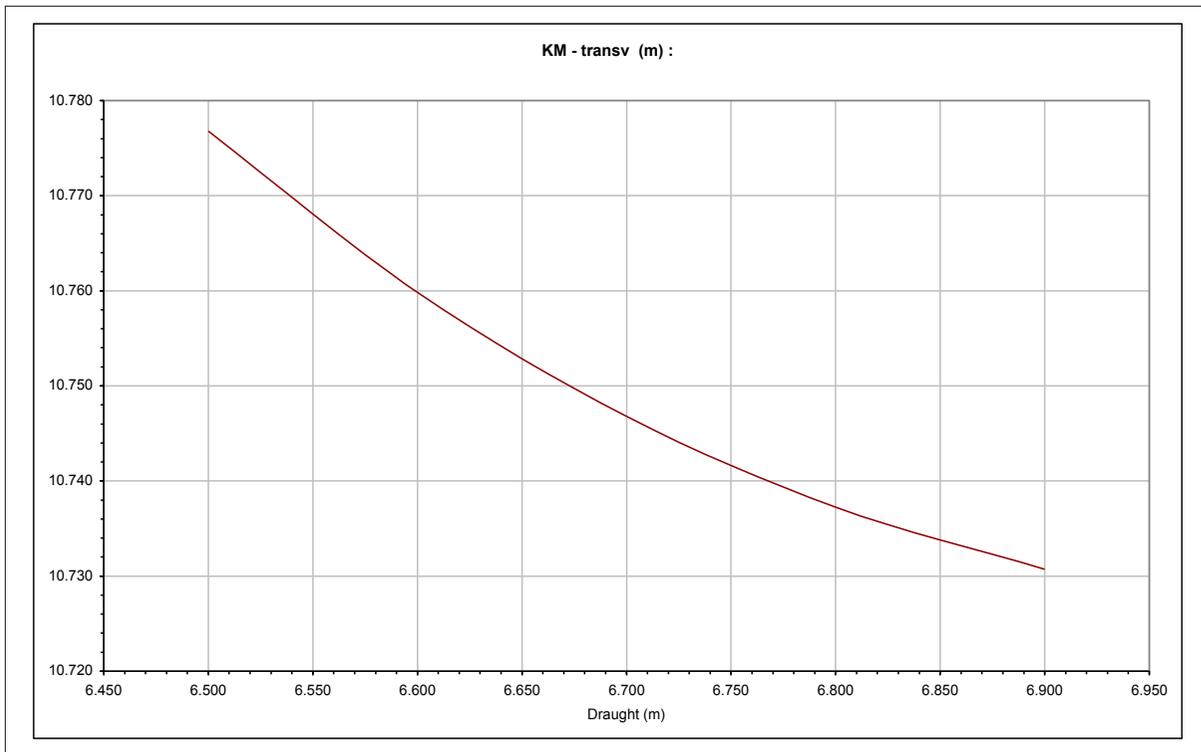
Hyd.standard Standard Hydrostatic Tables with even keel and up to 12 trim

No of T:	5	(Keel thk at L/2:)	0.018 (m)
T min:	6.5	Add keel thickness to moulded draught at L/2 only if you want Draught extr. to be printed	
T step:	0.1		
No of trim:	12	Note:	
trim 01:	2.4	Positive trim = s t e r n d o w n	
trim 02:	2	No of T < 255	
trim 03:	1.6		
trim 04:	1.2		
trim 05:	0.8		
trim 06:	0.6		
trim 07:	0.4		
trim 08:	0.2		
trim 09:	-0.2		
trim 10:	-0.4		
trim 11:	-0.6		
trim 12:	-0.8		

Hyss 2.00 Pro NB378 Cargo Vessel, L=150.000 Preliminary		HYDROSTATIC TABLES					1(1)
<i>Dens SW = 1.025 ton/m³</i>							
Draught ext at L/2 (m) :	6.516	6.616	6.716	6.816	6.916		
Draught mid at L/2 (m) :	6.500	6.600	6.700	6.800	6.900		
<i>Trim 0.000 m :</i>							
Displacement SW (ton) :	14 611.87	14 877.31	15 144.02	15 412.13	15 681.76		
Displacement vol (m ³) :	14 255.49	14 514.45	14 774.65	15 036.23	15 299.28		
LCB fw AP (m) :	73.682	73.669	73.654	73.638	73.621		
TCB ps CL (m) :	0.000	0.000	0.000	0.000	0.000		
KB (m) :	3.495	3.549	3.604	3.659	3.714		
Waterplane Area (m ²) :	2 583.62	2 595.42	2 608.90	2 622.98	2 637.19		
LCF fw AP (m) :	73.047	72.920	72.810	72.690	72.575		
KM - transv (m) :	10.777	10.760	10.747	10.737	10.731		
KM - longit (m) :	197.23	195.57	194.51	193.61	192.77		
TPcm (ton/cm) :	26.482	26.603	26.741	26.886	27.031		
MTcm (tonm/cm) :	184.30	190.50	192.79	195.23	197.71		
<i>Trim 2.400 m :</i>							
Displacement SW (ton) :	14 728.46	15 003.53	15 281.18	15 560.78	15 843.06		
LCB fw AP (m) :	70.440	70.448	70.448	70.444	70.431		
KM - transv (m) :	11.012	11.009	11.009	11.011	11.015		
<i>Trim 2.000 m :</i>							
Displacement SW (ton) :	14 702.40	14 974.63	15 249.08	15 525.82	15 805.08		
LCB fw AP (m) :	71.002	71.012	71.016	71.013	71.003		
KM - transv (m) :	10.954	10.949	10.947	10.948	10.952		
<i>Trim 1.600 m :</i>							
Displacement SW (ton) :	14 679.88	14 950.35	15 222.36	15 496.12	15 772.17		
LCB fw AP (m) :	71.552	71.560	71.564	71.564	71.557		
KM - transv (m) :	10.907	10.897	10.892	10.891	10.894		
<i>Trim 1.200 m :</i>							
Displacement SW (ton) :	14 660.54	14 929.51	15 199.96	15 471.87	15 745.27		
LCB fw AP (m) :	72.093	72.098	72.099	72.097	72.090		
KM - transv (m) :	10.867	10.854	10.846	10.842	10.842		
<i>Trim 0.800 m :</i>							
Displacement SW (ton) :	14 642.89	14 911.01	15 179.95	15 450.08	15 721.54		
LCB fw AP (m) :	72.629	72.628	72.625	72.618	72.608		
KM - transv (m) :	10.832	10.818	10.808	10.801	10.798		
<i>Trim 0.600 m :</i>							
Displacement SW (ton) :	14 634.61	14 902.08	15 170.65	15 439.99	15 710.64		
LCB fw AP (m) :	72.896	72.891	72.884	72.875	72.863		
KM - transv (m) :	10.816	10.802	10.791	10.783	10.779		
<i>Trim 0.400 m :</i>							
Displacement SW (ton) :	14 626.78	14 893.48	15 161.37	15 430.46	15 700.51		
LCB fw AP (m) :	73.160	73.153	73.142	73.129	73.116		
KM - transv (m) :	10.801	10.787	10.775	10.767	10.761		
<i>Trim 0.200 m :</i>							
Displacement SW (ton) :	14 619.21	14 885.25	15 152.47	15 421.05	15 691.06		
LCB fw AP (m) :	73.422	73.412	73.399	73.384	73.368		
KM - transv (m) :	10.788	10.772	10.761	10.752	10.745		
<i>Trim -0.200 m :</i>							
Displacement SW (ton) :	14 605.36	14 870.38	15 136.69	15 404.43	15 673.63		
LCB fw AP (m) :	73.940	73.925	73.909	73.892	73.873		
KM - transv (m) :	10.766	10.748	10.734	10.723	10.716		
<i>Trim -0.400 m :</i>							
Displacement SW (ton) :	14 599.19	14 863.84	15 129.86	15 397.24	15 666.01		
LCB fw AP (m) :	74.196	74.180	74.162	74.144	74.124		
KM - transv (m) :	10.755	10.738	10.723	10.711	10.703		
<i>Trim -0.600 m :</i>							
Displacement SW (ton) :	14 593.53	14 857.87	15 123.58	15 390.63	15 659.01		
LCB fw AP (m) :	74.452	74.434	74.415	74.396	74.375		
KM - transv (m) :	10.746	10.728	10.712	10.700	10.691		
<i>Trim -0.800 m :</i>							
Displacement SW (ton) :	14 588.49	14 852.53	15 117.91	15 384.63	15 652.65		
LCB fw AP (m) :	74.707	74.688	74.668	74.647	74.624		
KM - transv (m) :	10.737	10.718	10.703	10.690	10.680		
User: M Huss Naval Architect		Date: 2003-09-14			Time: 01.21.43		

Plot of hydrostatic data may easily be done by referring to the result tables. Below the normal preset printing area are three diagrams prepared. By default these diagrams show Displacement, LCB and KM for zero trim, but they may be adjusted to include any other, or a combination of several, of the results printed in the tables. The printout example at side here shows the three preset diagrams referring to the data from the previous printout.

If any of these diagrams is clicked upon with the cursor and following that the Excel preview function is activated, the diagram will be enlarged and fitted to a standard page size. The example below shows such a single diagram printout.



Hyd.loadcase

Hyd.loadcase

Exec

The buttons initiate calculations of hydrostatic data for a given load condition defined by either directly given displacement and centre of gravity or by a reference to a load condition set. LC No. The resulting floating condition is in both cases found by iteration with free draught, trim and heel.

In both alternatives, critical points may be evaluated by referring to a set of criteria defined by the CritNo. In addition when a load condition is referred to, separate output Sheets with Load Condition Data and with distributions of weight, hull girder shear force and bending moment may be created.

The example of the following three printouts is initiated by the input below. At right is the result printout with distribution diagrams. On the next page are the two Load Condition Data printouts, the first page showing fixed weights and the second showing the Tank Condition. Below the tables are some space left for an optional load condition drawing.

When directly given displacement and centre of gravity is given, the results will be put in a single table for all conditions but may not include plot of distributions (since they are not defined).

Hyd.loadcase Hydrostatics or Stability calculations for given loading conditions

Alternatively, spec. LC No:

No of Conditions: No of LC:

	Displ:	LCG:	TCG:	KG:	(Title 3):		LC No:
Cond 01:						LC No 01:	<input type="text" value="1"/>
Cond 02:						LC No 02:	<input type="text"/>
Cond 03:						LC No 03:	<input type="text"/>
Cond 04:						LC No 04:	<input type="text"/>
Cond 05:						LC No 05:	<input type="text"/>
Cond 06:						LC No 06:	<input type="text"/>
Cond 07:						LC No 07:	<input type="text"/>
Cond 08:						LC No 08:	<input type="text"/>
Cond 09:						LC No 09:	<input type="text"/>
Cond 10:						LC No 10:	<input type="text"/>

Use criteria/critical points from CritNo:

Note: If CritNo is empty (or 0) no criteria/critical points will be calculated

Calc. and Plot Distributions? (Y/N):

Print Load Condition Data? (Y/N):

Note: Distributions and Load Condition Data requires specified LC No

Hyss 2.20 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

LOAD CONDITION HYDROSTATICS 1(1)

Dens SW = 1.025 ton/m³ Full Load Arrival Condition

Displacement SW (ton) : 14672.65
 LCG fw AP (m) : 72.868
 TCG ps CL (m) : 0.001
 KG' (m) : 8.035

Equilibrium at
 Draught mid at L/2 (m) : 6.514
 Trim (pos aft) (m) : 0.635
 Heel a (pos ps) (deg) : 0.03

Displacement vol (m³) : 14314.78
 LCB fw AP (m) : 72.849
 TCB ps CL (m) : 0.004
 KB (m) : 3.509

Waterplane Area (m²) : 2605.56
 LCF fw AP (m) : 72.688
 TCF ps CL (m) : 0.002
 KF (m) : 6.524

I - transv (m⁴) : 104626.2
 KN - transv (m) : 0.006
 dKN/da - transv (m/rad) : 10.532
 GZ - transv (m) : 0.000
 dGZ/da - transv (m/rad) : 2.497

I - longit (m⁴) : 2847020
 dKN/da - longit (m/rad) : 202.7
 GZ - longit (m) : 0.0
 dGZ/da - longit (m/rad) : 194.4

max WL Breadth (m) : 25.02
 max Section Area (m²) : 160.90
 Wetted Surface (m²) : 3882.3

TPcm (ton/cm) : 26.707
 MTcm (tonm/cm) : 190.12

No of iterations: 4, (2)
 Critical points dist abv WL:

Pilot dr	6.705
Hatch 3a	8.015
Hatch 3f	8.112
Hatch 2a	8.129
Hatch 2f	8.227
Hatch 1a	8.244
Hatch 1f	8.341

Comp. Displacement (ton):
 Hull(1.000) : 14655.69
 Rudder(1.000) : 26.60
 BowThruster(-0.880) : -9.64

User: M Huss Naval Architect

Date: 2004-03-15

Time: 01.00.11

Hyss 2.20 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

LOAD CONDITION DATA 1(2)

Full Load Arrival Condition
Load Condition Data (Page 1)

Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG)'
	14672.65	72.868	0.001	8.035	8.035

Floating Condition
Dens SW = 1.025 ton/m³

Draught mid at L/2 (m) : 6.514
Trim (pos aft) (m) : 0.635
Heel a (pos ps) (deg) : 0.03
dGZ/da' (=GM') (m/rad) : 2.497

Fixed Positioned Weights :	W (ton):	LCG:	TCG:	KG:	dens*lx (tonm)	Distribution
Hold 01	800.00	126.000	0.000	11.000	0.000	Hold 01
Hold 02	2500.00	104.250	0.000	8.500	0.000	Hold 02
Hold 03	2500.00	74.500	0.000	8.500	0.000	Hold 03
Hold 04	2500.00	47.625	0.000	8.500	0.000	Hold 04
Hold 05	400.00	1.000	0.000	12.000	0.000	Hold 05
Stores	80.00	19.500	0.000	6.000	0.000	Stores
Cons.	42.00	19.500	0.000	4.300	0.000	Stores
Light Ship:	5430.00	65.738	0.000	7.120	0.000	Light Ship

Fixed Weight Summary :	W (ton):	LCG:	TCG:	KG:	KG':
	14252.00	72.023	0.000	8.186	8.186

User: M Huss Naval Architect Date: 2004-03-15 Time: 01.01.25

Hyss 2.20 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

LOAD CONDITION DATA 2(2)

Full Load Arrival Condition
Load Condition Data (Page 2)

Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG)'
	14672.65	72.868	0.001	8.035	8.035

Floating Condition
Dens SW = 1.025 ton/m³

Draught mid at L/2 (m) : 6.514
Trim (pos aft) (m) : 0.635
Heel a (pos ps) (deg) : 0.03
dGZ/da' (=GM') (m/rad) : 2.497

Direct Calculated Tanks :	W (ton):	LCG:	TCG:	KG:	liq.dens (ton/m ³):	(+)PermVol:
FP WB (100%)	161.02	147.982	0.000	5.194	1.025	1.000
DeepT WB (20%)	32.80	142.472	0.000	2.040	1.025	1.000
T02S HFO (15%)	43.76	99.659	-2.987	0.154	0.920	1.000
T02P HFO (15%)	43.76	99.621	3.007	0.154	0.920	1.000
T03S HFO						
T03P HFO						
T04S HFO (15%)	48.40	48.404	-3.885	0.135	0.920	1.000
T04P HFO (15%)	48.40	48.432	3.916	0.134	0.920	1.000
T14S GO (85%)	17.54	20.498	-2.000	6.850	0.860	1.000
DayTP HFO (85%)	24.98	16.997	2.003	6.850	0.920	1.000
AP WB						

Tank Summary :	W (ton):	LCG:	TCG:	KG:
	420.65	101.492	0.041	2.903

User: M Huss Naval Architect Date: 2004-03-15 Time: 01.01.25

Hyd.special

Hyd.special

Exec

As an option, also the sectional area curve may be plotted, but that will create a separate output Sheet for every condition

The buttons initiate hydrostatic calculations for a given floating condition defined by draught, trim and heel and with the possibility also to include the vertical centre of gravity (KG) for calculation of the righting lever GZ. The output from these calculations is more detailed than from an ordinary **Hyd.table** calculation.

The figures show an example of a **Hyd.special** calculation. Definitions are given in a separate section of this manual.

Hyd.special Detailed Hydrostatics for given draught, trim and heel

No of Conditions:

	T:	trim:	heel:	(TCG:)	(KG:)	(Title 3):
Cond 01:	6.9	0			9	trim 0.0
Cond 02:	6.9	0.1			9	trim 0.1
Cond 03:	6.9	0.2			9	trim 0.2
Cond 04:	6.9	0.3			9	trim 0.3
Cond 05:	6.9	0.4			9	trim 0.4
Cond 06:	6.9	0.5			9	trim 0.5
Cond 07:	6.9	0.6			9	trim 0.6
Cond 08:	6.9	0.7			9	trim 0.7
Cond 09:	6.9	0.8			9	trim 0.8
Cond 10:						

Use critical points from CritNo:

Note: If CritNo is empty (or 0) no critical points will be calculated

Plot Section Area ? (Y/N):

Note: if Plot is chosen, each Condition will generate a separate output Sheet

Hyss 2.00 Pro NB378 Cargo Vessel, L=150.000 Preliminary

DETAILED HYDROSTATICS 1(2)

Dens SW =1.025 ton/m^3

	trim 0.0	trim 0.1	trim 0.2	trim 0.3	trim 0.4
Draught mid at L/2 (m):	6.900	6.900	6.900	6.900	6.900
Trim (pos aft) (m):	0.000	0.100	0.200	0.300	0.400
Heel a (pos ps) (deg):	0.00	0.00	0.00	0.00	0.00
Displacement SW (ton):	15681.76	15686.32	15691.06	15695.73	15700.51
Displacement vol (m^3):	15299.28	15303.73	15308.35	15312.91	15317.57
LCB fw AP (m):	73.621	73.494	73.368	73.242	73.116
TCB ps CL (m):	0.000	0.000	0.000	0.000	0.000
KB (m):	3.714	3.715	3.716	3.717	3.718
Waterplane Area (m^2):	2637.19	2639.38	2640.04	2639.95	2642.25
LCF fw AP (m):	72.575	72.480	72.434	72.408	72.317
TCF ps CL (m):	0.000	0.000	0.000	0.000	0.000
KF (m):	6.900	6.902	6.903	6.905	6.907
I - transv (m^4):	107320.0	107449.5	107584.5	107722.7	107867.9
KN - transv (m):	0.000	0.000	0.000	0.000	0.000
dKN/da (m/rad):	10.731	10.738	10.745	10.753	10.761
I - longit (m^4):	2892472	2898653	2896464	2890582	2897355
KM - longit (m):	192.77	193.17	193.02	192.63	193.07
Wetted Length (m):	155.63	155.63	155.63	155.63	155.63
L-aft fw AP (m):	-3.00	-3.00	-3.00	-3.00	-3.00
L-fore fw AP (m):	152.63	152.63	152.63	152.63	152.63
max WL Breadth (m):	25.02	25.02	25.02	25.02	25.02
max Section Area (m^2):	169.7	169.9	170.0	170.1	170.3
Wetted Surface (m^2):	4019	4021	4024	4027	4028
CB:	0.591	0.591	0.591	0.591	0.591
CP:	0.601	0.601	0.600	0.600	0.600
CWA:	0.703	0.703	0.703	0.703	0.704
TPcm (ton/cm):	27.031	27.054	27.060	27.059	27.083
MTcm (tonm/cm):	192.13	192.55	192.40	192.00	192.46
KG (m):	9.000	9.000	9.000	9.000	9.000
TCG (m):	0.000	0.000	0.000	0.000	0.000
GZ (m):	0.000	0.000	0.000	0.000	0.000
dGZ/da (m/rad):	1.731	1.738	1.745	1.753	1.761
Distance above WL for Critical points:					
Pilot dr	6.550	6.515	6.479	6.444	6.409
Hatch 3a	7.800	7.774	7.748	7.722	7.696
Hatch 3f	7.800	7.789	7.779	7.768	7.757
Hatch 2a	7.800	7.792	7.784	7.776	7.768
Hatch 2f	7.800	7.807	7.815	7.822	7.829
Hatch 1a	7.800	7.810	7.820	7.830	7.840
Hatch 1f	7.800	7.825	7.851	7.876	7.901
Comp. Displacement (ton):					
Hull(1.000)	15664.53	15668.88	15673.41	15678.09	15682.87
Rudder(1.000)	26.87	27.08	27.28	27.28	27.28
BowThruster(-0.880)	-9.64	-9.64	-9.64	-9.64	-9.64

User: M Huss Naval Architect Date: 2003-09-14 Time: 11.29.50

Stab.KN-table

Stab.KN-table

Exec

Definitions are given in a separate section of this manual.

The buttons initiate calculations of KN-tables for heel angles between 0° and 60° for a sequence of draught and trim. For each floating condition it is also possible to have KG-max according to different intact stability criteria calculated as well as the flooding angle at which the specified flooding points reach the water surface.

The figures show an extract from a **Stab.KN-table** calculation. In the same way as for Hyd.table calculations, the result table may be plotted in diagrams. Below the preset print area are two diagrams prepared for KN-curves and for KG-max values.

Stab.KN-data **Standard KN-Tables with stability criteria**

No of T:	15	(Keel thk at L/2:)	0.016 (m)
T min:	5.5	Add keel thickness to moulded draught at L/2 only if you want Draught extr. to be printed	
T step:	0.1		
No of trim:	3	Note:	
trim 01:	0	Positive trim = s t e r n down	
trim 02:	0.6	If No of trim: = 0 or empty, trim=0 will be calculated	
trim 03:	-0.6	If No of trim: > 0 , only the specified trim will be calculated	
trim 04:		No of T * No of trim < 255	
trim 05:			
trim 06:			
trim 07:			
trim 08:			
trim 09:			
trim 10:		(Approx. KG (m):	8 for trim iterations)
trim 11:		(if empty, KG = upright KB)	
trim 12:			

Use criteria and critical points from CritNo: 1

Note: If CritNo is empty (or 0) no criteria or critical points will be calculated

Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

KN TABLES, KG CRITERIA 2(10)

Upright/Intact condition :

Draught ext at L/2 (m) :	6.016	6.116	6.216	6.316	6.416
Draught mid at L/2 (m) :	6.000	6.100	6.200	6.300	6.400
Trim (pos aft) (m) :	0.000	0.000	0.000	0.000	0.000
Displacement vol (m³) :	12 976.22	13 229.98	13 484.80	13 740.68	13 997.55
LCB fw AP (m) :	73.705	73.706	73.705	73.700	73.692

KN free trim (m) :

Heel angle 0° :	0.000	0.000	0.000	0.000	0.000
5° :	0.954	0.951	0.948	0.946	0.944
10° :	1.918	1.912	1.907	1.902	1.898
15° :	2.897	2.888	2.880	2.873	2.866
20° :	3.891	3.880	3.870	3.861	3.853
25° :	4.890	4.878	4.868	4.858	4.849
30° :	5.869	5.861	5.853	5.846	5.839
35° :	6.794	6.788	6.780	6.772	6.763
40° :	7.571	7.560	7.549	7.538	7.527
45° :	8.215	8.203	8.191	8.178	8.165
50° :	8.732	8.714	8.697	8.679	8.660
55° :	9.097	9.076	9.055	9.033	9.011
60° :	9.328	9.304	9.281	9.257	9.233

dKN/da free trim (m) :

Heel angle 0° :	10.915	10.880	10.849	10.821	10.797
5° :	10.974	10.942	10.911	10.883	10.859
10° :	11.132	11.097	11.064	11.034	11.007
15° :	11.318	11.287	11.255	11.237	11.211
20° :	11.451	11.440	11.427	11.410	11.391
25° :	11.378	11.398	11.415	11.419	11.427
30° :	11.013	11.073	11.117	11.164	11.208
35° :	9.801	9.763	9.697	9.633	9.576
40° :	8.043	8.010	7.974	7.988	7.983
45° :	6.726	6.715	6.675	6.620	6.560
50° :	5.028	4.962	4.893	4.841	4.812
55° :	3.383	3.339	3.321	3.282	3.245
60° :	1.880	1.892	1.882	1.867	1.853

Max KG' acc to criteria :

GZa(0.0°-30.0°)>0.055mrad	10.978	10.948	10.921	10.897	10.875
GZa(0.0°-40.0°)>0.090mrad	11.187	11.164	11.143	11.122	11.103
GZa(30.0°-40.0°)>0.030mrad	11.517	11.504	11.489	11.474	11.459
GZ(>30.0°)>0.200m	11.504	11.492	11.477	11.461	11.444
a(GZmax)>30.0°	10.916	10.881	10.850	10.822	10.799
a(GZmax)>25.0°	10.916	10.881	10.850	10.822	10.799
GMo>0.150m	10.765	10.730	10.699	10.671	10.647

Max KG' (m) acc to above : 10.765 10.730 10.699 10.671 10.647

Subm. angles (°)
for Critical points:

Pilot dr	35.2	34.7	34.3	33.9	33.4
Hatch 3a	47.6	47.0	46.4	45.9	45.3
Hatch 3f	46.1	45.5	45.0	44.5	43.9
Hatch 2a	45.8	45.3	44.8	44.2	43.7
Hatch 2f	44.5	44.0	43.5	42.9	42.4
Hatch 1a	44.3	43.8	43.2	42.7	42.2
Hatch 1f	43.1	42.6	42.1	41.6	41.1

User: M Huss Naval Architect Date: 2003-09-14 Time: 11.43.03

Stab.loadcase

Stab.loadcase

Exec

The buttons initiate ordinary stability calculations for a given load conditions including the calculation of righting lever GZ, dynamic lever (area below GZ-curve) slope of the GZ-curve (dGZ/da) and the floating condition at heel angles between 0° and 70°. For each load condition it is also possible to have stability criteria and critical points evaluated according to the reference CritNo. The lowest critical point angle is marked in the GZ diagram.

The input table is identical to that for a **Hyd.loadcase** calculation and in addition to the stability curve printout, distributions and load condition data can be automatically printed according to the previous example.

The figures show an example of a **Stab.loadcase** calculation.

Definitions are given in a separate section of this manual.

Stab.loadcase Hydrostatics or Stability calculations for given loading conditions

Alternatively, spec. LC No:

No of Conditions: No of LC:

	Displ:	LCG:	TCG:	KG:	(Title 3):		LC No:
Cond 01:						LC No 01:	1
Cond 02:						LC No 02:	
Cond 03:						LC No 03:	
Cond 04:						LC No 04:	
Cond 05:						LC No 05:	
Cond 06:						LC No 06:	
Cond 07:						LC No 07:	
Cond 08:						LC No 08:	
Cond 09:						LC No 09:	
Cond 10:						LC No 10:	

Use criteria/critical points from CritNo:

Note: If CritNo is empty (or 0) no criteria/critical points will be calculated

Calc. and Plot Distributions? (Y/N):

Print Load Condition Data? (Y/N):

Note: Distributions and Load Condition Data requires specified LC No

Hyss 2.00 Pro NB378 Cargo Vessel, L=150.000 Preliminary STABILITY FOR LOADING CONDITIONS 1(1)

Loading condition : Full Load Arrival Condition
 Dens SW =1.025 ton/m³
 Displacement SW (ton) : 14672.65
 LCG fw AP (m) : 72.882
 TCG ps CL (m) : 0.001
 KG' (m) : 8.035
 GMo' (m) : 2.497

Free trim stability :	Right. lever GZ (m)	Dyn. lever GZa(0-a) (mrad)	Incr. stab dGZ/da (m/rad)	Draught mid at L/2 (m)	Trim at CL (m)
0	-0.001	0.000	2.497	6.514	0.635
5	0.221	0.010	2.669	6.501	0.602
10	0.469	0.039	3.009	6.463	0.500
15	0.748	0.092	3.412	6.396	0.335
20	1.064	0.171	3.823	6.297	0.113
25	1.413	0.279	4.163	6.152	-0.158
30	1.784	0.418	4.311	5.941	-0.472
35	2.116	0.589	2.990	5.651	-0.839
40	2.322	0.784	1.835	5.301	-1.288
45	2.440	0.992	0.768	4.865	-1.774
50	2.455	1.207	-0.426	4.343	-2.279
55	2.375	1.418	-1.383	3.708	-2.845
60	2.220	1.619	-2.142	2.900	-3.551
65	2.006	1.804	-2.773	1.806	-4.524
70	1.741	1.968	-3.281	0.203	-6.021

GZmax at 48.2° : 2.461

Stability criteria :	Actual value / Compliance	Max KG' (m)	Crit. Points :	Subm.angle(°)
GZa(0.0°-30.0°)>0.055mrad	0.418 / OK	10.689	Pilot dr	32.1
GZa(0.0°-40.0°)>0.090mrad	0.784 / OK	10.968	Hatch 3a	44.2
GZa(30.0°-40.0°)>0.030mrad	0.366 / OK	11.393	Hatch 3f	43.1
GZ(>30.0°)>0.200m	2.461 / OK	11.381	Hatch 2a	42.9
a(GZmax)>30.0°	48.2 / OK	10.670	Hatch 2f	42.0
a(GZmax)>25.0°	48.2 / OK	10.670	Hatch 1a	41.9
GMo>0.150m	2.497 / OK	10.382	Hatch 1f	41.0
Weather(504/1500/13.0/70/50)	-- / OK	9.047		
Sum. Compliance, max KG' :	OK	9.047	Min.angle :	32.1

User: M Huss Naval Architect Date: 2003-09-14 Time: 14.11.41

Stab.special

Stab.special

Exec

The buttons initiate stability calculations for given load conditions including the calculation of righting lever GZ and the floating condition at arbitrary heel angles as specified in the input format.

The figures show an example of a **Stab.special** calculation where heel angles for a complete 360° roll have been specified. Any angle may be given but the program always transfer the angles to the interval [-180°,180°].

Since all draught and trim values are defined in the ship-fixed coordinate system, problem may arise when calculation angles of heel are very close to ±90° when

draughts approach infinity. By default the program change input of 90° to 89.999° but still some iteration problems may occur. In the example perfect iteration failed for -90° and a warning has been printed both for GZ-calculations (the first warning) and for dGZ/da iterations (the warning in parenthesis). The error introduced by this on the GZ-value is insignificant as can be seen in the diagram but the slope of the curve has not been possible to calculate by iterations at this point.

Definitions are given in a separate section of this manual.

Stab.special Stability calculations for arbitrary angles of heel

No of conditions: <input type="text" value="1"/>					Alternatively, spec. LC No:				
Displ: <input type="text" value="14500"/>					No of LC: <input type="text" value=""/>				
LCG: <input type="text" value="73.5"/>									
TCG: <input type="text" value=""/>									
KG: <input type="text" value="8"/>									
(Title 3): <input type="text" value=""/>									
Cond 01:	<input type="text" value="14500"/>	<input type="text" value="73.5"/>	<input type="text" value=""/>	<input type="text" value="8"/>	LC No 01:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 02:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 02:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 03:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 03:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 04:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 04:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 05:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 05:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 06:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 06:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 07:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 07:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 08:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 08:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 09:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 09:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>
Cond 10:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	LC No 10:	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>

No of heel angles: <input type="text" value="37"/>			
heel (deg)	heel (deg)	heel (deg)	heel (deg)
heel 01: <input type="text" value="-179.9"/>	heel 11: <input type="text" value="-80"/>	heel 21: <input type="text" value="20"/>	heel 31: <input type="text" value="120"/>
heel 02: <input type="text" value="-170"/>	heel 12: <input type="text" value="-70"/>	heel 22: <input type="text" value="30"/>	heel 32: <input type="text" value="130"/>
heel 03: <input type="text" value="-160"/>	heel 13: <input type="text" value="-60"/>	heel 23: <input type="text" value="40"/>	heel 33: <input type="text" value="140"/>
heel 04: <input type="text" value="-150"/>	heel 14: <input type="text" value="-50"/>	heel 24: <input type="text" value="50"/>	heel 34: <input type="text" value="150"/>
heel 05: <input type="text" value="-140"/>	heel 15: <input type="text" value="-40"/>	heel 25: <input type="text" value="60"/>	heel 35: <input type="text" value="160"/>
heel 06: <input type="text" value="-130"/>	heel 16: <input type="text" value="-30"/>	heel 26: <input type="text" value="70"/>	heel 36: <input type="text" value="170"/>
heel 07: <input type="text" value="-120"/>	heel 17: <input type="text" value="-20"/>	heel 27: <input type="text" value="80"/>	heel 37: <input type="text" value="180"/>
heel 08: <input type="text" value="-110"/>	heel 18: <input type="text" value="-10"/>	heel 28: <input type="text" value="90"/>	heel 38: <input type="text" value=""/>
heel 09: <input type="text" value="-100"/>	heel 19: <input type="text" value="0"/>	heel 29: <input type="text" value="100"/>	heel 39: <input type="text" value=""/>
heel 10: <input type="text" value="-90"/>	heel 20: <input type="text" value="10"/>	heel 30: <input type="text" value="110"/>	heel 40: <input type="text" value=""/>

Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

STABILITY FOR SPECIAL ANGLES OF HEEL 1(1)

Loading condition :
Dens SW = 1.025 ton/m³
Displacement SW (ton) : 14500.00
LCG fw AP (m) : 73.500
TCG ps CL (m) : 0.000
KG (m) : 8.000

Free trim stability :	Right. lever GZ (m)	Incr. stab dGZ/da (m/rad)	Draught mld at L/2 (m)	Trim at CL (m)	(No of iterations)
-179.9	0.010	5.813	10.280	2.028	6 (2)
-170.0	1.026	6.008	10.243	1.973	4 (3)
-160.0	1.939	3.731	10.186	1.962	4 (2)
-150.0	2.396	1.490	10.331	2.068	4 (3)
-140.0	2.478	-0.501	10.760	2.693	4 (3)
-130.0	2.246	-2.127	11.569	3.737	4 (3)
-120.0	1.760	-3.365	12.960	5.445	5 (4)
-110.0	1.100	-4.116	15.698	8.663	5 (4)
-100.0	0.347	-4.451	23.773	17.805	5 (4)
-90.0	-0.440	428.311	-15979793.965	3536.574	Warning,(Warning)
-80.0	-1.169	-3.984	-8.132	-15.715	5 (3)
-70.0	-1.810	-3.295	-0.032	-7.029	5 (3)
-60.0	-2.294	-2.136	2.760	-4.177	4 (3)
-50.0	-2.524	-0.345	4.249	-2.733	4 (3)
-40.0	-2.382	1.858	5.233	-1.665	4 (3)
-30.0	-1.839	4.299	5.884	-0.861	4 (4)
-20.0	-1.115	3.855	6.242	-0.310	4 (4)
-10.0	-0.508	3.118	6.406	0.033	4 (3)
0.0	0.000	2.794	6.456	0.147	3 (2)
10.0	0.508	3.123	6.406	0.034	4 (3)
20.0	1.115	3.861	6.242	-0.310	4 (4)
30.0	1.839				
40.0	2.382				
50.0	2.524				
60.0	2.294				
70.0	1.810				
80.0	1.169				
90.0	0.440				
100.0	-0.347				
110.0	-1.100				
120.0	-1.760				
130.0	-2.246				
140.0	-2.478				
150.0	-2.396				
160.0	-1.939				
170.0	-1.026				
180.0	0.000				

User: M Huss Naval Architect
Date: 2003-09-14
Time: 14.50.30

Tank capacity

Tank capacity

Exec

The buttons initiate calculations of the volume or weight of the liquid in a tank or a combination of tanks for different filling heights. Two reference points may be specified; one above the tank from which the height to the surface is measured downwards (by lead) as ullage, and one below or within the tank from which the height is measured as soundings (sounding pipe). If the liquid density is given, the weight is presented as output otherwise the volume is presented. Note that in this specific application all the heights (ullage as well as soundings) refer to a vertical line in an earth-fixed system of coordinates (not to the usual ship-fixed system).

The figures show an example of a **Tank capacity** calculation.

Diagrams for plotting of ullage or soundings may be created similar to those in the Hydrostatic tables

Definitions are given in a separate section of this manual.

Tank capacity **Liquid tank Soundings and Ullage calculations**

Note: The tank/(tank combination) geometry must be uniquely defined by the Calc Sheets and Permeabilities given below. The correct Ship Lpp, xAP, yCL and z KL must be given in the first Sheet 01 !

Tank (combination):
 (Title 3): **Fore Peak Water Ballast Tank**

No of Calc Sheets:	1	PermVol:	
Sheet 01 :	FP Calc		1
(Sheet 02):			
(Sheet 03):			
(Sheet 04):			
(Sheet 05):			
(Sheet 06):			
(Sheet 07):			
(Sheet 08):			
(Sheet 09):			
(Sheet 10):			
(Sheet 11):			
(Sheet 12):			

Floating Condition:
 trim:
 heel:

Soundings position (bottom):
 x: y: z:

Ullage position (top):
 x: y: z:

No of steps:
 z-step (m):

Liquid density (ton/m³):

(if no Liquid density is given, Volumes will be calculated instead of Weight)

Hyss 2.00 Pro TANK CAPACITY 1(1)
 NB378 Fore Peak Tank
 Preliminary

Tank Capacity Measurements Fore Peak Water Ballast Tank

	Volume (m³)	LCG (m)	TCG (m)	VCG (m)
Full Tank Capacity :	157.097	147.982	0.000	5.194

trim (m) : 0.000 Liquid density (ton/m³) : 1.025
 Heel (°) : 0.000

Soundings measurement position (bottom) : x: 145.000 y: 0.000 z: 0.000
 Ullage measurement position (top) : x: 145.000 y: 0.000 z: 11.000

All measurements are made from position and vertically in ship-fixed coordinates

Soundings (m)	Ullage (m)	Weight (ton)	LCG (m)	TCG (m)	VCG (m)	dens*V (tonm)
0.000	-11.000	0.000	0.000	0.000	0.000	0.000
0.250	-10.750	0.181	145.850	0.000	0.159	0.024
0.500	-10.500	0.704	146.275	0.000	0.331	0.125
0.750	-10.250	1.701	146.670	0.000	0.510	0.415
1.000	-10.000	3.315	147.028	0.000	0.692	1.125
1.250	-9.750	5.530	147.285	0.000	0.867	2.016
1.500	-9.500	8.253	147.462	0.000	1.036	3.285
1.750	-9.250	11.527	147.606	0.000	1.204	5.051
2.000	-9.000	15.384	147.734	0.000	1.373	7.431
2.250	-8.750	19.780	147.845	0.000	1.541	9.568
2.500	-8.500	24.596	147.937	0.000	1.705	11.973
2.750	-8.250	29.834	148.014	0.000	1.866	14.778
3.000	-8.000	35.506	148.083	0.000	2.028	18.018
3.250	-7.750	41.561	148.144	0.000	2.188	20.266
3.500	-7.500	47.880	148.198	0.000	2.344	22.438
3.750	-7.250	54.470	148.246	0.000	2.500	24.804
4.000	-7.000	61.331	148.291	0.000	2.653	27.379
4.250	-6.750	68.354	148.330	0.000	2.805	27.367
4.500	-6.500	75.307	148.360	0.000	2.950	26.622
4.750	-6.250	82.179	148.384	0.000	3.090	25.896
5.000	-6.000	88.974	148.404	0.000	3.226	25.188
5.250	-5.750	95.531	148.417	0.000	3.356	20.723
5.500	-5.500	101.481	148.422	0.000	3.474	15.795
5.750	-5.250	106.792	148.420	0.000	3.581	11.815
6.000	-5.000	111.467	148.411	0.000	3.677	8.642
6.250	-4.750	115.300	148.396	0.000	3.759	4.101
6.500	-4.500	117.729	148.372	0.000	3.812	1.780
6.750	-4.250	119.298	148.348	0.000	3.849	1.376
7.000	-4.000	120.827	148.325	0.000	3.888	1.348
7.250	-3.750	122.375	148.303	0.000	3.928	1.375
7.500	-3.500	123.959	148.281	0.000	3.972	1.436
7.750	-3.250	125.646	148.259	0.000	4.022	1.743
8.000	-3.000	127.481	148.236	0.000	4.077	2.095
8.250	-2.750	129.481	148.213	0.000	4.140	2.732
8.500	-2.500	131.740	148.189	0.000	4.212	3.713
8.750	-2.250	134.270	148.164	0.000	4.295	4.910
9.000	-2.000	137.067	148.138	0.000	4.389	6.343
9.250	-1.750	140.156	148.111	0.000	4.493	8.457
9.500	-1.500	143.663	148.084	0.000	4.613	11.502
9.750	-1.250	147.597	148.057	0.000	4.746	15.223
10.000	-1.000	151.958	148.029	0.000	4.894	19.691
10.250	-0.750	156.782	148.003	0.000	5.055	25.584
10.500	-0.500	161.025	147.982	0.000	5.194	0.000
10.750	-0.250	161.025	147.982	0.000	5.194	0.000
11.000	0.000	161.025	147.982	0.000	5.194	0.000

User: M Huss Naval Architect Date: 2003-09-14 Time: 15.23.35

Stretch Geom.

Stretch Geom.

Exec

The buttons initiate iterative calculations where the hull geometry is stretched in order to reach specific displacement and LCB. The stretching is performed with special fairing functions which as far as possible maintain a smooth hull form. The output Sheet reflects the characteristics of the new stretched geometry, but no changes are actually made in the original Calc Sheets. However, stretching parameters are transferred to HyssLines from where new geometry Sheets may be created.

The two lines drawings on the next page show the effect of the stretching in this example. Note that the longitudinal positions of the sections have been changed. Since the stretched ship has lower displacement and more aft LCB, the stretching is most visible in the foreship.

Stretch geometry

Stretching means changing the sections x-coordinates to adjust LCB and slenderness.
 With this module, the stretch parameters necessary for achieving the target condition, are calculated.

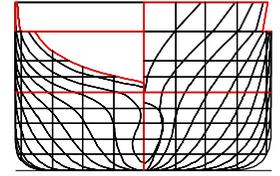
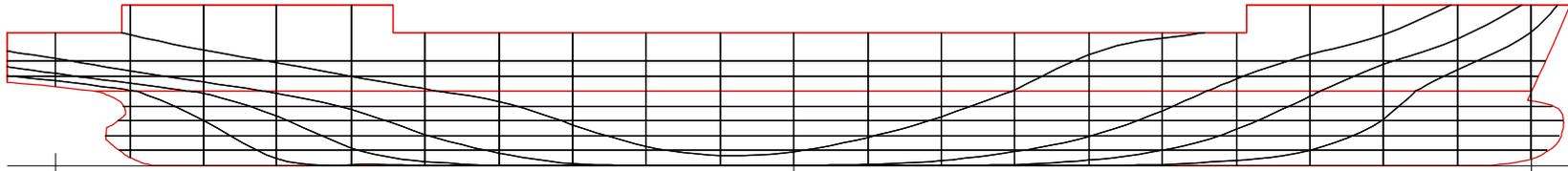
Target condition:	
T (m):	7.505
trim (m):	0
Displacement (ton):	16450 (if blank, the original Displacement is maintained)
LCB fwd AP (m):	72 (if blank, the original LCB is maintained)
original xfull, (m):	68 (if blank, Lpp/2 is assumed)

Note 1: The original Calc Sheet is not changed but parameter results are transferred to HyssLines for further modifications of Sheet coordinates.

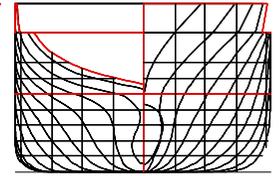
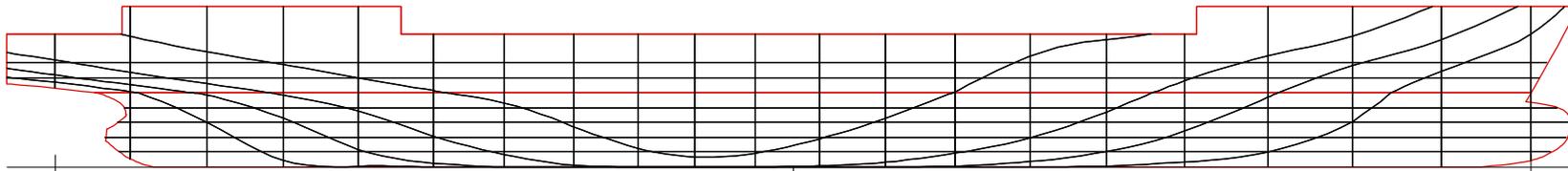
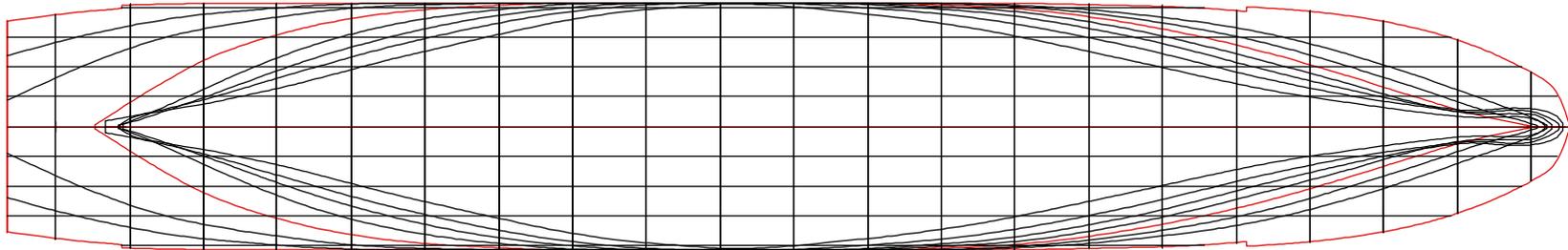
Note 2: The stretch parameters will be printed in the Hsp output Sheet as Title 1.

Note 3: If a combination of Calc Sheets are stretched, Lpp is taken from the Main Sheet 01.

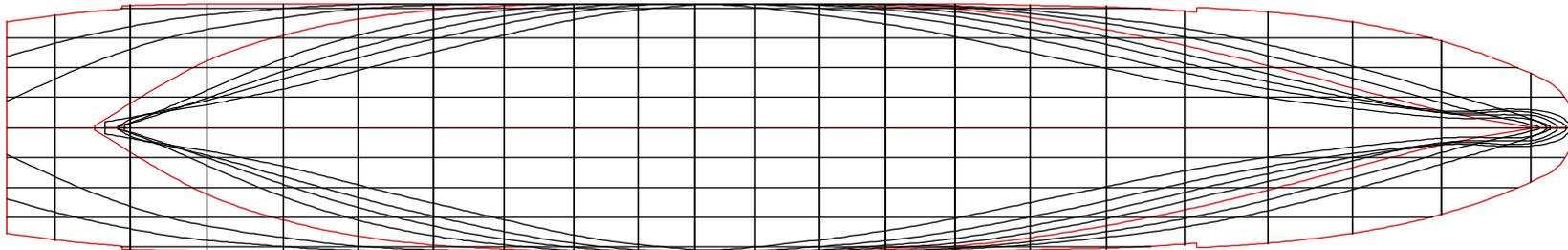
Hyss 2.00 Pro		STRETCHED HYDROSTATICS		1(1)
NB378 Cargo Vessel, L=150.000				
Preliminary				
CS Stretched: L0=150.000; m0=68.000; m1=65.452; s2=-17.021				
Dens SW =1.025 ton/m ³		ORIGINAL:	STRETCHED:	
Draught mid at L/2 (m) :	7.505	7.505		
Trim (pos aft) (m) :	0.000	0.000		
Heel a (pos ps) (deg) :	0.00	0.00		
Displacement SW (ton) :	17344.10	16450.00		
Displacement vol (m ³) :	16921.07	16048.78		
LCB fwd AP (m) :	73.492	72.000		
TCB ps CL (m) :	0.000	0.000		
KB (m) :	4.048	4.068		
Waterplane Area (m ²) :	2731.59	2625.55		
LCF fwd AP (m) :	71.768	70.251		
TCF ps CL (m) :	0.000	0.000		
KF (m) :	7.505	7.505		
I - transv (m ⁴) :	113348.6	105717.0		
KN - transv (m) :	0.000	0.000		
dKN/da (m/rad) :	10.750	10.659		
I - longit (m ⁴) :	3143277	2894698		
KM - longit (m) :	189.81	184.44		
Wetted Length (m) :	155.63	156.27		
L-aft fw AP (m) :	-3.00	-3.00		
L-fore fw AP (m) :	152.63	153.27		
max WL Breadth (m) :	25.02	25.02		
max Section Area (m ²) :	184.9	184.9		
Wetted Surface (m ²) :	4257	4158		
CB :	0.601	0.570		
CP :	0.610	0.579		
CWA :	0.728	0.699		
TPcm (ton/cm) :	27.999	26.912		
MTcm (tonm/cm) :	209.06	192.40		
KG (m) :	9.000	9.000		
TCG (m) :	0.000	0.000		
GZ (m) :	0.000	0.000		
dGZ/da (m/rad) :	1.750	1.659		
Comp. Displacement (ton):				
Hull(1.000)	17326.45	16434.08		
Rudder(1.000)	27.28	27.29		
BowThruster(-0.880)	-9.64	-11.37		



NB378 ORIGINAL



NB378 STRETCHED



Power



The buttons initiate several different calculations related to the ship resistance and propulsion. The basis of the resistance calculations is the well known regression method as published by Holtrop et al. which uses a wide variety of different ships resistance data. Most of the necessary data for the method may be directly calculated from Hyss.xls for a ship where the geometry is defined. However, it is also possible to use the method for any other ship, but then more detailed data must be given as input. The input format includes some information for guidance and several of the parameters are automatically set as default to facilitate preliminary calculations.

The propulsion calculations use Holtrops analysis for ship propulsive coefficients and the well known NSMB B-series for propeller characteristics and optimization.

In order to optimize a propeller, design point data have to be given instead of propeller data. If propeller data (diameter, pitch ratio, blade area ratio) is given explicitly, no optimization will be performed.

A full calculation will result in three different output Sheets for Resistance, Power and Propeller data. It is also possible to restrict the calculations to include only resistance and then no propulsion data are needed.

The printouts on the following page show power, resistance and propulsion results from a complete calculation of the same sample ship that has been used for all other examples. More detailed information is available outside of the preset print area which can be used for creating user defined diagrams.

Power Resistance, Propulsion and Power Calculations (Holtrop-84, Oosterveldt-75 et al.)

(Title3):

Conditional Data: visc (m²/s): (Optional) Roughness (microm): (Optional)

Floating Condition: T: trim:

General Hull Data:

Calc. General Hull Data? (Y/N):

Displacement vol (m ³):	<input type="text"/>
Waterline length, LWL (m):	<input type="text"/>
LCB %LWL fwd LWL (m):	<input type="text"/>
max WL Breadth (m):	<input type="text"/>
Midship section coeff. CM (-):	<input type="text"/>
Waterpl. Area coeff. CWA (-):	<input type="text"/>
Wetted Surface (m ²):	<input type="text"/> (Optional)

Note: if Hull Data are calculated then results will be filled in automatically in empty fields only

Additional Hull Data:

Wetted Area of Appendices (m ²):	<input type="text" value="120.0"/> (Default)	Info
Appendices Form Coeff., 1+k2 (-):	<input type="text"/>	Info
Bulb Sect. Area (m ²):	<input type="text" value="14"/> (Default)	Info
Center of Bulb above KL (m):	<input type="text" value="4.2"/> (Default)	Info
Submerged Transom Area (m ²):	<input type="text"/>	Info
Stem coefficient (-):	<input type="text"/>	Info

Propulsion:

Propulsion Type (-):	<input type="text"/>	Info
No of Propellers:	<input type="text"/>	(Default)
Propeller Diameter (m):	<input type="text" value="5.2"/> (Default)	Info
Propeller clearance from KL, (m):	<input type="text" value="0.2"/> (Default)	Info
No of blades (-):	<input type="text" value="4"/> (Default)	Info P)
Pitch ratio, P/D (-):	<input type="text"/>	(Optimized) P)
Blade area ratio, Ae/Ao:	<input type="text"/>	(Optimized) P)

Design point:

MCR Power (kW):	<input type="text" value="8500"/> (Default)	Info
Design speed for opt. Propeller (kn):	<input type="text" value="18.5"/> (Default)	Info
Shaft rpm att design speed (rpm):	<input type="text" value="140"/> (Default)	Info
Spec. FC at design speed (g/kWh):	<input type="text" value="170"/> (Optional)	Info

Calculations:

Speed:	No of V: <input type="text" value="20"/>	Calc. Resistance? (Y/N): <input type="text" value="Y"/>
	Vmin (kn): <input type="text" value="10"/>	Calc. Propeller Curves? (Y/N): <input type="text" value="Y"/> P)
	Vstep: <input type="text" value="0.5"/>	Calc. Power and FC? (Y/N): <input type="text" value="Y"/>

Notes:

Resistance and Power may be calculated directly for a given hull geometry (defined by the Calc Sheets) using default values for all other data
To calculate Propeller Curves, only the data marked P) are necessary

Hyss 2.00 Pro
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POWER (HOLTROP-84) 1(1)

Power Calculations:
 Dens SW (ton/m³): 1.025
 Viscosity (m²/s): 0.0000012

General Hull Data:
 Draught mid at L/2 (m): 7.500
 Trim (pos aft) (m): 0.000
 Displacement vol (m³): 16890.2
 Waterline Length (m): 149.89
 LCB %LWL fwd LWL: -2.69
 max WL Breadth (m): 25.02
 CM: 0.984
 CWA: 0.727
 Wetted Surface (m²): 4176.2

Additional Hull data:
 Wetted Area of Appendices (m²): 120.0
 Appendices Form Coeff., 1+k2 (-): 1.5
 Bulb Sect. Area (m²): 14
 Center of Bulb above KL (m): 4.2
 Submerged Transom Area (m²): 0
 Stern coefficient (-): 0
 Hull Roughness (microm): 150

Propulsion Data:
 Propulsion Type (-): Normal
 No of Propellers: 1
 Propeller Diameter (m): 5.200
 Propeller clear. abv KL (m): 0.20
 No of blades (-): 4
 Pitch ratio, P/D (-): 0.850
 Blade area ratio, Ae/Ao: 0.691

Design Point and Fuel Consumption:
 Design speed for opt. Propeller (kn): 18.5
 Power at design speed (kW): 7718
 Shaft rpm at design speed (rpm): 140
 Spec. FC at design speed (g/kWh): 170
 FC at design speed (kg/h): 1313
 MCR Power (kW): 8500

User: M Huss Naval Architect Date: 2003-09-30 Time: 12.27.15

RESISTANCE (HOLTROP-84)

Power 1
 1.025
 0.0000012

Additional Hull data:
 Wetted Area of app: 7.500
 Appendices Form C: 0.000
 Bulb Sec: 16890.2
 Center of Bulb: 149.89
 Submerged Transo: -2.69
 Stern: 25.02
 Hull Roughn: 0.984
 0.727
 4176.2

Resistance (kN)

Date: 2003-09-30

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PROPELLER CURVES (B-SERIES, OOSTERVELDT-75) 1(1)

Propeller Curves:
 Dens SW (ton/m³): 1.025
 Viscosity (m²/s): 0.0000012

Propeller Data:
 No of blades (-): 4
 Pitch ratio, P/D (-): 0.850
 Blade area ratio, Ae/Ao: 0.691

(Ship Data):
 Diameter (m): 5.20

Propeller KT, KQ*10 and Eff at Rn 2*10⁶ (and dashed at ship Rn)

User: M Huss Naval Architect Date: 2003-09-30 Time: 12.27.22

Customize Hyss.xls

User interface

It is with Excel's standard functionality possible to customize the interface and windows in order to facilitate the work. When new lines are created it may be efficient to simultaneously view the Sheets for existing

geometry coordinates, for new created geometries and for plots together with the HyssLines program window. The windows may be scaled to appropriate percentage individually and adjusted to the screen size. All new plot Sheets created in an existing Workbook with scaled window will automatically be adjusted to fit the window size. However, new Workbooks created from

calculations will always appear in standard scaling and size.

Output Sheets

New output Sheets created from calculations are to their format and style copies of the output templates (Hst, Hlc, Hsp, ...) incorporated in the Hyss.xls Workbook. If the style in these template is changed, the new output Sheets will follow these changes. This may be used to customize printouts for a certain graphic profile e.g. including company logo, special fonts etc. in the templates. Fonts may, by the way, be changed in all Hyss.xls Sheets including HyssLines and HyssCalc. The default font used in the original application may not be included in the users local font library and will then be substituted to the users default Excel font.

The screenshot displays the Excel interface with the Hyss.xls workbook open. The left pane shows a data table with columns for various parameters and their values. The right pane contains a control panel for configuring the output sheets.

Parameter	Value 1	Value 2
CS Stretched: L0=150.000; m0=68.000; m1=65.462; s2=-17.021		
Dens SW =1.025 ton/m ³	ORIGINAL:	STRETCHED:
Draught mid at L2 (m):	7.505	7.505
Trim (pos arb) (m):	0.000	0.000
Heel a (pos ps) (deg):	0.00	0.00
Displacement SW (ton):	17344.10	16450.00
Displacement vol (m ³):	16921.07	16048.78
LCB \bar{x} AP (m):	73.462	72.000
TCB ps CL (m):	0.000	0.000
KB (m):	4.048	4.088
Waterplane Area (m ²):	2731.59	2625.55
LCF \bar{x} AP (m):	71.768	70.251
TCF ps CL (m):	0.000	0.000
KF (m):	7.505	7.505
I - transv (m ⁴):	113348.6	105717.0
KN - transv (m):	0.000	0.000
dKNda (m ² rad):	10.750	10.659
I - longit (m ⁴):	2143277	2894698
KM - longit (m):	189.81	184.44
Wetted Length (m):	155.63	156.27
L-ait \bar{x} AP (m):	-3.00	-3.00
L-fore \bar{x} AP (m):	152.63	153.27
max WL Breadth (m):	25.02	25.02
max Section Area (m ²):	184.9	184.9
Wetted Surface (m ²):	4257	4158
CB:	0.601	0.570
CP:	0.610	0.579
CWA:	0.728	0.699
TPom (ton/cm):	27.999	26.912
Mfcm (ton/cm):	209.06	192.40
KG (m):	9.000	9.000
TCS (m):	0.000	0.000
GZ (m):	0.000	0.000
dGZda (m ² rad):	1.750	1.659
Comp. Displacement (ton):		
Hull(1.000)	17326.46	16434.08
Rudder(1.000)	27.28	27.29
BowThruster(0.880)	-9.84	-11.37

The control panel on the right includes sections for:

- Plot Full Drawing (+1st)**: Section Sheet (Calc21 Str), WL Sheet (WL7-DWL Str), Btk Sheet (Btk4 Str).
- Plot Entire Sheets (+1st)**: No of Sheets (2), Section Sheet (DTP Calc).
- Plot Sections Drawing (+1st)**: Section Sheet (Btk4), No of Waterlines (0), WL min (m), WL step (m), No of Buttocks (0), Btk step (m).
- Stretch & Scale Sheet Coordinates**: original xtl, ml (m), new xtl, ml (m), fullness stretch, s2, xscale, yscale.

Cell references my not be changed!

The major limitation for adjustments is that no input or output cell positions may be changed neither in HyssLines, HyssCalc nor in the output templates. The absolute cell references are used by the program and changed references will therefore not be recognised but may lead to corrupt results or to program errors.

Post-processing of results

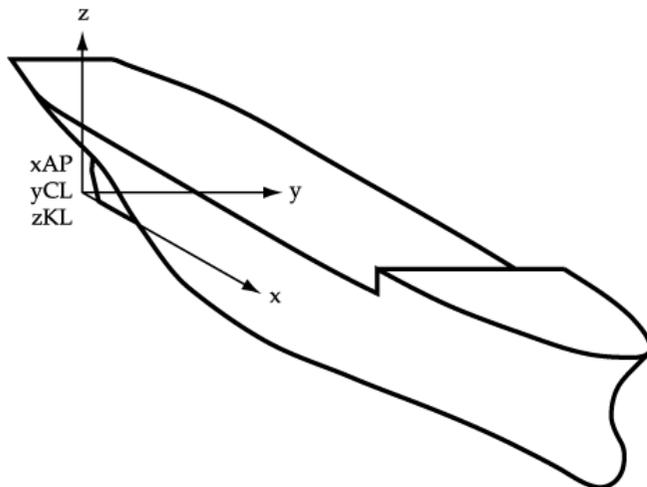
All results are stored as editable strings or numbers in the output Sheets. In some templates there are already included diagrams in other cases it is up to the user to create his own diagrams with input from the result tables using Excel standard functionality. The advanced user may also use VBA code or recordings in order to create different macros to post-process results in different ways. While macros in Hyss.xls are locked, the new Workbooks created by calculations are free to adjust and open for user defined macros.

Definitions

Ship-fixed system of coordinates

All coordinates used in geometry description, input and output Sheets refer to a ship-fixed system with the main directions: x pointing forward, y pointing to port side and z pointing upward.

The position reference, system origo, is in all calculation input and output defined as the cross-point between AP (aft perpendicular), CL (centre line) and KL (keel or base line). However it is possible to locally use a different reference point in the geometry Sheets. After reading the coordinates for the geometry, the program transform them according to the specified three local reference coordinates x_{AP} , y_{CL} and z_{KL} which are to be specified in all geometry Sheets. As an example, it is possible to use two identical geometry Sheet, one with $y_{CL} = -4$ and the other with $y_{CL} = +4$. The resulting geometry, if both are used, will represent a twin hull geometry with the distance between the hulls 8m, (the first Sheet in this example will represent the port side hull and the other the starboard hull).



Length, draught, trim, heel

The ship (characteristic) length is specified in the geometry Sheet at the Lpp position. The given length will be used for defining trim, form coefficients such as C_b and in some cases also in the stability criteria. If a geometry is consisting of parts defined in separate Sheets, the definition of length will be taken only from the first (main) Sheet. As a standard procedure it is however advisable to always specify the same Lpp for all Sheets referring to the same ship.

The ship-fixed system of coordinates used throughout the program leads to a definition of draught as the z -distance between KL and the water surface cross points with the CL-plane, both measured at Lpp/2 for mean draught. In a condition when the ship is floating at exactly 90° heel, this leads to an infinite draught! To avoid numerical problems in this condition $\pm 89.999^\circ$ heel is in calculations substituted with $\pm 89.999^\circ$ which in practice has no influence on the floating condition nor on hydrostatic data.

The trim is defined as the difference in draught between AP ($x=0$) and FP ($x=L_{pp}$) with the above given definition of draught. Positive trim is defined as a positive rotation of the waterline around the y -axis, i.e. stern down.

In a similar way as for trim, positive heel is defined as a positive rotation of the waterline around the x -axis, i.e. port side down.

Mean thickness

In the geometry Sheets it is possible to define a general mean thickness (thm) of the hull surface. This thickness gives in conjunction with hydrostatical calculations a contribution of displacement approximately equal to the thickness times the wetted surface. However, since it only is an approximation, care should be taken in

applying a large thickness. In such cases it is far better to use the outer surface for geometry description instead of the moulded surface.

The mean thickness is used in the same way in all type of calculations. This means that if the geometry represents an internal tank or flooded compartment, the thickness is still added to the volume (not subtracted). For flooded geometries (displacement subtractions) the mean thickness is generally to be zero.

The (moulded) draught is the only measure which is not affected by the mean thickness. The reason for this is that the draught needs to be defined independent of whether the geometry is given as an addition or a subtraction of displacement.

Displacement, combined geometries

The ship displacement is given either as volume (m^3) or as mass (ton) where the density of seawater (ton/m^3) is defined within the general input to calculations.

The centre of buoyancy (displacement) is given as LCB, TCB and KB (VCB) in the three main directions of the ship-fixed system of coordinates.

When a geometry is given by several separate Calc Sheets (combined geometry) the resulting displacement is the sum of all contributions (positive or negative). Note that there is no check whether one geometry overlap another. If two identical geometry Sheets are used to define a hull, both with the given permeability 1.0, the resulting displacement will be twice as large as the displacement of one of the geometries, (but the centre of buoyancy will be the same). If one of the two identical geometries is used with permeability -1.0, the resulting displacement will be zero.

Waterplane area, moment of inertia and hull surface

The waterplane area (WA) is calculated including the mean thickness. The same goes for the moment of inertia around the x-axis (I_x) and the y-axis (I_y). They both refer to the centre of floatation defined by LCF, TCF and KF (VCF) in the ship-fixed system of coordinates. Note that these moment of inertia are equal to the principal moments of inertia only in the specific case when the waterplane area is symmetrical with respect to the CL.

The wetted surface given as result in some of the hydrostatic calculations is developed along the sections but not developed along the waterlines. The actual wetted surface is thus somewhat larger than the calculated one.

Metacentre

The metacentre is a virtual point in space describing the cross-line of displacement force vectors for small changes of heel or trim. It used to play a significant role in former hand calculations of stability but has limited value in a more strict physical descriptions. Furthermore, unfortunately there are several different definitions of the metacentre.

In order to avoid any misinterpretations of results from HyssCalc, the term metacentre is only used for 0° heel where the vertical position of metacentre, KM, still is used due to the tradition. In all other connections the derivatives of KN or GZ with respect to heel or trim is used as a more concise description of initial stability characteristics. These derivatives, dKN/da or dGZ/da , are obtained from iterative calculations with free floating condition (constant displacement and CG) which for non-symmetric displacement gives a more exact description than a "static" metacentre based on waterplane area moment of inertia. For 0° heel or trim, $KM = dKN/da$ and the metacentre height $GM_0 = dGZ/da$.

Description of stability

The stability characteristics are in the calculation results described as KN and GZ and where applicable also by derivatives or integrations of these.

KN is a measure of the form stability (independent of centre of gravity) as defined below. A common alternative to KN is to use MS for form stability description. MS is related to the deviation of metacentre from the initial value (M_0). The interrelation between KN and MS is illustrated in the figure where also other significant stability characteristics are defined. The figure shows an example where the centre of mass (G) is positioned in the CL (TCG=0). In case of unsymmetrical loading, the equations below are the only strictly well defined quantities to be used to describe the stability.

For transverse stability (heel):

$$GZ_T(\phi) = KN_T(\phi) - (TCG \cos\phi + KG \sin\phi)$$

$$KN_T(\phi) = (TCB \cos\phi + KB \sin\phi)$$

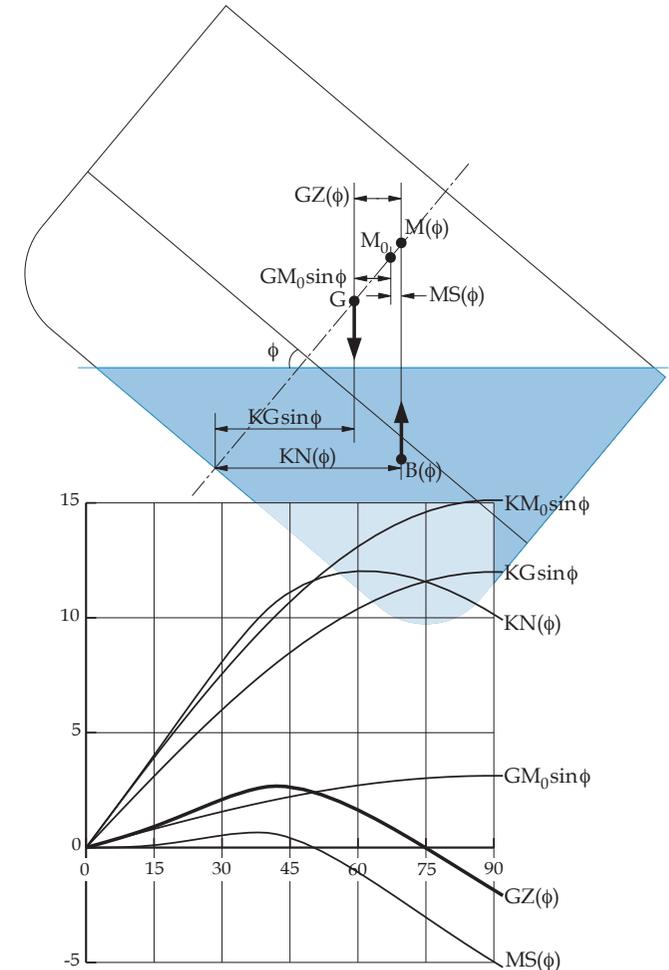
For longitudinal stability (trim):

$$GZ_L(\theta) = (LCG \cos\theta - KG \sin\theta) - KN_L(\theta)$$

$$KN_L(\theta) = (LCB \cos\theta - KB \sin\theta)$$

where ϕ is the angle of heel and θ is the angle of trim, ($\theta = \arctan(\text{trim}/L_{pp})$).

The difference in signs follows from the definition of coordinate system.



When TCG = 0 the following relations are valid for transverse stability:

$$GZ(\phi) = KN(\phi) - KG \sin\phi$$

$$GZ(\phi) = MS(\phi) + GM_0 \sin\phi$$

$$KN(\phi) = KM(\phi) \sin\phi = KM_0 \sin\phi + MS(\phi)$$

Sources of error

All programs for calculations of hydrostatics and stability and for hull geometry modelling includes approximations and simplifications. Most programs do these approximations without the possibility for the user to judge how they affect the results or without the possibility to influence the accuracy. However, in Hyss.xls it is possible to achieve full control over the precision.

The final precision in modelling and calculations is affected by the following sources of error:

Information about the hull geometry

Simplification in connection with geometry modelling.

Precision in numerical procedures

Precision in iterative calculations

These sources of error are briefly discussed here. In all cases it is of utter importance to critically judge the conditions for the work and in case of uncertainty test different degrees of refinement until the necessary accuracy is ascertained. Besides the “natural” sources of error there is also the risk of introducing erroneous data. In order to eliminate mistakes by “human factors”, strict self-control routines should be used together with a continuous check of reasonableness of calculation results. The most effective way to check results is to use the possibility of plotting geometry and results. It is always much more easy to visually observe anomalous behaviour than to check tables of numerical data.

Prime information about the hull geometry

When an existing hull is to be modelled the prime source of information is usually copies of drawings. A high quality, hand-made drawing of lines can be expected to have an accuracy of about 1 mm measured in the scale of the drawing; a CAD drawing may of course be much more precise. When coordinates are picked from a drawing by scanning or direct measurements, it is important to check and calibrate the scale by using prescribed measures in both main directions of the drawing. As far as possible the measures should be based on the closest possible specified ruler lines in the drawing in order to avoid cumulative errors. Under good conditions, the measuring should be possible to perform with a precision below 1 mm. For an ordinary sections drawing of a ship in the scale 1:100 the coordinates should be possible to specify within an inch in full scale. This means an error significantly less than 1% related to the displacement; in good conditions the error should not exceed 0.2%.

Simplification in connection with geometry modelling

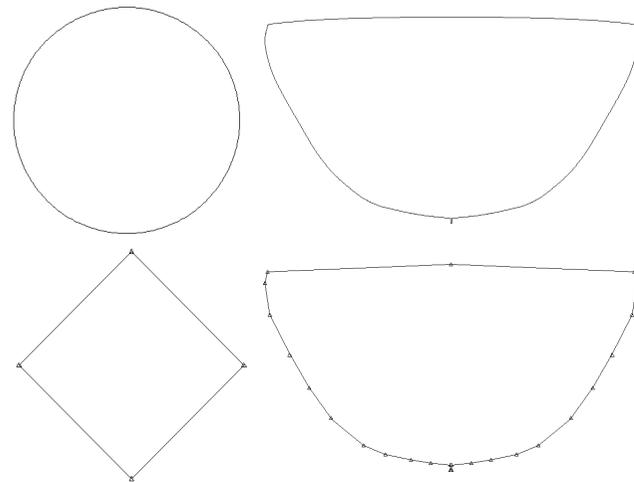
When the hull is modelled in HyssLines by specifying coordinates and lines, the accuracy will be dependent on the amount of work one is prepared to put into the project. In general, with a careful modelling, the modelling errors should be possible to keep at the same level as the errors in measurements from drawings. Since these two sources of errors in practice can be treated as independent of each other, the cumulative error on displacement should be possible to keep below 0.2-0.4%.

Precision in numerical procedures

Calculation procedures for hydrostatics and stability in HyssCalc, made with the section-based geometry description, includes two levels of integration. First sectional data like area and centre of area are integrated from the sections geometry and thereafter these data are integrated in the longitudinal direction to achieve displacement and centre of buoyancy etc. The sectional integration is performed with a polar method which is exact with respect to the straight line segments as given in the Calc Sheet. The only source of error at this stage is introduced by the division of curved lines into straight line segments (as done by converting the Sections Sheet to a Calc Sheet).

Example of convergence - line segments

To illustrate the influence from segmentation of curved lines, two examples of section area calculations are shown below, one for a circle and one for the full midship section of the icebreaker St Erik from Example 2.2. The circle is defined by 4 coordinate points (one for each quadrant) while the midship section is defined by 25 points, which is a representative number for ordinary ship sections. In the latter case an accuracy better than the expected modelling accuracy as discussed above is achieved already with a division of each line between coordinate points into 5 segments. For the circle a similar accuracy requires 20 segments because of the low number of guiding coordinate points. The figures shows the sections described by 50 and by 1 segment respectively.



	Circle Sect Area	Diff %	St Erik Sect Area	Diff %
Analytical	78.540	0.00	-	-
50 segments	78.527	-0.02	119.189	0.00
20 segments	78.459	-0.10	119.183	-0.01
10 segments	78.217	-0.41	119.161	-0.02
5 segments	77.254	-1.64	119.073	-0.10
3 segments	75.000	-4.51	118.872	-0.27
1 segment	50.000	-36.34	117.204	-1.67

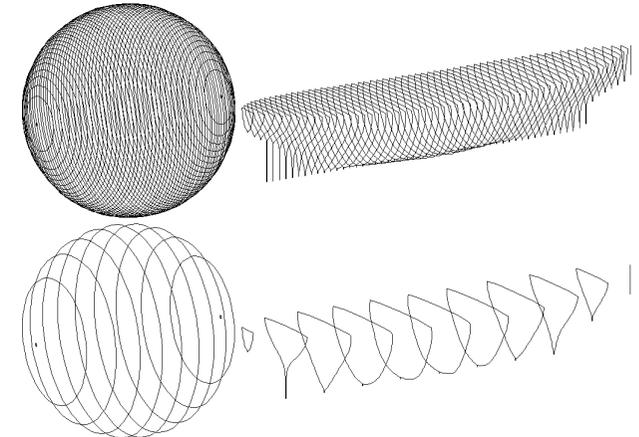
Example of convergence - number of sections

The longitudinal integration of section data is performed with a piece-wise third-degree polynomial approximation procedure. The polynomial function for each distance between two sections is governed by the four surrounding values and stabilised to avoid any overturn in relation to the sectional values at the ends. If one of the end values is zero, the previous polynomial is extrapolated to find the zero crossing point within the distance. In order to achieve a high level of accuracy the sections should be narrow spaced at the hull ends.

The following examples illustrate convergence related to the sectional spacing. The sphere from Example 1.4 and the hull of St Erik from Example 2.2 has been divided into different number of sections with equal spacing. All sections for the sphere have been modelled with 20 line segments between coordinate points and the sections for St Erik with 5 line segments (see the example above). The three tables show the convergence of Displacement, LCB and KM respectively. The attached figures show the geometry description with 61 and with 11 sections.

An accuracy better than can be expected from measurements is achieved with only 11 sections for the sphere, and the actual small deviation from the analytical displacement arises from the line segmentation rather than from the sectional division. The reason for this stable and high precision is that the smooth geometry of a sphere fits the integration procedure well. However, to achieve this precision it is necessary to include sections very close to the geometry ends, since the extrapolation of polynomial description is not performed outside of the last sections. In the example the first and last sections have been created 0.001 m inside of the end points.

The hip hull geometry needs at least 21 equally spaced sections to reach the same level of accuracy. Less sections makes it impossible to represent the aft and fore ends in sufficient detail. If one uses a more narrow spacing at the ends, the necessary total number of sections would decrease. LCB (and LCF) are more sensitive to the spacing at the ends than the displacement



	Half Sphere		St Erik T=6m	
	Displacement	Diff %	Displacement	Diff %
Analytical	261.799	0.00	-	-
61 sections	261.460	-0.13	2262.114	0.00
41 sections	261.460	-0.13	2262.540	0.02
21 sections	261.454	-0.13	2265.646	0.16
11 sections	261.457	-0.13	2248.433	-0.60

	Half Sphere		St Erik T=6m	
	LCB	Diff %	LCB	Diff %
Analytical	5.000	0.00	-	-
61 sections	5.000	0.00	24.685	0.00
41 sections	5.000	0.00	24.680	-0.02
21 sections	5.000	0.00	24.632	-0.21
11 sections	5.000	0.00	24.783	0.40

	Half Sphere		St Erik T=6m	
	KM	Diff %	KM	Diff %
Analytical	5.000	0.00	-	-
61 sections	5.001	0.02	7.962	0.00
41 sections	5.001	0.02	7.961	-0.02
21 sections	5.001	0.02	7.950	-0.15
11 sections	5.001	0.02	7.972	0.13

Even though general conclusions cannot be drawn from these examples, they show that a very high level of accuracy may be reached if a sufficiently detailed geometry description is used. Hyss.xls may handle a very large number of segments and sections without excessive calculation time (at least on a PC under Windows operating system). Therefore numerical procedure based errors can be kept far below other sources of errors.

Precision in iterative calculations

The incremental stability dKN/da is always calculated for constant displacement with free draught and trim found by iteration and also in calculations for given loading conditions, the complete floating condition (draught, trim and heel) is found by iteration. The convergence criterion is based on the parameter **eps** as given among the general data in HyssCalc. The default value for **eps** is 0.001 which normally gives an insignificant error in equilibrium draught, trim (less than 0.5 mm) and heel (less than 0.01°). Under some conditions the program may have difficulties in finding full convergence during iterations. In these cases it is possible to adjust the number of iterations **itermax** or the precision criterion **eps**.

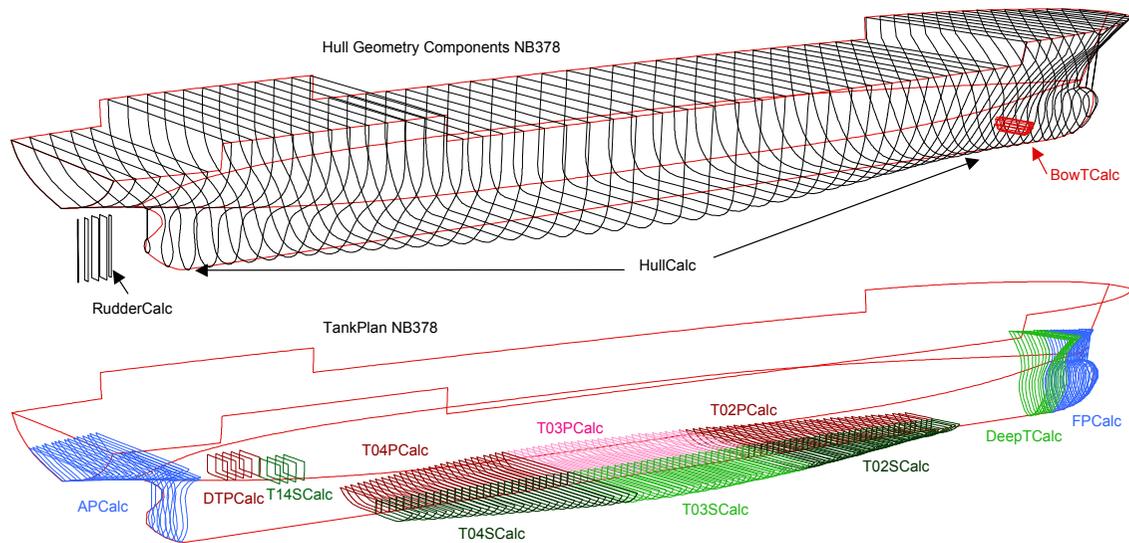
When iterations have failed, a warning message is included in the result tables but the calculations will continue. Usually these warnings are not critical since the accuracy still may be far better than the printed significant numbers in the presented results. However, a warning should always be treated as a trigger to extra careful examination of the results.

Even though each geometry needs special considerations, some general advice for reaching high precision may be of value:

Guidance for high accuracy

1. Always check the scale in drawings in both main directions since drawings may be distorted significantly when copied.
2. Plot the geometry model from several different perspectives and with different divisions, to assure that it does not include any local errors. Always make a separate plot of the Calc Sheet to be used in calculations.
3. A full hull section with curved lines should generally be defined by 50-100 line segments in total. When no knuckles can be observed in a full screen plot, the number of segments usually is sufficient.
4. Use generally at least 20-40 sections to describe a curved ship hull.
5. Special care should be taken with respect to the number of sections at the aft and fore ends of the hull. Preferably use more narrow spaced sections at ends compared to the midship part of the hull.
6. If the geometry includes steps in the longitudinal directions, at least two narrow spaced sections should be positioned at each side and close to the step. This is for instance applicable to superstructures that are included in the model.
7. Make it a routine to plot at least some table of calculation results in order to validate the model and possibly detect any discontinuous behaviour that may indicate malfunctions or insufficient modelling.
8. Always check the reasonableness in results!

HYSS Manual



Hyss 2.20 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

LOAD CONDITION DATA

Full Load Arrival Condition
Condition Data (Page 2)

(ton)	LCG:	G:	KG:	(KG)
2.65	2.868	01	8.035	8.035

Floating Condition
Displacement: 1.025 ton

Draft mid (m):	5.14
Trim (post) (m):	535
Heel a (post) (deg):	0.03
Z/da' (=GM) (m/rad):	497

Calculation	W (ton)	LCG	TCG	KG	KG
FP WB (100%)	161.02	147.362	0.000	0.134	1.025
DeepT WB (20%)	32.80	142.472	0.000	2.040	1.025
T02S HFO (15%)	43.76	99.659	-2.987	0.154	0.920
T02P HFO (15%)	43.76	99.621	3.007	0.154	0.920
T03S HFO					
T03P HFO					
T04S HFO (15%)	48.40	48.404	-3.885	0.135	0.920
T04P HFO (15%)	48.40	48.432	3.916	0.134	0.920
T14S GO (85%)	17.54	20.498	-2.000	6.850	0.860
DayTP HFO (85%)	24.98	16.997	2.003	6.850	0.920
AP WB					

Tank Summary :

W (ton)	LCG:	TCG:	KG:
420.65	101.492	0.041	2.903

Version 2.2 Part 2 - Examples

About the examples

The examples in this Part 2 of the Manual range from very simple "How to do" examples to more advanced ones open for discussion about the methodology and physics.

It is not the intention to cover every aspect of the program and its functions. The only way to learn to master the program is actually to use it and use it in a reflective way.

Possibly more examples may be published on the web as separate documents. I also encourage anyone to submit examples to me, that may be published either as illustrations or as working documents for the benefit of everyone.

The "Gallery" on the web is also open for anyone to submit nice geometry plots of different ships. The plots are published as .gif or .png pictures so that the geometry will not be possible to use for other purposes.

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HyssLines

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2. Examples

Example 1.1 Create a square prism

Step 1: Write data in a new Lines Sheet

We start the modelling examples by creating a square prism (block) defined by the four knuckle lines representing the section corners along the length of the prism.

Step 1: Open a new Workbook and write coordinate data for the 4+1 corner lines in a Lines Sheet according to the figure. Lines must always (within their valid length) be given in sequence as a successive clockwise rotation around the section if they are to be used for creating sections. The final fifth line is actually not necessary but it is a good practice to always define lines that form a closed body. (If the last returning line which is a copy of the first, is omitted, the program will automatically assume that a copy of the first line is to be added as the last when new sections are created).

The 0-values for coordinates and curvature parameters may be omitted since empty numerical cells are interpreted as =0. However, the Lines Sheet will then be more difficult to read and adjust. When min and max point number for lines are omitted, the whole line is assumed to be valid for section generation.

This first Lines Sheet forms a prism with a length of 10m and squared section with 8m diagonal. Further explanations to the different values are given after the figure.

Rename the new Lines Sheet to e.g. **1.1_Lines** and save the whole Workbook as e.g. **Example1.xls** but leave it open and active.

	1	2	3	4	5	6	7
1	Lines						
2	Example 1.1						
3	10						
4	0	0	0				
5	0						
6	5						
7	#1	Bottom Line					
8	0	0	0	0	0	0	0
9	10	0	0	0	0	0	0
10	2	1	2				
11	0	0	0	0	0		
12	10	0	0	0	0		
13	#2	Portside line					
14	0	0	0	0	0	0	0
15	10	0	0	0	0	0	0
16	2	1	2				
17	0	4	4	0	0		
18	10	4	4	0	0		
19	#3	Top line					
20	0	0	0	0	0	0	0
21	10	0	0	0	0	0	0
22	2	1	2				
23	0	0	8	0	0		
24	10	0	8	0	0		
25	#4	Starboard line					
26	0	0	0	0	0	0	0
27	10	0	0	0	0	0	0
28	2	1	2				
29	0	-4	4	0	0		
30	10	-4	4	0	0		
31	#5	Bottom Line					
32	0	0	0	0	0	0	0
33	10	0	0	0	0	0	0
34	2	1	2				
35	0	0	0	0	0		
36	10	0	0	0	0		

Explanation to the different input values:

Cell R1C1: Specifies the type of geometry Sheet
 Cell R2C1: Any chosen name of the geometry
 Cell R3C1: Lpp
 Cell R4C1: xAP, Cell R4C2: yCL, Cell R4C3: zKL
 (local coordinates for origo)
 Cell R5C1: Mean thickness of shell surface
 Cell R6C1: Number of lines

Cell R7C1: Number of the first line (optional)
 Cell R7C2: Name of the first line (optional)
 Cell R8C1: xmin (lower x-coordinate for the valid length of the line)
 Cell R8C2: Change of line (backward)type at xmin (change of tangent length and direction backwards for sections created from the line; 0 specifies no change, 1 specifies linear change towards xmax)
 Cell R8C3: Change of line (forward)type at xmin (change of tangent length and direction forwards for sections created from the line; 0 specifies no change, 1 specifies linear change towards xmax)
 Cell R8C4: Tangent length backwards to be used for sections crossing the line at xmin (0 gives a knuckle, 1 gives a standard tangent length for a smooth curvature)
 Cell R8C5: Tangent length forwards to be used for sections crossing the line at xmin (0 gives a knuckle, 1 gives a standard tangent length for a smooth curvature)
 Cell R8C6: Tangent direction backwards to be used for sections crossing the line at xmin (0 gives a standard smooth direction, -1 gives a direction towards the previous point, +1 gives a direction towards the next point)
 Cell R8C7: Tangent direction forwards to be used for sections crossing the line at xmin (0 gives a standard smooth direction, -1 gives a direction towards the previous point, +1 gives a direction towards the next point)

Note that backwards and forwards in this context refer to sections curvature when crossing the line. (It has nothing to do with the curvature of the line itself).

In our example, all lines are knuckle lines for the sections, thus all line type parameters are given 0 values.

Similar to the data for line type at xmin, line type parameters at xmax is given:

Cell R9C1: xmax (upper x-coordinate for the valid length of the line)

Cell R9C2: Change of line (backward)type at xmax (change of tangent length and direction backwards for sections created from the line; 0 specifies no change, 1 specifies linear change towards xmin)

Cell R9C3: Change of line (forward)type at xmax (change of tangent length and direction forwards for sections created from the line; 0 specifies no change, 1 specifies linear change towards xmin)

Cell R9C4: Tangent length backwards to be used for sections crossing the line at xmax (0 gives a knuckle, 1 gives a standard tangent length for a smooth curvature)

Cell R9C5: Tangent length forwards to be used for sections crossing the line at xmax (0 gives a knuckle, 1 gives a standard tangent length for a smooth curvature)

Cell R9C6: Tangent direction backwards to be used for sections crossing the line at xmax (0 gives a standard smooth direction, -1 gives a direction towards the previous point, +1 gives a direction towards the next point)

Cell R9C7: Tangent direction forwards to be used for sections crossing the line at xmax (0 gives a standard smooth direction, -1 gives a direction towards the previous point, +1 gives a direction towards the next point)

Cell R10C1: Number of points along the line

Cell R10C2: Pmin, (lowest number of point for the valid part of the line; may be omitted if all points are to be valid)

Cell R10C3: Pmax, (highest number of point for the valid part of the line; may be omitted if all points are to be valid)

repeated for all points along the line:

Cell R11C1: x-coordinate for the point

Cell R11C2: y-coordinate for the point

Cell R11C3: z-coordinate for the point

Cell R11C4: tangent length backwards for the line at the point (0 indicates knuckle, 1 indicates standard smooth curvature backwards)

Cell R11C5: tangent length forwards for the line at the point (0 indicates knuckle, 1 indicates standard smooth curvature forwards)

Cell R11C6: tangent direction backwards for the line at the point (0 gives standard smooth direction, -1 gives direction towards the previous point, +1 gives direction towards the next point)

Cell R11C7: tangent direction forwards for the line at the point (0 gives standard smooth direction, -1 gives direction towards the previous point, +1 gives direction towards the next point)

Input for the second line is given in a similar way at rows R7-R12, for the third line in R13-R18, etc. The only difference is the y- and z-coordinates that differs as we proceed around the edges of the prism. Since the description is parametric, lines may be defined in any direction. However, if lines are to be used for creation of

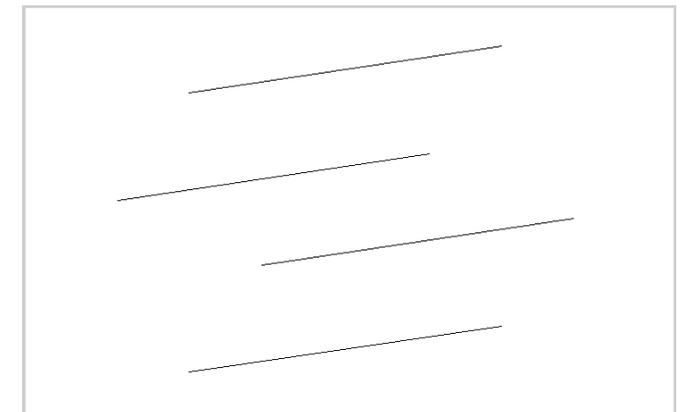
sections, the valid length must be defined with increasing x-coordinates and the order of the given lines must be clockwise around the sections (around the x-axis).

Step 2: Plot and check the lines

We may now make a first check of the lines geometry by plotting them. Open the program Hyss.xls and the Sheet **HyssLines**. Write the name of the Geometry Workbook and the new Lines Sheet according to below:

Press the button **Plot 1st Sheet**. A perspective plot of the lines will now appear in a new Sheet within the geometry Workbook **Example1.xls**.

HyssLines		Pro	Plot 1st Sheet
Geom. Workbook:	Example1.xls		1st Sheet: 1.1_Lines
Output Workbook:			No of Lines:
Plot Workbook:			From LineNo:
SplineType HVB:	H		LineNo 01:
General Plotdata:			LineNo 02:
rotx (deg):	105		LineNo 03:
roty (deg):	0		LineNo 04:
rotz (deg):	30		LineNo 05:

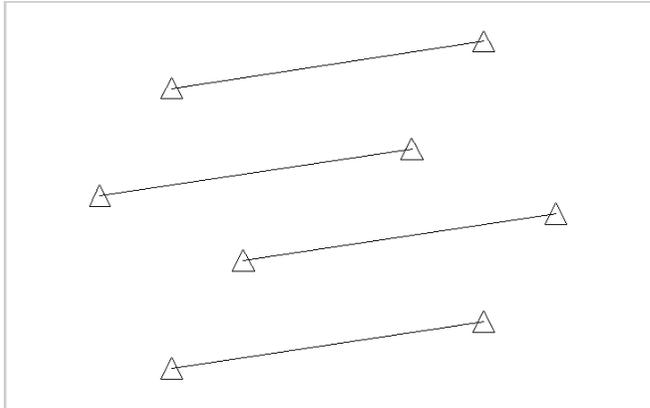


The lines plot is automatically scaled to fit a full landscape oriented page if no specified data previously have been assigned xmin, xmax, ymin, ymax, zmin or zmax in HyssLines. After the first plot has been executed, these values are assigned from the Lines Sheet.

xmin (m):	0.000	The automatically assigned values may be modified (or deleted) manually if other plot restrictions are wanted for new plots.
xmax (m):	10.000	
ymin (m):	-4.000	
ymax (m):	4.000	
zmin (m):	0.000	
zmax (m):	8.000	

The points defining the lines may be highlighted in the plot. This is done by specifying the desired point symbol size in pt. The figure below shows a symbol size of 24 pt. (Size less than 3 pt will not be plotted).

Points size:



Try also to use different perspectives and rotations. The basic principle of rotations is that they are applied in sequence, i.e. rotation around the x-axis first then around the new oriented y-axis and finally around the prevailing z-axis. After testing, all unwanted plot Sheets can be deleted from the plot Workbook.

Step 3: Cut Sections from the Lines

We continue the example by creating a Sections Sheet with 21 sections from the existing Lines Sheet. Note that the Lines Sheet must still be given below the button **Plot 1st Line**. Rename the new created Sections Sheet **1.1_Sections**.

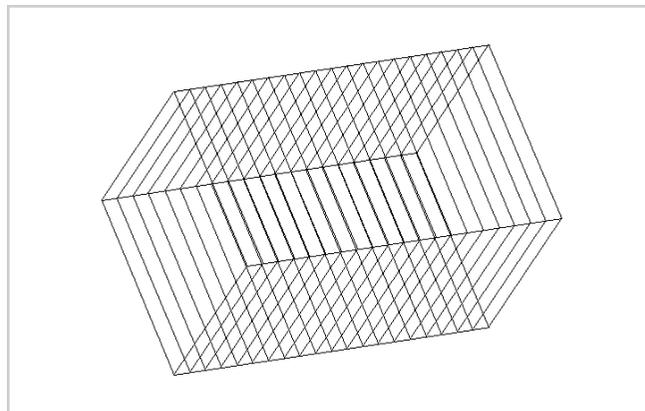
Cut Sections from 1st Sheet

No of sections:	21
xmin (m):	0
xstep (m):	0.5
Add to Sheet:	
Add after sectNo:	

The Sections Sheet may now be plotted together with the Lines Sheet.

Plot Entire Sheets (+1st)

No of Sheets:	1
Sheet 01:	1.1_Sections

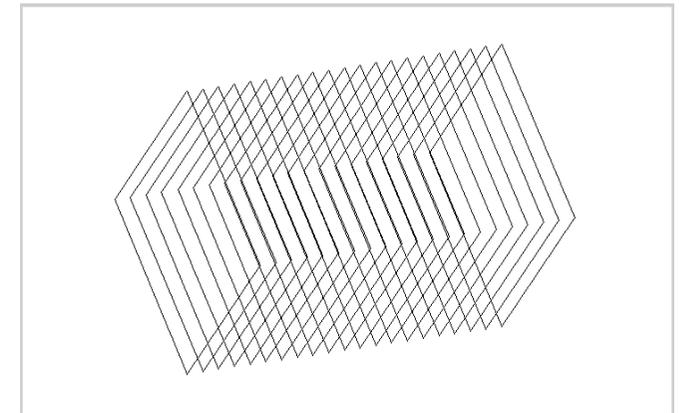


If only the Sections Sheet is to be plotted, specify No of Lines: 0 for the Lines Sheet according to below.

Plot 1st Sheet

1st Sheet:

No of Lines:
From LineNo:



Step 4: Create Calc from Sections

The final step to achieve a geometry that may be used for calculations is to transform the Sections Sheet to a Calc Sheet. We need not in this example specify No of segments since the sections consists of straight lines.

Create Calc from Sections

Section/Calc Sheet:
No of segments:

Rename the new Sheet e.g. **1.1_Calc** and save the Workbook. By this, the Example 1.1 is finished and we have created our first geometry from scratch.

Example 1.2 Create a circular cylinder

Step 1: Write data in a new Lines Sheet

This time we start from the previous Lines Sheet in Example 1.1. Start with opening the Workbook **Example1.xls** and make a copy of the Lines Sheet **1.1_Lines**, rename the copy e.g. **1.2_Lines**. Modify the Lines type in a way that sections created will have a smooth curvature with standard tangent length (1) instead of knuckles at the cross-points with the lines. The new Lines Sheet should now look like the figure where modified values are marked (yellow).

Step 2: Plot and check the lines

When the new Lines Sheet is plotted, we find it identical as the previous. This is because we actually have not changed the lines, just their effect on sections cut from them.

	1	2	3	4	5	6	7
1	Lines						
2	Example 1.2 Cylinder						
3	10						
4	0	0	0				
5	0						
6	5						
7	#1	Bottom Line					
8	0	0	0	1	1	0	0
9	10	0	0	1	1	0	0
10	2	1	2				
11	0	0	0	0	0		
12	10	0	0	0	0		
13	#2	Portside line					
14	0	0	0	1	1	0	0
15	10	0	0	1	1	0	0
16	2	1	2				
17	0	4	4	0	0		
18	10	4	4	0	0		
19	#3	Top line					
20	0	0	0	1	1	0	0
21	10	0	0	1	1	0	0
22	2	1	2				
23	0	0	8	0	0		
24	10	0	8	0	0		
25	#4	Starboard line					
26	0	0	0	1	1	0	0
27	10	0	0	1	1	0	0
28	2	1	2				
29	0	-4	4	0	0		
30	10	-4	4	0	0		
31	#5	Bottom Line					
32	0	0	0	1	1	0	0
33	10	0	0	1	1	0	0
34	2	1	2				
35	0	0	0	0	0		
36	10	0	0	0	0		

Step 3: Cut Sections from Lines

As in Example 1.1 we automatically create a new Sections Sheet with 21 sections from the Lines Sheet (which must be specified under the button **Plot 1st Sheet**). Rename the new Sections Sheet e.g. **1.2_Sections**.

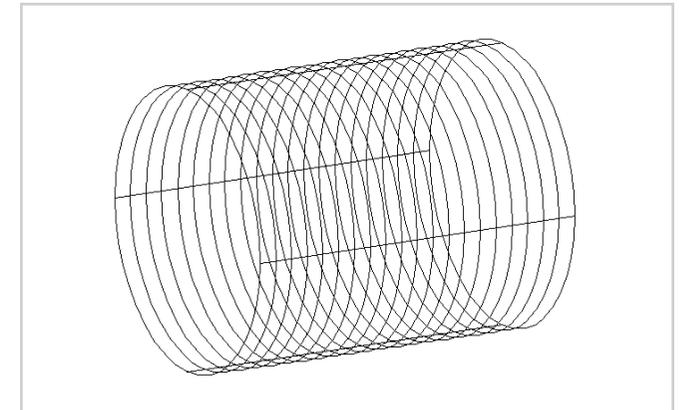
The new Sections Sheet is plotted in the same way as in the previous example together with the Lines Sheet.

Cut Sections from 1st Sheet

No of sections: 21
 xmin (m): 0
 xstep (m): 0.5
 Add to Sheet:
 Add after sectNo:

Plot Entire Sheets (+1st)

No of Sheets: 1
 Sheet 01: 1.2_Sections



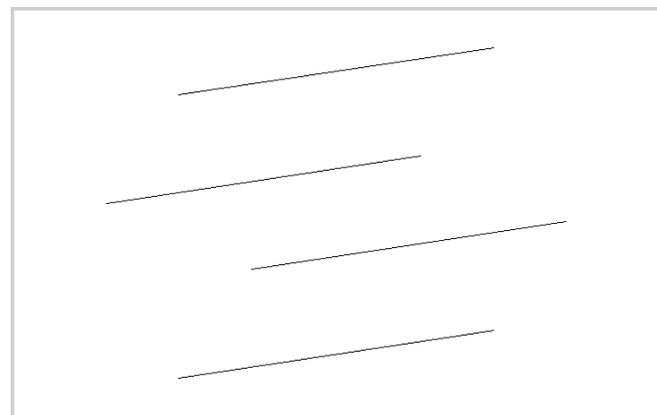
Step 4: Create Calc from Sections

Create Calc from Sections

Section/Calc Sheet: 1.2_Sections
 No of segments: 10

The final step in again to create a geometry model for calculations i.e. a Calc Sheet. In this case we must specify No of segments since the curved (quarter circle) section segments will be transferred to a number of straight line segments. The figure above is plotted with 10 segments which seems to give a sufficient representation. Rename the new Sheet **1.2_Calc**. The Sheet will contain 21 sections, each with 42 point coordinates.

Plot 1st Sheet
 1st Sheet: 1.2_Lines



Example 1.3 Modify geometries

Use decks and bulkheads to limit the geometry

We start with the previous geometry model **1.2_Sections** which was created in Example 1.2. At the stage of creating a Calc Sheet, it is possible to introduce limitations to the geometry in the transverse and vertical directions. Below are a few self-explanatory examples of different limitations plotted together with the necessary input when the Calc Sheets were created.

Create Calc from Sections

Section/Calc Sheet: 1.2_Sections
 No of segments: 10

Plane limits:

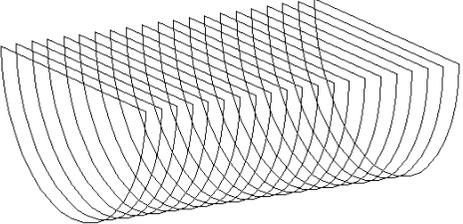
xmin (m): 0
 xmax (m): 10

Plane limits at xmin:

yplmin (m):
 yplmax (m):
 zplmin (m):
 zplmax (m): 4

Plane limits at xmax:

yplmin (m):
 yplmax (m):
 zplmin (m):
 zplmax (m): 4



Create Calc from Sections

Section/Calc Sheet: 1.2_Sections
 No of segments: 10

Plane limits:

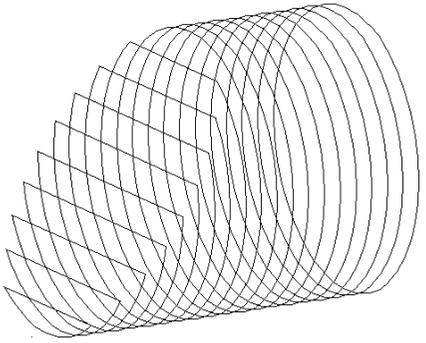
xmin (m): 0
 xmax (m): 5

Plane limits at xmin:

yplmin (m):
 yplmax (m):
 zplmin (m):
 zplmax (m): 0

Plane limits at xmax:

yplmin (m):
 yplmax (m):
 zplmin (m):
 zplmax (m): 8



Create Calc from Sections

Section/Calc Sheet: 1.2_Sections
 No of segments: 10

Plane limits:

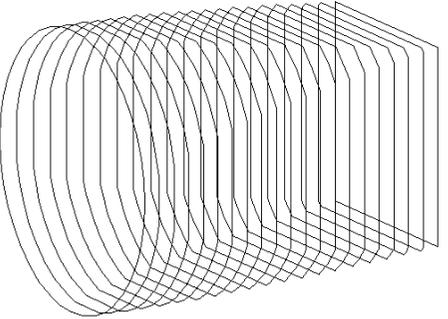
xmin (m): 0
 xmax (m): 10

Plane limits at xmin:

yplmin (m): -4
 yplmax (m): 4
 zplmin (m): 0
 zplmax (m): 8

Plane limits at xmax:

yplmin (m): -2.828
 yplmax (m): 2.828
 zplmin (m): 1.172
 zplmax (m): 6.828



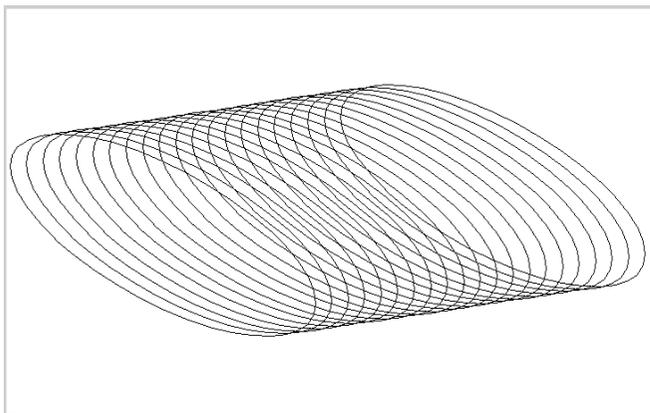
Scale geometries

Scaling may be applied to all three kind of geometry Sheets. In a scaling operation, all coordinates are multiplied with specified scaling factors. Note that curvature parameters such as tangent length or direction is not affected, since all lines are dealt with in parametric form, the curvature is independent of the coordinate scaling. In the plotted example below, the circular sections in Sheet **1.2_Sections** are scaled with a factor 2.0 in the y-direction and a factor 0.5 in z-direction. When the input cell for scale factor is left empty, a default factor of 1.0 will be used (as for *xscale* below).

(If only the effect of scaling is to be studied, it is more simple to use the scaling factors for plotting instead of creating a new geometry Sheet).

Stretch & Scale Sheet Coordinates

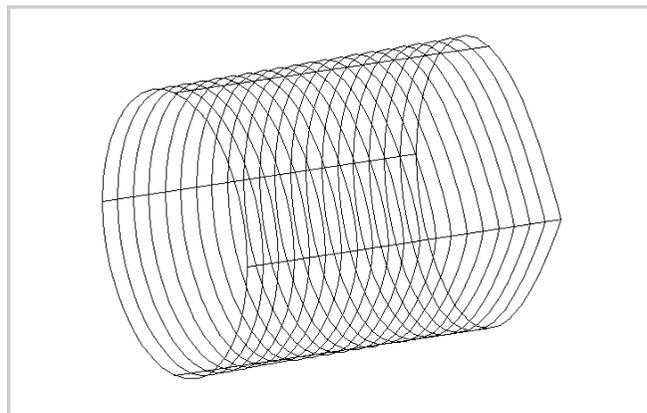
Sheet:	1.2_Sections
original xfull, m0 (m):	
new xfull, m1 (m):	
fullness stretch, s2:	
xscale:	
yscale:	2
zscale:	0.5



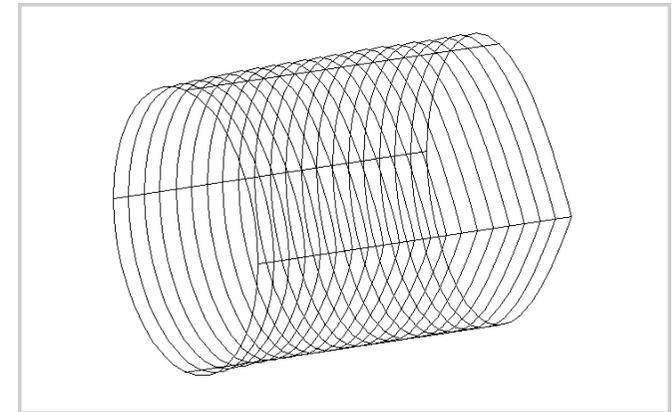
Change the line type along a line

The line types tangent length and directions backwards and forwards in a Lines Sheet are used for defining the curvature of sections when crossing the lines. These line type parameters may be specified to change along the line from *xmin* to *xmax*. Furthermore, the rate of change may be specified by the line type change parameters at *xmin* and *xmax* separately. If the change parameter is specified to 0 at one of the lines ends, there will initially be no change of the type but the change will increase while proceeding towards the other end. If the change parameter is specified to 1 the change will initially at that end be linear towards the line type of the other end. If the parameter is specified to 1 at both end, the change will be linear all along the line. In the two examples given here, the line type has been changed for line No4 in the Sheet **1.2_Lines**.

	1	2	3	4	5	6	7
25	4 Starboard line						
26	0	1	1	1	1	0	0
27	10	1	1	0	0	0	0
28	2	1	2				
29	0	-4	4	0	0		
30	10	-4	4	0	0		



	1	2	3	4	5	6	7
25	4 Starboard line						
26	0	3	3	1	1	0	0
27	10	1	1	0	0	0	0
28	2	1	2				
29	0	-4	4	0	0		
30	10	-4	4	0	0		



The figures may not appear very different but the tangent length is in the first changed linear from 1 at *xmin* to 0 at *xmax*. In the second figure above, the change is much faster at the beginning after *xmin* (change parameter 3) while the change becomes zero at *xmax* (change parameter 0).

By an intelligent combination of changing line coordinates and curvature and changing line types, almost any continuous change of form may be modelled. If the change has to be modelled in detail, it is possible to make duplicates of lines and specify them to be partial valid; the first from *x1* to *x2*, the second from *x2* to *x3* the next from *x3* to *x4* ... Each of the duplicates may then be assigned different change parameters along their valid length. (As long as their border values are the same as the surrounding duplicates values, the form will be changed continuously of at least first order).

Example 1.4 Create a sphere

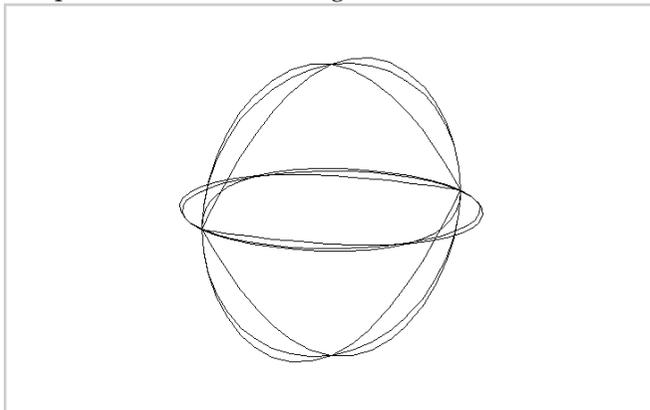
In order to model a sphere, the prime lines shall be curved in the same way as the sections in Example 1.2 (as saved in Sheet **1.2_Sections**). One of the unique characteristics of H-splines is that circular forms may be modelled exactly with only on control point at each quadrant (with tangent length =1 and direction =0). However, since the tangent length and direction is calculated relative to the two surrounding control points, the lines must be defined at least two points before and two points after their valid length. Otherwise their curvature will not be correct at the end points. This condition was fulfilled for the sections since they were defined as closed curves automatically with their first and last point given by lines which had type parameters tangent length backwards and forwards =1 and directions backwards and forwards =0.

Step 1: Write data in a new Lines Sheet

Start with adding a new Sheet to the Workbook **Example1.xls** and enter data according to the figure here at side. Rename the new Sheet e.g. **1.4_Lines**.

Step 2: Plot and check the lines

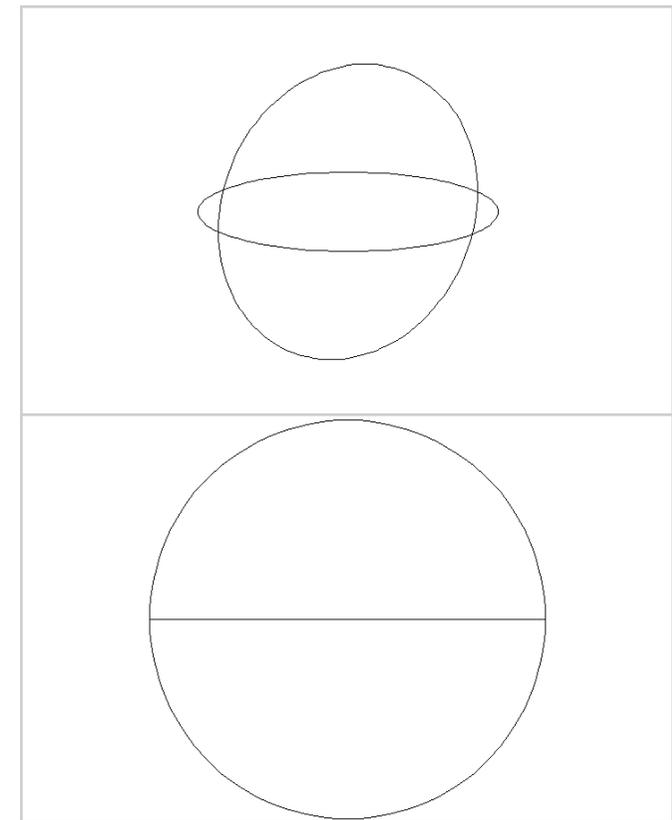
The plot will look something like this:



	1	2	3	4	5	6	7
1	Lines						
2	Example 1.4 Sphere						
3	10						
4	0	0	0				
5	0						
6	5						
7	# 1	Bottom Longitude					
8	0	0	0	1	1	0	0
9	10	0	0	1	1	0	0
10	7	1	7				
11	10	0	5	0	0	0	0
12	5	0	10	1	1	0	0
13	0	0	5	1	1	0	0
14	5	0	0	1	1	0	0
15	10	0	5	1	1	0	0
16	5	0	10	1	1	0	0
17	0	0	5	0	0	0	0
18	# 2	Portside Latitude					
19	0	0	0	1	1	0	0
20	10	0	0	1	1	0	0
21	7	1	7				
22	10	0	5	0	0	0	0
23	5	-5	5	1	1	0	0
24	0	0	5	1	1	0	0
25	5	5	5	1	1	0	0
26	10	0	5	1	1	0	0
27	5	-5	5	1	1	0	0
28	0	0	5	0	0	0	0
29	# 3	Top Longitude					
30	0	0	0	1	1	0	0
31	10	0	0	1	1	0	0
32	7	1	7				
33	10	0	5	0	0	0	0
34	5	0	0	1	1	0	0
35	0	0	5	1	1	0	0
36	5	0	10	1	1	0	0
37	10	0	5	1	1	0	0
38	5	0	0	1	1	0	0
39	0	0	5	0	0	0	0
40	# 4	Starboard Latitude					
41	0	0	0	1	1	0	0
42	10	0	0	1	1	0	0
43	7	1	7				
44	10	0	5	0	0	0	0
45	5	5	5	1	1	0	0
46	0	0	5	1	1	0	0
47	5	-5	5	1	1	0	0
48	10	0	5	1	1	0	0
49	5	5	5	1	1	0	0
50	0	0	5	0	0	0	0
51	# 5	Bottom Longitude					
52	0	0	0	1	1	0	0
53	10	0	0	1	1	0	0
54	7	1	7				
55	10	0	5	0	0	0	0
56	5	0	10	1	1	0	0
57	0	0	5	1	1	0	0
58	5	0	0	1	1	0	0
59	10	0	5	1	1	0	0
60	5	0	10	1	1	0	0
61	0	0	5	0	0	0	0

As can be seen from the first plot, the lines do not seem to give the form of a sphere. This is due to the lack of curvature information for the two first and last end points. However, if we limit the valid length to the central part of the lines from point No3 to point No5, as shown for one of the lines below, they now appear as perfect segments of a circle.

7	# 1	Bottom Longitude					
8	0	0	0	1	1	0	0
9	10	0	0	1	1	0	0
10	7	3	5				
11	10	0	5	0	0	0	0
12	5	0	10	1	1	0	0
13	0	0	5	1	1	0	0
14	5	0	0	1	1	0	0
15	10	0	5	1	1	0	0
16	5	0	10	1	1	0	0
17	0	0	5	0	0	0	0



Step 3: Create Sections from Lines

The input lines are now perfect circles (even though they may appear somewhat knuckled depending on the number of segments used for plotting). We now create 49 sections from the Lines Sheet. Rename the new Sections Sheet e.g. **1.4_Sections**.

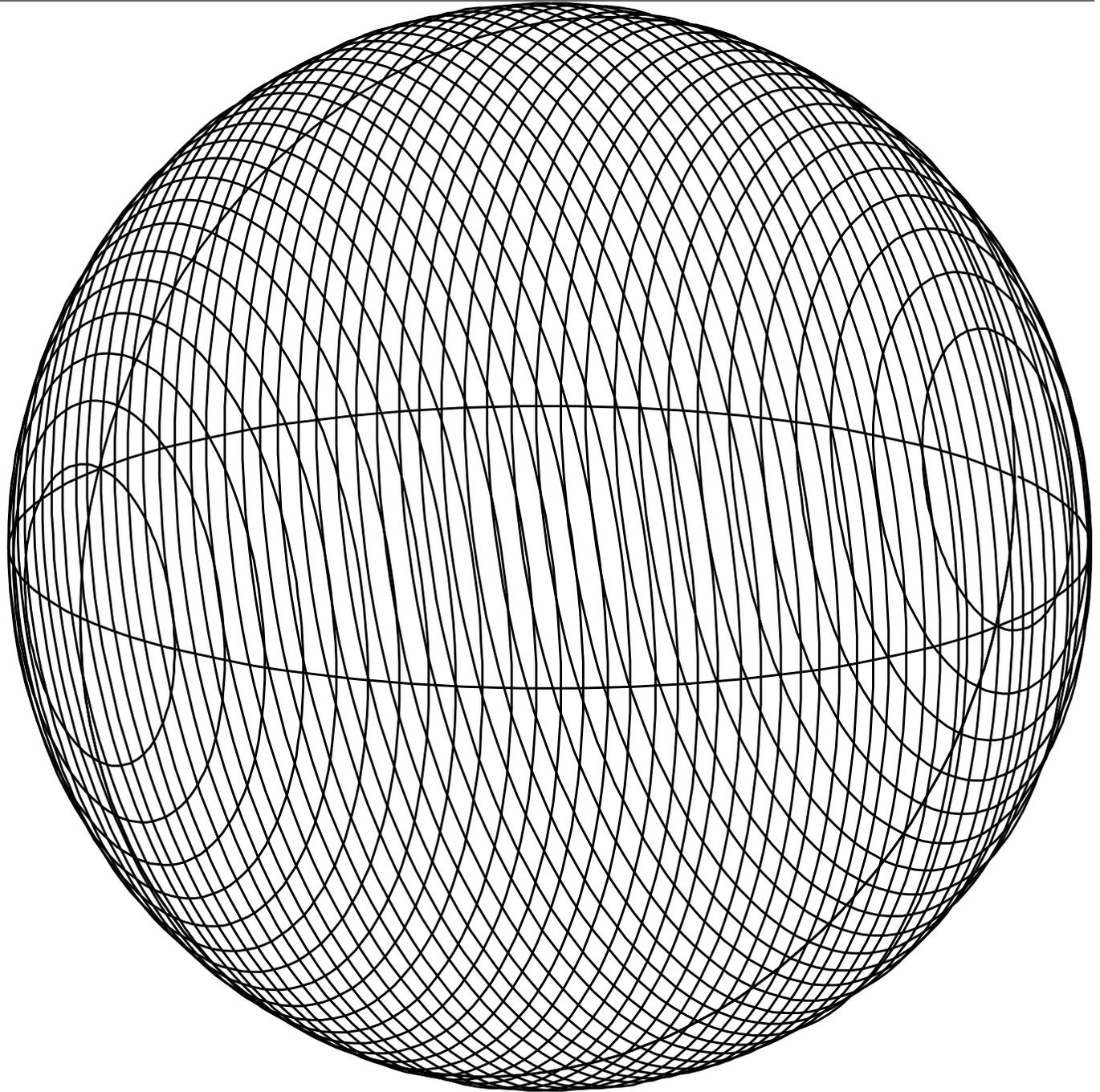
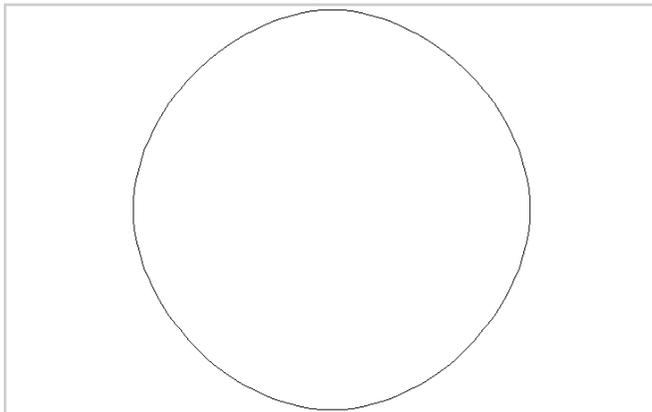
Cut Sections from 1st Sheet

No of sections:	49
xmin (m):	0.2
xstep (m):	0.2
Add to Sheet:	
Add after sectNo:	

When the new Sections Sheet is plotted together with the Lines Sheet, we can see that the sphere is completed! See the large figure here at side.

Difference between H-spline and B-spline

To illustrate the difference between the special H-spline function and ordinary cubic B-splines, the subsequent figure has been included. It shows lines No1 and No3 in the Lines Sheet plotted with B-splines. The difference in smoothness should be quite obvious.



Example 2.1 Create a ship geometry

Motor yacht from only 12 points!

We will in this example use the possibility to vary the line type for creating a yacht hull from only four lines defined by all together only 12 points. The basic lines are: Keel line (CL at bottom), port side lower knuckle line, port side deck knuckle and the CL at deck. These lines are further mirrored to create the full hull geometry.

Step 1: Fill in lines coordinates in a new Sheet

	1	2	3	4	5	6	7
1	Lines						
2	Motor Yacht						
3	20						
4	0	0	0				
5	0						
6	4						
7	# 1	Keel					
8	0						
9	20						
10	3	1	3				
11	0	0	0.6	0	0	0	0
12	12	0	0.2	0	1	0	-1
13	20	0	2.9	1	0	0	0
14	# 2	Deck lower knuckle					
15	0						
16	20						
17	3	1	3				
18	0	2	2.3	0	0	0	0
19	12	1.9	2.6	0	1	0	-1
20	20	0	2.9	1	0	0	0
21	# 3	Deck knuckle					
22	0						
23	20						
24	3	1	3				
25	0	2	2.4	0	0	0	0
26	12	1.9	2.7	0	1	0	-1
27	20	0	3	1	0	0	0
28	# 4	CL					
29	0						
30	20						
31	3	1	3				
32	0	0	2.5	0	0	0	0
33	12	0	2.75	0	1	0	-1
34	20	0	3	1	0	0	0

Start by creating a new Workbook and save it as **Myacht.xls**. Open a Sheet and fill in the point coordinates for the four lines according to the previous figure. Rename the Sheet as e.g. **MY_Lines1**.

This time we will only briefly go through the input by looking at the Keel line points.

The first aft most point has the coordinates (0, 0, 0.6) and is a knuckle (tangent length is set to 0 both backwards and forwards) in the direction of the line.

The second point has the coordinates (12, 0, 0.2) and is a knuckle point for the line backwards (i.e. the line segment between point 1 and 2 is straight), but a curve point for the line forwards with the tangent length 1 and direction -1 i.e. directed from the previous point.

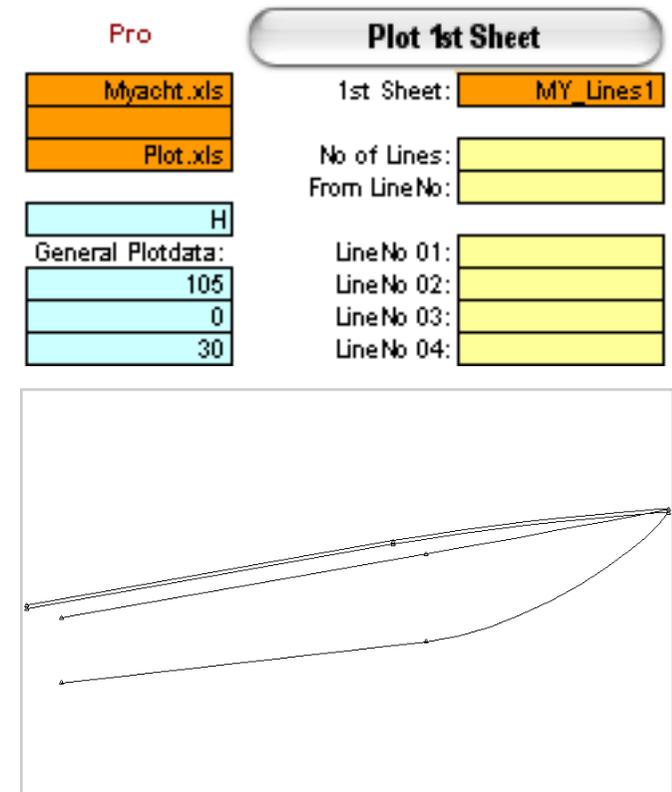
The third and last point is the cross-point between the keel line and the lower deck knuckle (line 2) and has the coordinates (20, 0, 2.9). The point is a curve point directed backwards with tangent length 1 and direction 0 but a knuckle point forwards.

The other two lines are defined similar as the keel line. Note here that the two deck knuckle lines are parallel with a distance of 0.1 m along the whole hull.

In this example, the keel line has not been modelled up along the transom stern nor between the two deck knuckles. If we assume that the transom stern and the upper stem are vertical they will anyhow be cut out as sections from the other lines and are therefore not necessary to include in the lines definition. Since all lines must be modelled with increasing x-coordinate within their valid length when cutting sections, we cannot define an absolute vertical keel line in this case. (However, it had in principle been possible to define an insignificant increase in x by e.g. 0.0001 m).

Step 2: Adjust the lines geometry

Make a first few plots of the lines in different perspectives to validate their form. Start with creating a new Workbook in which all plots are to be stored, save it as e.g. **Plot.xls**. By putting all plots in a separate Workbook it will be easy to clear them out by just throwing the Workbook when the modelling is finished. (Otherwise it will be a mess to sort the relevant plots out since usually a large number of invalid plots will be created during a modelling session). Two examples of different plot views are shown below.



Pro

Plot 1st Sheet

1st Sheet: **MY_Lines1**

No of Lines:

From LineNo:

LineNo 01:

LineNo 02:

LineNo 03:

LineNo 04:

General Plotdata:

H

0

0

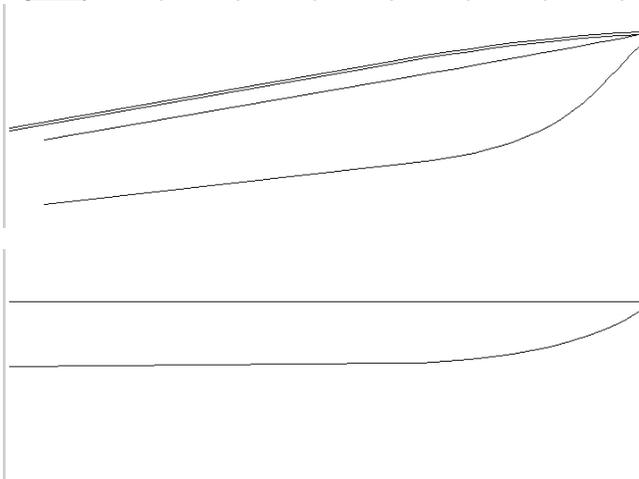
0

As the plot appears, it might be suitable to make the deck somewhat more rounded and also to adjust the stem. Instead of introducing more points, this can be done by adjusting the tangent length and direction for the second point of the lines. Use the example to play around and test the influence of the different curve parameters.

After some testing, we may be satisfied by a geometry according to the extracted Sheet in the next figure. Save the Workbook **Myacht.xls** in order to secure the data. The major part of intermediate plots may well be thrown away at this stage.

Next step in the process will now be to examine what line types are to be defined in order to create nice sections.

<	1	2	3	4	5	6	7
1	Lines						
2	Motor Yacht						
3	20						
4	0	0	0				
5	0						
6	4						
7	# 1	Keel					
8	0						
9	20						
10	3						
11	0	0	0.6	0	0	0	0
12	12	0	0.2	0	1.6	0	-1
13	20	0	2.9	1.3	0	-0.5	0
14	# 2	Deck lower knuckle					
15	0						
16	20						
17	3						
18	0	2	2.3	0	0	0	0
19	12	1.9	2.6	0	1.7	0	-1
20	20	0	2.9	0.2	0	0	0
21	# 3	Deck knuckle					
22	0						
23	20						
24	3						
25	0	2	2.4	0	0	0	0
26	12	1.9	2.7	0	1.7	0	-1
27	20	0	3	0.2	0	0	0
28	# 4	CL					
29	0						
30	20						
31	3						
32	0	0	2.5	0	0	0	0
33	12	0	2.75	0	1.7	0	-1
34	20	0	3	0.2	0	0	0



Step 3: Adjust the line types when they are cut by sections

To be able to study the influence of line types, we must study the inherited sections. Start by mirroring the lines to form the complete hull. Rename the new mirrored Sheet e.g. **MY_Lines2**.

Cut sections from the Lines Sheet according to the figure below. Rename the new Sections Sheet e.g. **MY_Sec1**.

Cut Sections from 1st Sheet

No of sections: 41

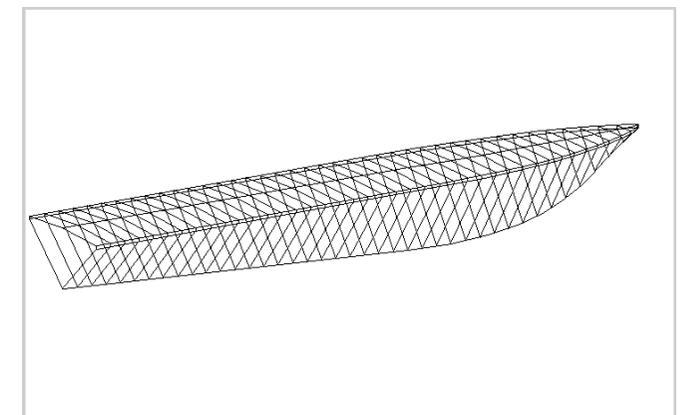
xmin (m): 0

xstep (m): 0.5

Add to Sheet:

Add after sectNo:

Plot the new Sections Sheet **MY_Sec1** (together with the Lines Sheet **MY_Lines2**).



The result at least starts to look like a yacht hull but is probably still not as we like it to be. If we want a rounded hull, we must add curvature parameters to the lines guiding the form of the sections.

Return to the first (un-mirrored) Lines Sheet **MY_Lines1** as it was saved. Make a copy of the Sheet and rename it e.g. **MY_Lines1b**. Add curvature parameters (line type) to the keel line (Line 1), the lower deck knuckle line (Line 2) and the deck centerline (Line 4). Modify the line type, mirror the lines, create and plot new sections. Study the influence from the given parameters, adjust them in the Lines Sheet and redo the process until the hull form is to your satisfaction. In order to enable a smooth transition between a round bilged aft body and

	1	2	3	4	5	6	7
1	Lines						
2	Motor Yacht						
3	20						
4	0	0	0				
5	0						
6	4						
7	# 1	Keel					
8	0	0	0	2	2	0	0
9	20	1	3	0	1	0	2
10	3						
11	0	0	0.6	0	0	0	0
12	12	0	0.2	0	1.6	0	-1
13	20	0	2.9	1.3	0	-0.5	0
14	# 2	Deck lower knuckle					
15	0	0	0	5	0	1	0
16	20	3	3	3	0	-2	0
17	3						
18	0	2	2.3	0	0	0	0
19	12	1.9	2.6	0	1.7	0	-1
20	20	0	2.9	0.2	0	0	0
21	# 3	Deck knuckle					
22	0	0	0	0	0	0	0
23	20	0	0	0	0	0	0
24	3						
25	0	2	2.4	0	0	0	0
26	12	1.9	2.7	0	1.7	0	-1
27	20	0	3	0.2	0	0	0
28	# 4	CL					
29	0	0	0	2	2	0	0
30	20	0	0	2	2	0	0
31	3						
32	0	0	2.5	0	0	0	0
33	12	0	2.75	0	1.7	0	-1
34	20	0	3	0.2	0	0	0

a more sharp fore body we must here use the possibility to vary both tangent length and direction along the lines. The result may be judged acceptable according to the figures below.

Step 4: Adjust the plotting of the hull

If the form is found acceptable after careful examination, we may now want to make a few final representative plots. Here we have the possibility to adjust the plot area, to increase the number of curve segments and to add a more natural "camera" perspective by input of a 1/View distance value. We may also add a plot title, a printout of the plotdata, a boundary box which describes the plotrangle (in the chosen perspective) and the system of coordinates.

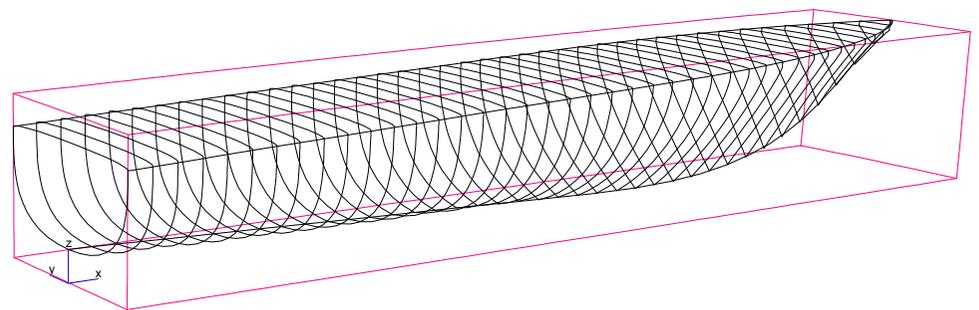
As in the plot at side, the sections may also be combined by a limited number of lines to give a more realistic view. The specific input for the geometry plot is shown in the screen plot above.

Note: The button **Add from 1st to Target** may be used to assemble a number of "plot lines" in a separate Sheet with the only purpose to enhance the plotting.

The screenshot shows the 'HyssLines Pro' interface. On the left, there are settings for 'General Plotdata' including rotation angles (rotx, roty, rotz), range update, and coordinate limits (xmin, xmax, ymin, ymax, zmin, zmax). Below these are plot scale settings (xscale, yscale, zscale), number of segments (15), points size (0.5), line weight (0.5), and 1/View distance (0.5). The plot title is '20m Motor Yacht'. On the right, there are buttons for 'Plot 1st Sheet', 'Cut Sections, WLs, Btk & Plot Full Drawing from 1st', 'Plot Full Drawing (+1st)', 'Plot Entire Sheets (+1st)', 'Add from 1st to EditLines', 'Clear EditLines', 'Add from 1st to Target', 'Mirror in CL; Double', and 'Mirror in CL; Switch'. A list of sheets is shown on the far right, with 'MY_Sec2' selected.

Hyss 2.20 Pro

Example 2.1 / 20m Motor Yacht

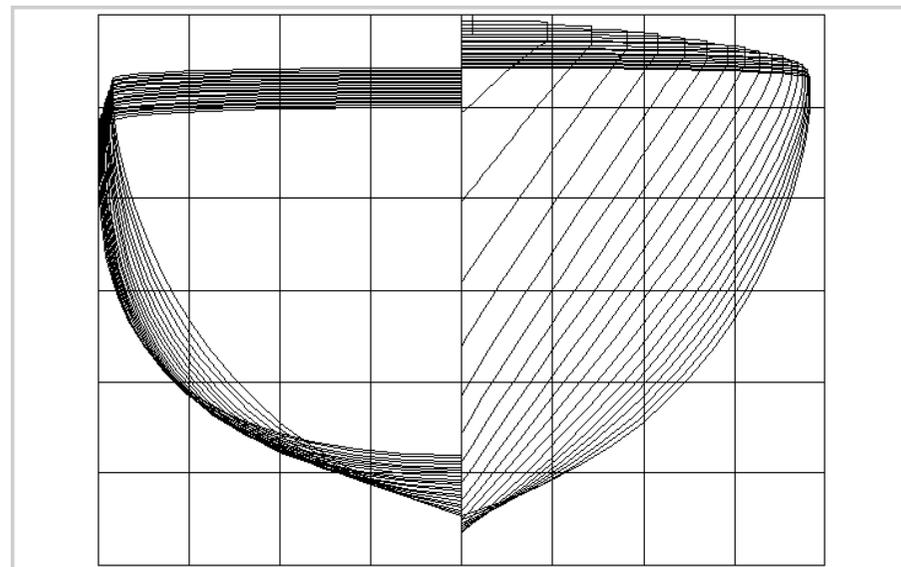


Plotdata: rx=105, ry=0, rz=30, nseg= 15, 1/View=0.5

Sections Drawing

A traditional sections drawing with waterlines and buttocks may also be plotted. Here the rotations are automatically adjusted to $rotx=90$, $roty=0$ and $rotz=90$ and the sections are divided in aft body and fore body according to the figure below. (Lines may be included in the sections drawing and will be divided in fore and aft body perspective as the sections)

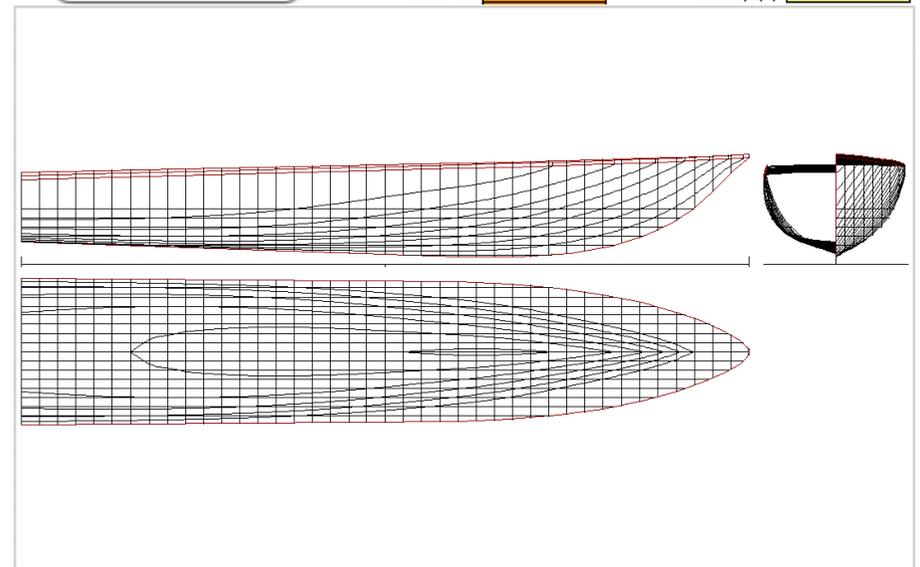
Plot Sections Drawing (+1st)	
Section Sheet:	MY_Sec2
x amidships (m):	
No of Waterlines:	6
W/L min (m):	0.5
W/L step (m):	0.5
No of Buttocks:	4
Btk step (m):	0.5



Lines Drawing

A traditional lines drawing consists of sections, waterlines and buttocks plotted in the three main coordinate planes. There are two alternatives for creating a lines drawing, either direct by letting all the necessary lines be created from a complete Lines definition of the hull, or by creating these lines separately and then combining them in one plot. The first alternative is suitable for a quick check of the fairing of the hull definition. The second alternative enables a more proper final drawing since the number of plotted sections may be different from the number of sections used for creating waterlines and buttocks.

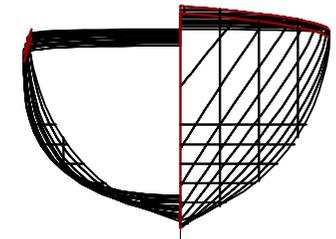
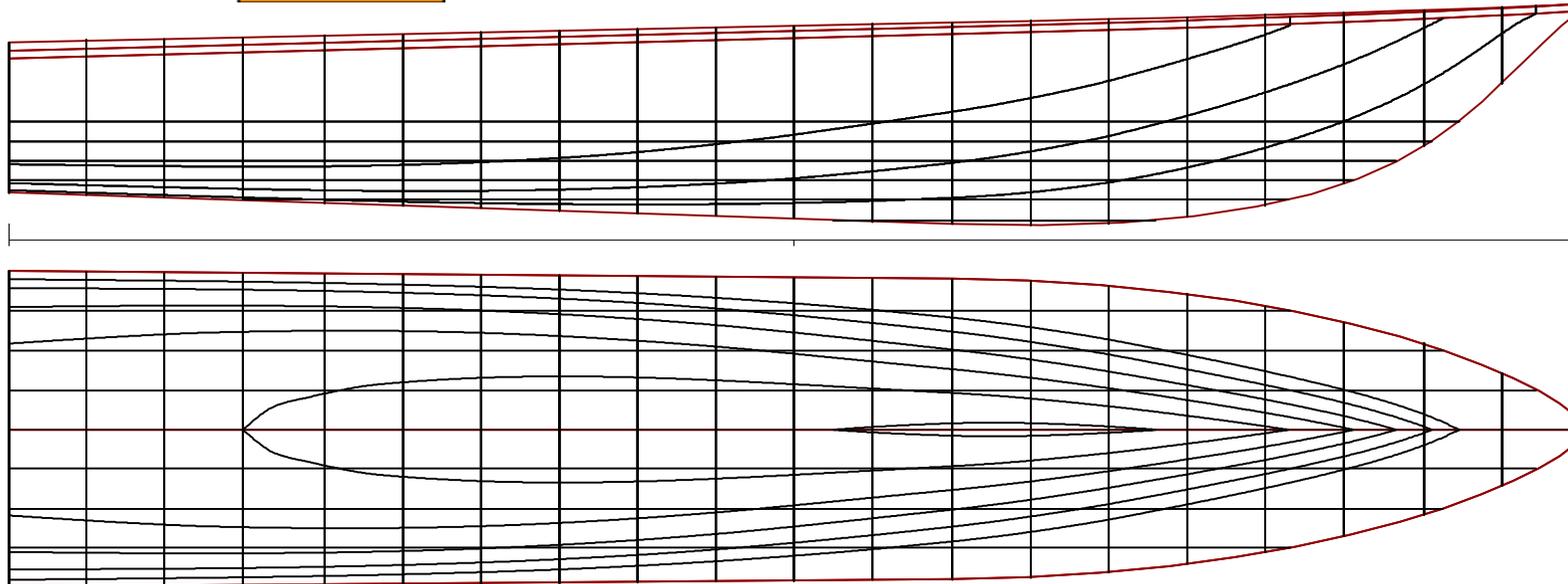
Plot 1st Sheet		Cut Sections, W/Ls, Btk & Plot Full Drawing from 1st		Cut Sections from 1st Sheet	
1st Sheet:	MY_Lines2b	(1st must be a full Lines Sheet, Section, W/L and Btk data have to be given in the fields to the right)		No of sections:	41
No of Lines:	6	Plot Full Drawing (+1st)		xmin (m):	0
From LineNo:		Section Sheet:		xstep (m):	0.5
LineNo 01:	1	W/L Sheet:		Add to Sheet:	
LineNo 02:	2	Btk Sheet:		Add after sectNo:	
LineNo 03:	3	Plot Entire Sheets (+1st)		Cut WL from Sections + 1st	
LineNo 04:	4	No of Sheets:		Cut Btk from Sections + 1st	
LineNo 05:	5	Sheet 01:		Plot Sections Drawing (+1st)	
LineNo 06:	7	Sheet 02:		Section Sheet:	
LineNo 07:		Sheet 03:		x amidships (m):	
LineNo 08:		Sheet 04:		No of Waterlines:	6
LineNo 09:		Sheet 05:		W/L min (m):	0.25
LineNo 10:		Sheet 06:		W/L step (m):	0.25
Add from 1st to EditLines				No of Buttocks:	7
Clear EditLines				Btk step (m):	0.25



Since the number of sections (together with the original Lines description) is decisive for the precision of the created waterlines and buttocks, it is preferable to use a large number of sections when these are created. On the other hand a large number of sections is not suitable for a lines drawing. Therefore, one may use different Sections Sheets when creating lines and when plotting sections.

The figure below shows such a drawing where the waterlines and buttocks have been cut out from a 0,25 m sections spacing (81 sections) and then plotted together with a 1.0 m section spacing (21 sections). Please still note that this ship is an example of how a full hull may be created from a very limited number of coordinate points. It is not necessary a very good ship from other points of view!

Plot Full Drawing (+1st)	
Section Sheet:	Sec21
WL Sheet:	WL81
Btk Sheet:	Btk81



Motor Yacht

Length 20 m
Speed 16 kn

design mhuss 2001

The Plot Title which may be given among the general plot data will in a lines drawing be placed in a separate text frame adjusted to the the drawing. (The font has then been further changed in the figure below).

Limitations when creating waterlines and buttocks

It is not guaranteed that waterlines and buttocks created by cutting sections and definition lines will be perfectly faired. Although the crosspoints always will be correct, the curvature may sometimes be less suitable. The reason for this is that Sections do not contain any information of the curvature in other directions than the yz-plane. When lines are cut from sections, a standard curvature (length = 1 and direction = 0) is assigned all points but the first and last which are assumed knuckles. At crosspoints with the Lines, an approximate adjustment to the Lines type is done (such as a crosspoint with a knuckle will also generate a knuckle in the waterlines and buttocks) but still this may sometimes

be insufficient. Waterlines and buttocks may therefore need some modifications in the curvature in order to appear well in the drawing.

Another limitation is that the coordinate points always are assumed to be the first crosspoint with a section or line. If the section e.g. describes a double hull, only the outmost waterline at portside will be created. For the same reason only one-sided waterlines and buttocks are created (which easily may be mirrored by the **Mirror in CL; Double** button).

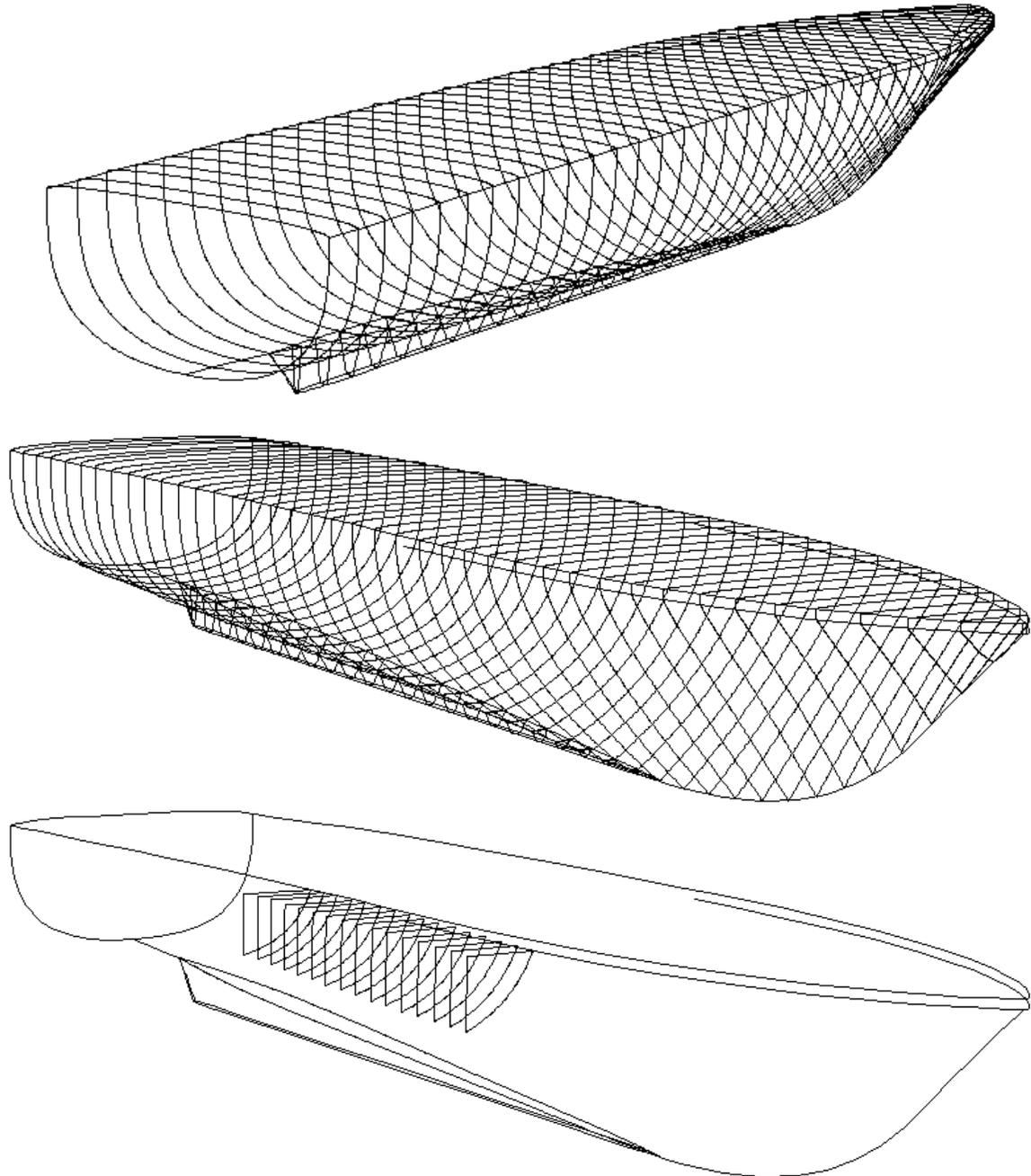
In rare cases very closely positioned crosspoints with sections and lines may result in directly faulty waterlines or buttocks. It is recommended then first to try another sectional spacing for the lines creation and if this does not solve the problem the only solution is to edit the geometry Sheets by hand after they have been created.

Step 5: Create Calc Sheets for the main hull geometry and possible additional appendices and compartments

When the main hull modelling is finished, we can create different geometries for calculations by transferring the Sections Sheet with curvature information to Calc Sheets consisting of sections with straight line segments. By limiting the geometry at this stage, different Calc Sheets representing integrated tanks or compartments may be created. By using the coordinates at the limiting planes, additional lines may be created that may form hull appendices. The technique has been used to create a separate skag and a port side tank in this example.

It is in general recommended to use separate geometry Sheets for the different parts in a discontinuous geometry but the different parts must then have exactly the same boundary plane without any overlap or gap. The best way to ascertain this is to in a first step model the parts with overlap and then use the same limit planes for both geometries when creating Calc Sheets.

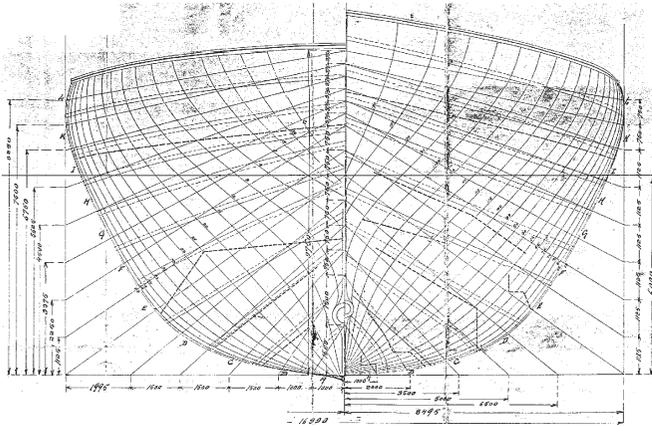
The two first figures at right show main hull and an integrated skag in different perspectives. The third figure shows an integrated port side fuel tank which has been cut out from the main geometry. The contour lines are added in the plot just to show the position.



Example 2.2 Model an existing ship geometry

Icebreaker St Erik

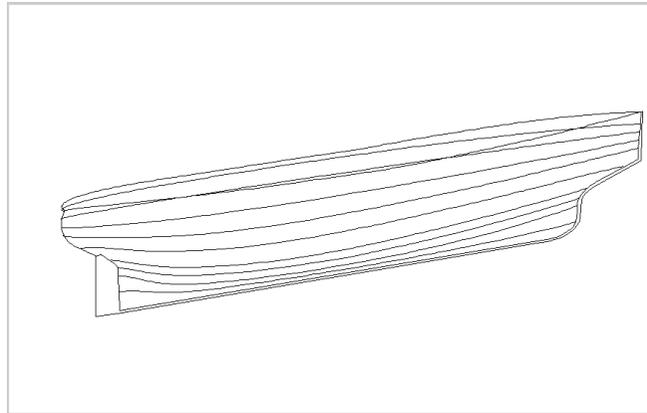
This example shows how an existing ship may be modelled for new hydrostatic calculations. The basis for the example consists of a sections drawing and a profile. The sections drawing has been scanned and coordinates have been read directly from Adobe Photoshop.



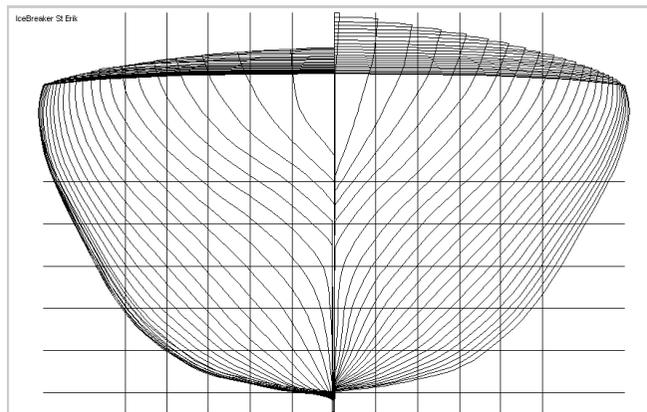
Coordinates for the following 14 lines have been given:

- 1 Keel line at CL from the aft most stern position to the uppermost stem (knuckle)
- 2 Keel line half breadth from the stern to the stem (knuckle)
- 3 Rabbet line (cross line between hull and keel) (knuckle)
- 4-12 9 diagonal lines (standard curvature)
- 13 Deck line at side from stern to stem (knuckle)
- 14 Deck line at CL from aft most stern to uppermost stem (curvature with increased tangent length (1.5) to form a camber)

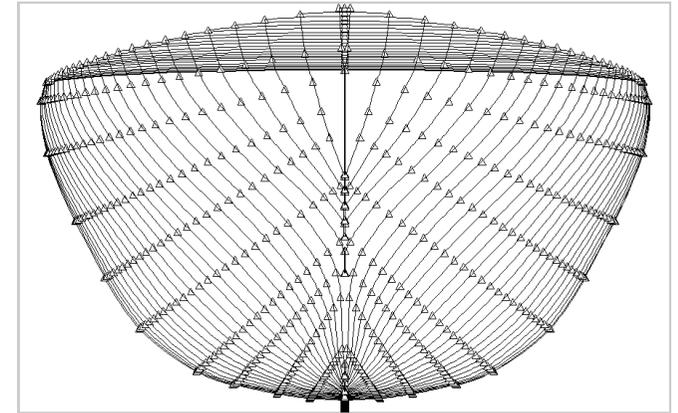
All lines have been defined by between 15 to 20 coordinates where in most cases the first and last coordinate point have been positioned outside the hull and are just used for getting the curvature at stern and stem. (In the Lines Sheet these lines have been defined valid from the second point to the next to last point).



The input lines (at port side) are mirrored at CL and used for creating a Sections Sheet which is further transformed to a Calc Sheet for calculations. Below is shown the thus achieved sections drawing for 51 sections. (Note that the sections are not positioned equal to the sections in the original sections drawing).

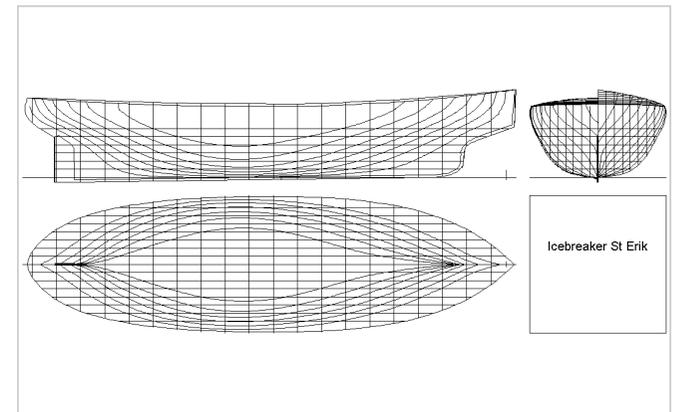


The following sections plot shows the fore body with marked coordinates from the lines. The figure clearly shows which diagonal lines that have been used for the geometry modelling.



If we like to check the smoothness of the created geometry we may plot a full lines drawing or separately create and plot waterlines or buttocks.

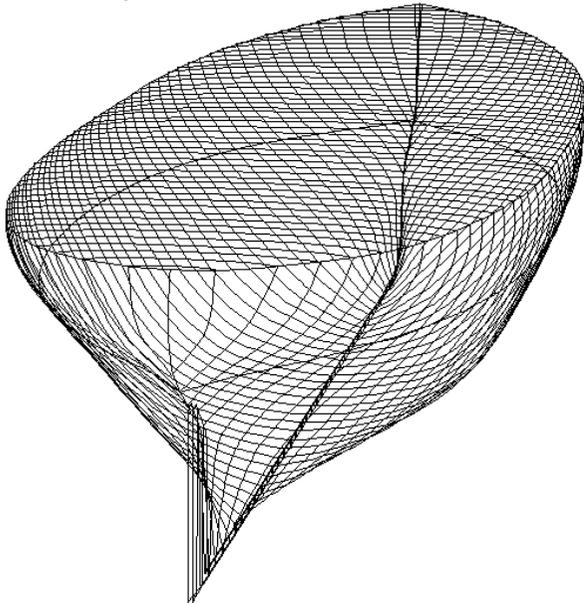
Below is shown a new lines drawing created from the diagonals of the original paper drawing.



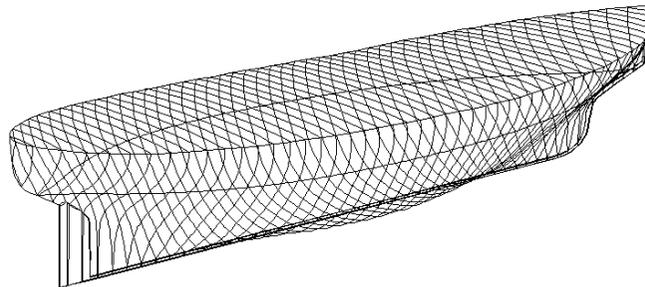
A sample of perspective plots of the modelled hull geometry of St Erik

The best way to assure a (reasonably) correct geometry model is to use the possibility to plot in different perspectives and to combine different geometries in the same plot. A more visually realistic view is achieved by positioning the view distance closer to the body than in a pure isometric perspective (infinite distance). 1/View distance: which may be specified among the general plot data can be given values between 0 (infinite distance) and 1.5 (fish-eye perspective). Usually a good looking perspective is achieved by giving values between 0.5 and 0.8 depending on the geometry extension. (All figures below have been plotted with 1/View distance: 0.8). If the hull is to appear unheeled, the rotation around the y-axis (roty) shall be kept to zero. Specifying rotx larger than 90° gives a view from above and less than 90° a view from below, rotz larger than 0 gives a view from abaft and less than 0 from forward.

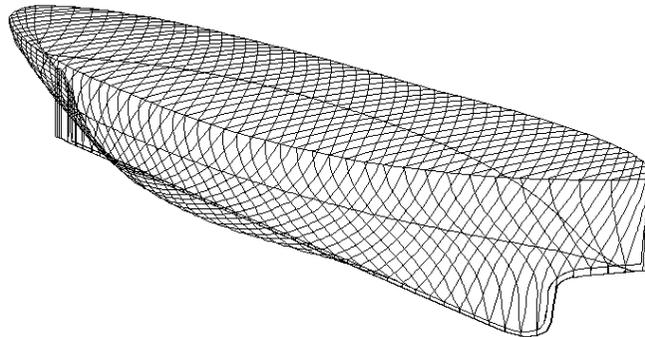
rotx=105 roty=0 rotz=80:



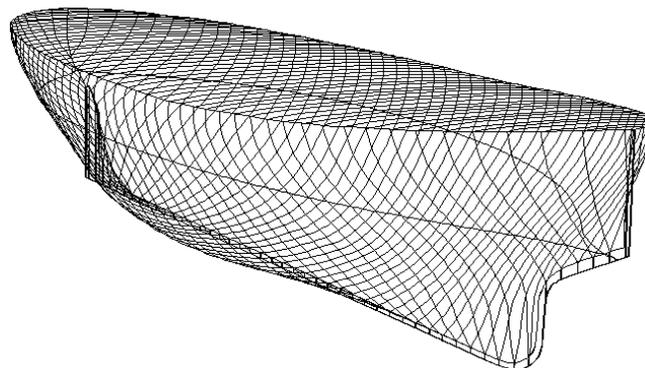
rotx=110 roty=0 rotz=35:



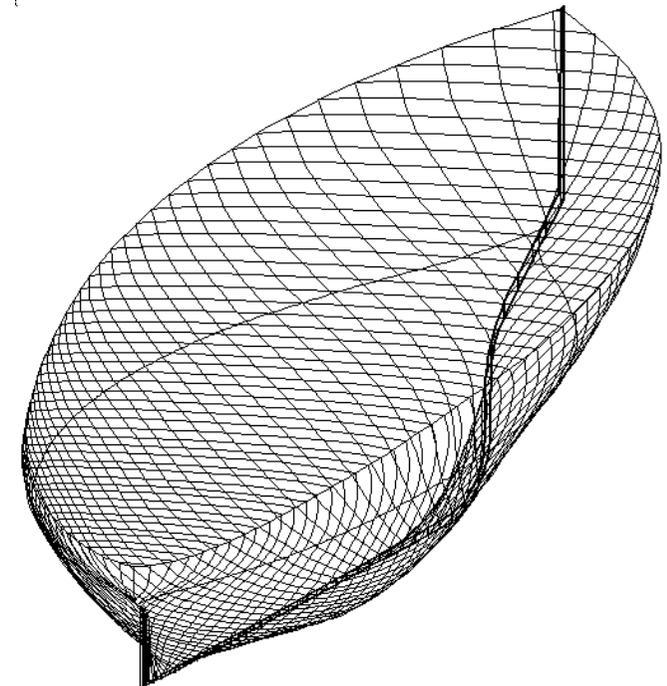
rotx=105 roty=0 rotz=-60:



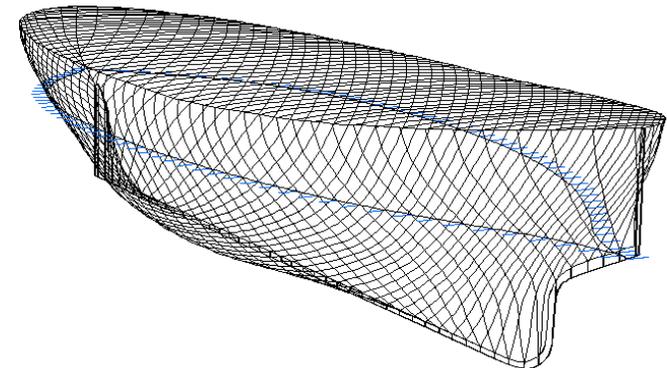
rotx=105 roty=0 rotz=-70:



rotx=85 roty=0 rotz=-80:



All the previous figures include the design water line as added in a separate Lines Sheet. An alternative option is to add waterline marks by specifying a floating condition in the general plot data. All cross points between the specified waterline and given geometry lines (or sections) will then be highlighted by small blue lines.



Example 3.1 Post-processing results from calculations - Hydrostatic curves

In the previous part of this manual different examples of calculations have been shown. Since HyssCalc is designed to be self-instructive, no more such examples will be given here. Instead this example will show how results from calculations may be further processed and presented in a diagram.

We start by initiating a standard hydrostatic table for the icebreaker St Erik. The previously shown 51 sections have been created from HyssLines and stored in a Calc Sheet named **SE_Calc51** included in the Workbook **SE.xls**.

The following input is given for the calculations:

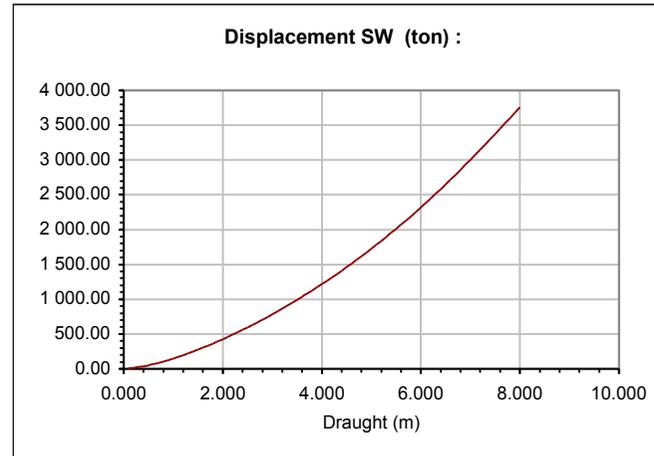
Geom. Workbook:	SE.xls	(Title 1):	Example 3.1	Dens SW:	1.025
Output Workbook:	SE.xls	(Title 2):		itemax:	20
Hull & Compartments:				eps:	0.001
No of Calc Sheets:	1	PermVol:	(Name):		
(Main)Sheet 01:	SE_Calc51	1	Hull	<input type="button" value="Hyd.table"/>	<input type="button" value="Exec"/>
Sheet 02:					

No of T:	80
T min:	0.1
T step:	0.1
No of trim:	0

When the calculation is executed (pressing **Exec**) a new Workbook is created in which all results are stored. The beginning of the new Sheet **Hst** will look as follows (depending on the formatting of the Hst template):

6	Draught mid at L/2 (m) :	0.100
7	Trim 0.000 m :	
8	Displacement SW (ton) :	7.21
9	Displacement vol (m ³) :	7.04
10	LCB fw AP (m) :	17.388
11	TCB ps CL (m) :	0.000
12	KB (m) :	-0.001
13	Waterplane Area (m ²) :	54.71
14	LCF fw AP (m) :	19.627
15	KM - transv (m) :	5.002
16	KM - longit (m) :	330.84
17	TPcm (ton/cm) :	0.561
18	MTCm (tonm/cm) :	0.43

Below the preset print area are in addition some diagrams that may be modified to show any of the results in the table.



When in a similar way all data have been transferred to values between 0 and 1, we create a new diagram from the Excel menu. The diagram chosen is of a type showing coordinate pairs (point diagram). Since we in this case have a large number of data points in each series it is sufficient to use straight lines between points.

Then we specify the source range for all series to be included either by typing the range or by marking it in the Sheet.

Finally we arrange and format the diagram including titles and axes as we want it to appear. The diagram is by this finalised!

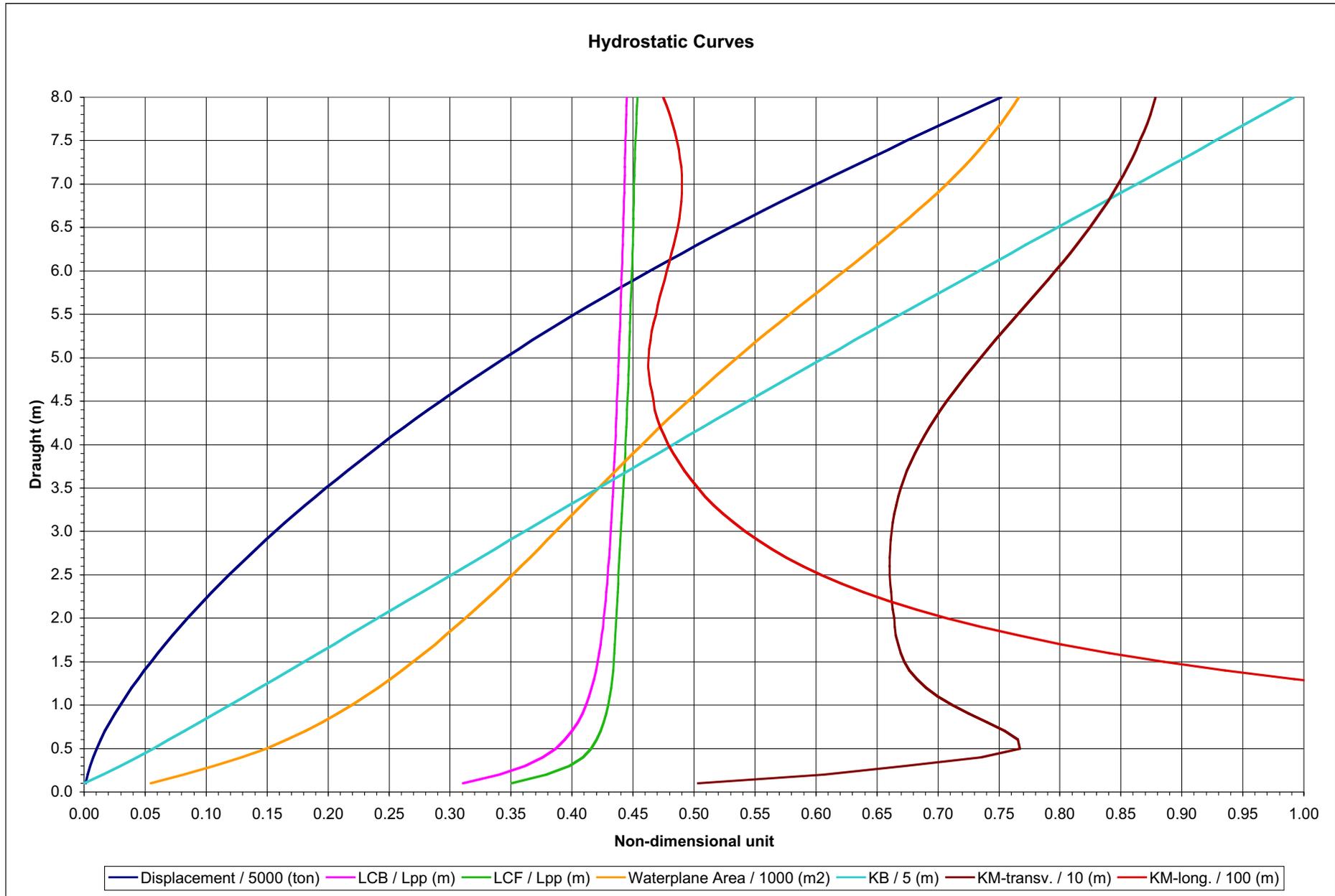
In a similar way we may create different diagrams for different type of results. In many cases they can be defined directly from the output tables without any copying or modification of data.

Diagrams may be copied and moved to other Sheets in the same Workbook without losing their references. However, if the diagram is moved to another Workbook the references will follow over to the same positions in the new Workbook. Since all calculations of the same type create new Workbooks with identical formatting, a personal archive of diagrams for different calculations may be stored and reused just by copying or dragging the relevant type of diagram over to the new result Sheet. In this way, advanced post-processing, including plotting and further calculations may be carried out in just a few seconds. The advanced Excel user may even write his own macros for further extensive post-processing.

If several different hydrostatics are to be included in the same diagram, the values have to be made dimensionless. We copy all rows including data to be presented in the diagram to another position in the same Sheet. Then, we modify the data by typing a reference formula at the position of the first data divided by a suitable round number (larger than the largest value in the row). For the displacement in sea water we may in this case specify = R8C2/5000 and then copy this formula to all other data in the same row.

We also modify the title of the row to the title we want to be presented in the diagram.

Hydrostatic curves for icebreaker St Erik



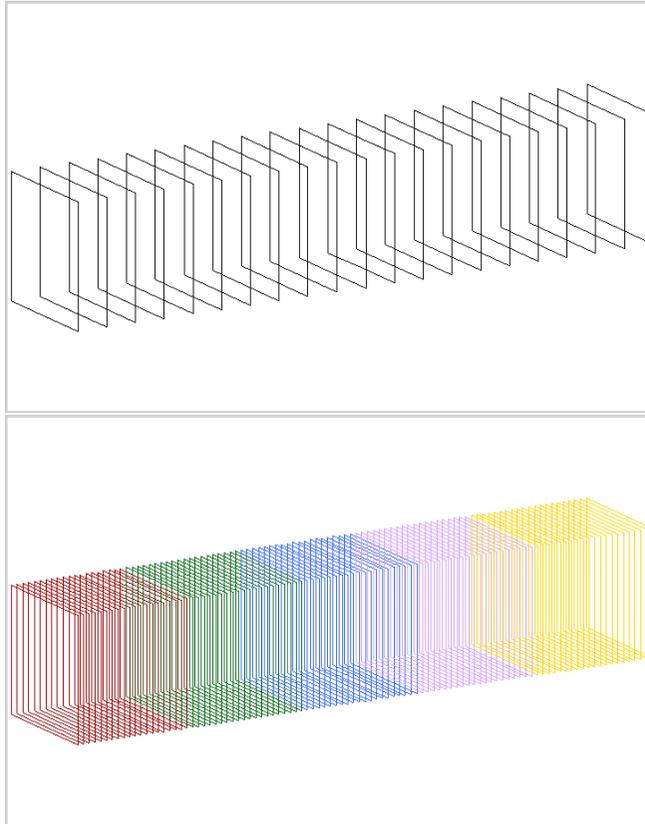
Example 4.1 Calculations with several geometry Sheets

Calculations with several separate geometry Sheets do not in principle differ from calculations with only one. This example is therefore included only in order to illustrate the meaning of positive and negative permeability. For that reason we will use the most simple geometry, a square prism.

We start by creating a cube with main dimensions 10*10*10 m and with xAP=0, yCL=0 and zKL=0. From this we create a Calc Sheet with 21 sections with 0.5 m spacing. The Sheet is renamed **Calc00-10**. This Sheet is then scaled with a factor 5.0 in the x-direction, the new scaled Sheet is renamed **Calc00-50**. Subsequently we make four new copies of the first Calc Sheet by using the **Add from 1st to Target** button, but temporarily change xAP to -10 m, -20 m, -30 m and -40 m respectively before the new Sheets are created. By doing this, all coordinates in the new Sheets will be transferred forward 10, 20, 30 and 40 m. The new Sheets are renamed **Calc10-20**, **Calc20-30**, **Calc30-40**, **Calc40-50**. Finally we specify Lpp to 50 m in all six Sheets.

We have now at hand two alternative ways of describing a 50*10*10 geometry, either by using the single Sheet **Calc00-50** for the full geometry or by using the five Sheets **Calc00-10 ... Calc40-50** linked together. With these Sheets we may now also calculate damage stability by using a part geometry as a compartment within the full geometry.

The two figures at right shows the alternative geometry descriptions. By specifying different text colours in the input cells for the Sheet names, the different Sheets will be plotted in that colour.

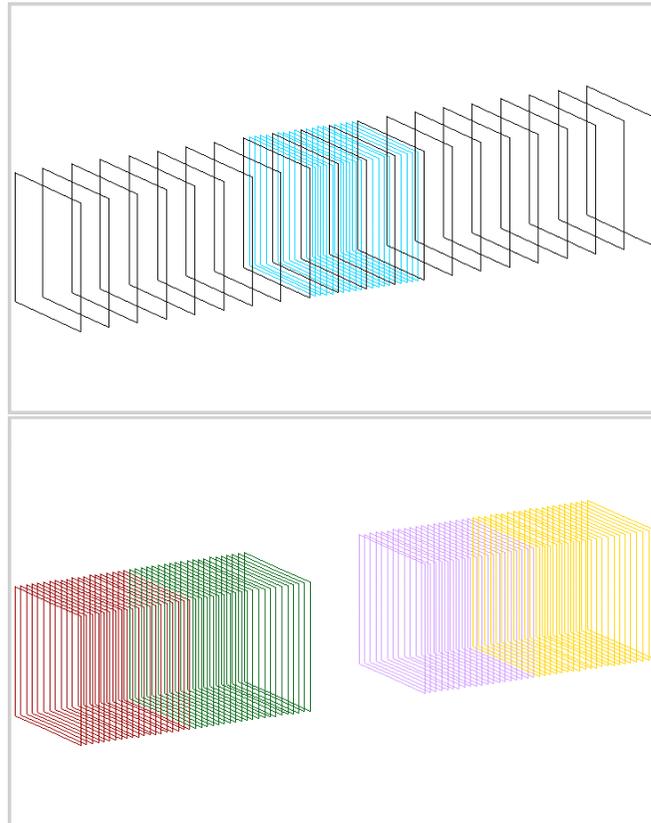


The two alternative models are now compared by a **Hyd.loadcase** calculation where we assume a displacement of 2500 ton at a density of water of 1.000 ton/m³, and with LCB amidships (25 m). Input and results from the two calculations are shown in the figure at right. We find the results identical.

Workbook: Block.xls (Title 1): Example 4.1 (Title 2): 00-50		Workbook: Block.xls (Title 1): Example 4.1 (Title 2): 00-10,10-20	
Partments:	6	PermiVol:	(Name):
Sheet 01:	Calc00-50	1	
Sheet 02:	Calc00-10	0	
Sheet 03:	Calc10-20	0	
Sheet 04:	Calc20-30	0	
Sheet 05:	Calc30-40	0	
Sheet 06:	Calc40-50	0	
Sheet 07:			
Sheet 08:			
Sheet 09:			
Sheet 10:			
Sheet 11:			
Sheet 12:			

Hyss 2.00 Pro LOAD CON Example 4.1 00-50		Hyss 2.00 Pro LOAD CON Example 4.1 00-10,10-20,20-30,30-40,40-50	
Dens SW =1.000 ton/m ³			
Displacement SW (ton):	2500.00	Displacement SW (ton):	2500.00
LCG fw AP (m):	25.000	LCG fw AP (m):	25.000
TCG ps CL (m):	0.000	TCG ps CL (m):	0.000
KG' (m):	0.000	KG' (m):	0.000
Equilibrium at			
Draught mid at L/2 (m):	5.000	Draught mid at L/2 (m):	5.000
Trim (pos aft) (m):	0.000	Trim (pos aft) (m):	0.000
Heel a (pos ps) (deg):	0.00	Heel a (pos ps) (deg):	0.00
Displacement vol (m ³): 2500.00			
LCB fw AP (m):	25.000	LCB fw AP (m):	25.000
TCB ps CL (m):	0.000	TCB ps CL (m):	0.000
KB (m):	2.500	KB (m):	2.500
Waterplane Area (m ²): 500.00			
LCF fw AP (m):	25.000	LCF fw AP (m):	25.000
TCF ps CL (m):	0.000	TCF ps CL (m):	0.000
KF (m):	5.000	KF (m):	5.000
I - transv (m ⁴):	4166.7	I - transv (m ⁴):	4166.7
KN - transv (m):	0.000	KN - transv (m):	0.000
dKN/da - transv (m/rad):	4.167	dKN/da - transv (m/rad):	4.167
GZ - transv (m):	0.000	GZ - transv (m):	0.000
dGZ/da - transv (m/rad):	4.167	dGZ/da - transv (m/rad):	4.167
I - longit (m ⁴):	104167	I - longit (m ⁴):	104167
dKN/da - longit (m/rad):	44.2	dKN/da - longit (m/rad):	44.2
GZ - longit (m):	0.0	GZ - longit (m):	0.0
dGZ/da - longit (m/rad):	44.2	dGZ/da - longit (m/rad):	44.2
max WL Breadth (m):	10.00	max WL Breadth (m):	10.00
max Section Area (m ²):	50.00	max Section Area (m ²):	50.00
Wetted Surface (m ²):	1000.0	Wetted Surface (m ²):	1000.0
TPcm (ton/cm):	5.000	TPcm (ton/cm):	5.000
MTcm (tonn/cm):	22.08	MTcm (tonn/cm):	22.08
Comp. Displacement (ton):			
Calc00-50(1.000)	2500.00	Calc00-10(1.000)	500.00
		Calc10-20(1.000)	500.00
		Calc20-30(1.000)	500.00
		Calc30-40(1.000)	500.00
		Calc40-50(1.000)	500.00

In a similar way we can now calculate damage conditions by two alternatives, either by using the full geometry and subtract the displacement from the damaged part or by only using the undamaged part geometries. A comparison between these two alternatives is shown in the following figures where the amidships "compartment" **Calc20-30** is assumed damaged with full loss of displacement (permVol = -1). Also this time the results are identical. With the first alternative, the amount of water in the open compartment is printed in the table of results. The second alternative has no open/damaged compartment (only a dismissed geometry) and therefore nothing is printed for this. (Note that it is not possible just to take away sections from the full geometry in the first alternative!)



Workbook:	Block.xls	(Title 1):	Example 4.1
Workbook:		(Title 2):	00-50, Flood
partments:			
alc Sheets:	6	PermVol:	(Name):
Sheet 01:	Calc00-50	1	
Sheet 02:	Calc00-10	0	
Sheet 03:	Calc10-20	0	
Sheet 04:	Calc20-30	-1	
Sheet 05:	Calc30-40	0	
Sheet 06:	Calc40-50	0	

Hyss 2.00 Pro	LOAD CON
Example 4.1	
00-50, Flooded 20-30	
Dens SW =1.000 ton/m^3	
Displacement SW (ton):	2500.00
LCG fw AP (m):	25.000
TCG ps CL (m):	0.000
KG' (m):	0.000
Equilibrium at	
Draught mid at L/2 (m):	6.250
Trim (pos aft) (m):	0.000
Heel a (pos ps) (deg):	0.00
Displacement vol (m^3):	2500.00
LCB fw AP (m):	25.000
TCB ps CL (m):	0.000
KB (m):	3.125
Waterplane Area (m^2):	400.00
LCF fw AP (m):	25.000
TCF ps CL (m):	0.000
KF (m):	6.250
1 - transv (m^4):	3333.3
KN - transv (m):	0.000
dKN/da - transv (m/rad):	4.458
GZ - transv (m):	0.000
dGZ/da - transv (m/rad):	4.458
1 - longit (m^4):	103333
dKN/da - longit (m/rad):	44.5
GZ - longit (m):	0.0
dGZ/da - longit (m/rad):	44.5
max WL Breadth (m):	10.00
max Section Area (m^2):	62.50
Wetted Surface (m^2):	1350.0
TPcm (ton/cm):	4.000
MTcm (tonn/cm):	22.23
Comp. Displacement (ton):	
Calc00-50(1.000)	3125.00
Calc20-30(-1.000)	-625.00

Workbook:	Block.xls	(Title 1):	Example 4.1
Workbook:		(Title 2):	00-10,10-20
partments:			
alc Sheets:	6	PermVol:	(Name):
Sheet 01:	Calc00-50	0	
Sheet 02:	Calc00-10	1	
Sheet 03:	Calc10-20	1	
Sheet 04:	Calc20-30	0	
Sheet 05:	Calc30-40	1	
Sheet 06:	Calc40-50	1	

Hyss 2.00 Pro	LOAD CON
Example 4.1	
00-10,10-20,30-40,40-50	
Dens SW =1.000 ton/m^3	
Displacement SW (ton):	2500.00
LCG fw AP (m):	25.000
TCG ps CL (m):	0.000
KG' (m):	0.000
Equilibrium at	
Draught mid at L/2 (m):	6.250
Trim (pos aft) (m):	0.000
Heel a (pos ps) (deg):	0.00
Displacement vol (m^3):	2500.00
LCB fw AP (m):	25.000
TCB ps CL (m):	0.000
KB (m):	3.125
Waterplane Area (m^2):	400.00
LCF fw AP (m):	25.000
TCF ps CL (m):	0.000
KF (m):	6.250
1 - transv (m^4):	3333.3
KN - transv (m):	0.000
dKN/da - transv (m/rad):	4.458
GZ - transv (m):	0.000
dGZ/da - transv (m/rad):	4.458
1 - longit (m^4):	103333
dKN/da - longit (m/rad):	44.5
GZ - longit (m):	0.0
dGZ/da - longit (m/rad):	44.5
max WL Breadth (m):	10.00
max Section Area (m^2):	62.50
Wetted Surface (m^2):	900.0
TPcm (ton/cm):	4.000
MTcm (tonn/cm):	22.23
Comp. Displacement (ton):	
Calc00-10(1.000)	625.00
Calc10-20(1.000)	625.00
Calc30-40(1.000)	625.00
Calc40-50(1.000)	625.00

If the damaged compartment has a permeability of 0.85, the PermVol = -0.85 shall be specified when using the first alternative and PermVol = +0.15 when using the second. See the next figure in which the two alternatives are compared.

Workbook:	Block.xls	(Title 1):	Example 4.1
Workbook:		(Title 2):	00-50, Flood
partments:			
alc Sheets:	6	PermVol:	(Name):
Sheet 01:	Calc00-50	1	
Sheet 02:	Calc00-10	0	
Sheet 03:	Calc10-20	0	
Sheet 04:	Calc20-30	-0.85	
Sheet 05:	Calc30-40	0	
Sheet 06:	Calc40-50	0	

Hyss 2.00 Pro	LOAD CON
Example 4.1	
00-50, Flooded 20-30(0.85)	
Dens SW =1.000 ton/m^3	
Displacement SW (ton):	2500.00
LCG fw AP (m):	25.000
TCG ps CL (m):	0.000
KG' (m):	0.000
Equilibrium at	
Draught mid at L/2 (m):	6.024
Trim (pos aft) (m):	0.000
Heel a (pos ps) (deg):	0.00
Displacement vol (m^3):	2500.00
LCB fw AP (m):	25.000
TCB ps CL (m):	0.000
KB (m):	3.012
Waterplane Area (m^2):	415.00
LCF fw AP (m):	25.000
TCF ps CL (m):	0.000
KF (m):	6.024
1 - transv (m^4):	3458.3
KN - transv (m):	0.000
dKN/da - transv (m/rad):	4.395
GZ - transv (m):	0.000
dGZ/da - transv (m/rad):	4.395
1 - longit (m^4):	103458
dKN/da - longit (m/rad):	44.4
GZ - longit (m):	0.0
dGZ/da - longit (m/rad):	44.4
max WL Breadth (m):	10.00
max Section Area (m^2):	60.24
Wetted Surface (m^2):	1322.9
TPcm (ton/cm):	4.150
MTcm (tonn/cm):	22.20

Comp. Displacement (ton):	
Calc00-50(1.000)	3012.05
Calc20-30(-0.850)	-512.05

Workbook:	Block.xls	(Title 1):	Example 4.1
Workbook:		(Title 2):	00-10,10-20
partments:			
alc Sheets:	6	PermVol:	(Name):
Sheet 01:	Calc00-50	0	
Sheet 02:	Calc00-10	1	
Sheet 03:	Calc10-20	1	
Sheet 04:	Calc20-30	0.15	
Sheet 05:	Calc30-40	1	
Sheet 06:	Calc40-50	1	

Hyss 2.00 Pro	LOAD CON
Example 4.1	
00-10,10-20,20-30(0.15),30-40,40-50	
Dens SW =1.000 ton/m^3	
Displacement SW (ton):	2500.00
LCG fw AP (m):	25.000
TCG ps CL (m):	0.000
KG' (m):	0.000
Equilibrium at	
Draught mid at L/2 (m):	6.024
Trim (pos aft) (m):	0.000
Heel a (pos ps) (deg):	0.00
Displacement vol (m^3):	2500.00
LCB fw AP (m):	25.000
TCB ps CL (m):	0.000
KB (m):	3.012
Waterplane Area (m^2):	415.00
LCF fw AP (m):	25.000
TCF ps CL (m):	0.000
KF (m):	6.024
1 - transv (m^4):	3458.3
KN - transv (m):	0.000
dKN/da - transv (m/rad):	4.395
GZ - transv (m):	0.000
dGZ/da - transv (m/rad):	4.395
1 - longit (m^4):	103458
dKN/da - longit (m/rad):	44.4
GZ - longit (m):	0.0
dGZ/da - longit (m/rad):	44.4
max WL Breadth (m):	10.00
max Section Area (m^2):	60.24
Wetted Surface (m^2):	1102.4
TPcm (ton/cm):	4.150
MTcm (tonn/cm):	22.20

Comp. Displacement (ton):	
Calc00-10(1.000)	602.41
Calc10-20(1.000)	602.41
Calc20-30(0.150)	90.36
Calc30-40(1.000)	602.41
Calc40-50(1.000)	602.41

The specified permeability (PermVol) works always so that a positive value adds displacement and a negative value subtract displacement. This is the case irrespective of the geometries overlap or not!

Example 4.2 Working with Load Conditions and Tanks

Note: The figures in this example are all produced with Hyss 2.0. Hyss 2.2 allows more fixed weights and tanks and the LCdata printout is therefore extended to two pages.

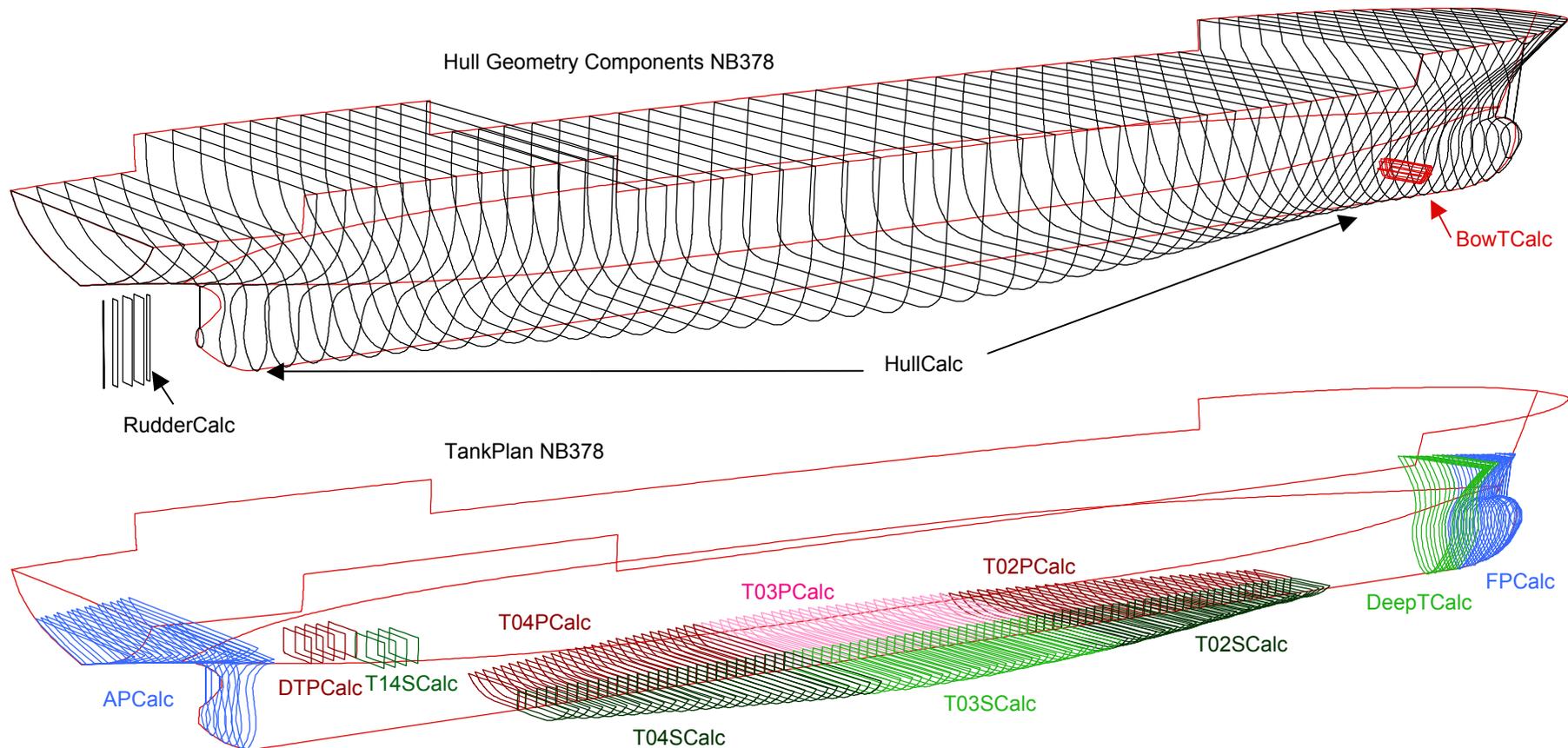
We continue to work with the same sample ship as has been used in Part 1 of this Manual. The ship hull geometry is defined by three geometry Sheets, HullCalc, RudderCalc and BowTCalc (where the latter is a deduction of displacement). Furthermore, 11 interior tanks have been defined and included in the Tank Condition (see

Part 1 page 1.15). The hull components and tanks are shown in the figures below. In load condition calculations, tanks may either be directly calculated or may be treated as a fixed weight with free surface effect. Direct calculations of tanks is only available in the **Pro** edition while **Intact** and **Basic** editions are stuck to the more rough fixed weight approach. This example shows the differences between the two ways of handling tanks.

What is the effect of free surfaces?

A free surface in a liquid tank enables the liquid to move when the ship is heeled or trimmed and thus the

centre of gravity of the liquid is changed. For very small changes of heel and trim, this effect may be accounted for by a (virtual) correction on the total vertical centre of gravity, $KG' = KG + (I \cdot \rho) / (\text{Total displacement})$, where I is the surface moment of inertia and ρ is the density of the liquid. However, although this correction is theoretically correct for infinite small angles of heel or trim, it becomes less correct for larger changes of angles since it does not account for the actual change of geometry of the liquid in a closed tank. Especially when the tank is very narrow or broad and/or the filling rate is close to 0% or 100% the KG correction approach may not describe the actual behaviour of the liquid.



Alternative 1; Direct calculated tanks

We define a Load Condition with fixed weights and with reference to a Tank Condition where the filling rate is defined. Both the Load Condition No1 and the Tank Condition No2 are defined using the Settings Buttons. The same example input is chosen as on pages 1.13 and 1.15 in Part 1 of this Manual:

In this case we define the filling rates as % (which usually is the most convenient), but we could also have given the actual weight in ton and then the summary below the tank table would have shown the total weight and centre of gravity.

When defining the first Tank Conditions it is a good habit to include all tanks even if some are empty. (Hyss 2.2 allows for a maximum of 35 tanks).

When new Tank Conditions are to be defined, the first condition can easily be edited and the filling rates changed, and then the condition is saved under a new condition number.

After a **Hyd.loadcase** calculation, the resulting LCdata output will be as shown in the figure on the next page.

Load Condition		Detailed Specified Load Condition				
LC No: 1						
(Title 3): Full Load Arrival Condition						
Fixed Positioned Weights:						
	Name:	W(ton):	LCG:	TCG:	KG:	dens*lx (tonm):
W01:	Hold 01	800	126		11	
W02:	Hold 02	2500	104.25		8.5	
W03:	Hold 03	2500	74.5		8.5	
W04:	Hold 04	2500	47.625		8.5	
W05:	Hold 05	400	1		12	
W06:	Stores	80	19.5		6	
W07:	Cons.	42	19.5		4.3	
W08:						
W09:						
W10:						
W11:						
W12:						
W13:						
W14:						
W15:						
W16:						
W17:						
W18:						
W19:						
W20:						
W21:						
W22:						
W23:						
W24:						
Light Ship:		5430	65.732		7.12	
Fixed W Summary:		14252.0	72.021	0.000	8.186	8.186
Include Tank Condition No: 2						

Tank Condition		Detailed Specified Tank Condition					
TC No: 2							
Weight, in %? (Y/N):							Y
Tanks:	Name:	W(ton/%)	(upright) LCG:	(upright) TCG:	(upright) KG:	liq.dens (ton/m³)	Calc Sht: (+)PermVol:
Tank 01:	FP WB	100				1.025	FP Calc 1
Tank 02:	DeepT WB	20				1.025	DeepT Calc 1
Tank 03:	T02S HFO	15				0.92	T02S Calc 1
Tank 04:	T02P HFO	15				0.92	T02P Calc 1
Tank 05:	T03S HFO	0				0.92	T03S Calc 1
Tank 06:	T03P HFO	0				0.92	T03P Calc 1
Tank 07:	T04S HFO	15				0.92	T04S Calc 1
Tank 08:	T04P HFO	15				0.92	T04P Calc 1
Tank 09:	T14S GO	85				0.86	T14S Calc 1
Tank 10:	DayTP HFO	85				0.92	DTP Calc 1
Tank 11:	AP WB	0				1.025	AP Calc 1
Tank 12:							1
Tank 13:							1
Tank 14:							1
Tank 15:							1
Tank 16:							1
Tank 17:							1
Tank 18:							1
Tank 19:							1
Tank 20:							1
Prel. Tank Summary:		--	--	--	--		
Note: preliminary LCG, TCG, VCG are only available if Tank Weight is given in ton							

Reference

Alternative 2; Tanks treated as fixed weights without free surface effect

to get as equal results as possible. The new Load Condition No2 is shown in the figure below, and the resulting LCdata after calculations is shown on the next page.

We define a second Load Condition set where the tank weights have been included and the reference to a Tank Condition has been excluded. The weights and centre of gravity are directly taken from the previous output

The difference in floating condition is insignificant but the initial stability dGZ/da (GM) is almost 0.3 m higher (since no free surface effects have been given).

Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.00
Preliminary

LOAD CONDITION DATA 1(1)

Full Load Arrival Condition
Load Condition Data

Fixed Positioned Weights :	W (ton):	LCG:	TCG:	KG:	dens*lx (tonm):	Distribution
Hold 01	800.00	126.000	0.000	11.000	0.000	Hold 01
Hold 02	2500.00	104.250	0.000	8.500	0.000	Hold 02
Hold 03	2500.00	74.500	0.000	8.500	0.000	Hold 03
Hold 04	2500.00	47.625	0.000	8.500	0.000	Hold 04
Hold 05	400.00	1.000	0.000	12.000	0.000	Hold 05
Stores	80.00	19.500	0.000	6.000	0.000	Stores
Cons.	42.00	19.500	0.000	4.300	0.000	Stores
Light Ship:	5430.00	65.738	0.000	7.120	0.000	Light Ship
Fixed Weight Summary :	W (ton):	LCG:	TCG:	KG:	KG':	
	14252.00	72.023	0.000	8.186	8.186	
Direct calculated Tanks :	W (ton):	LCG:	TCG:	KG:	liq.dens (ton/m³):	(+)PermVol:
FP WB (100%)	161.02	147.982	0.000	5.194	1.025	1.000
DeepT WB (20%)	32.80	142.472	0.000	2.040	1.025	1.000
T02S HFO (15%)	43.76	99.659	-2.987	0.154	0.920	1.000
T02P HFO (15%)	43.76	99.621	3.007	0.154	0.920	1.000
T03S HFO						
T03P HFO						
T04S HFO (15%)	48.40	48.404	-3.885	0.135	0.920	1.000
T04P HFO (15%)	48.40	48.432	3.916	0.134	0.920	1.000
T14S GO (85%)	17.54	20.498	-2.000	6.850	0.860	1.000
DayTP HFO (85%)	24.98	16.997	2.003	6.850	0.920	1.000
AP WB						
Tank Summary :	W (ton):	LCG:	TCG:	KG:		
	420.65	101.492	0.041	2.903		
Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG)'	
	14672.65	72.868	0.001	8.035	8.035	

Floating Condition
Dens SW = 1.025 ton/m³

Draught mid at L/2 (m) :	6.514
Trim (pos aft) (m) :	0.635
Heel a (pos ps) (deg) :	0.03
dGZ/da' (=GM') (m/rad) :	2.497

User: M Huss Naval Architect Date: 2003-09-14 Time: 00:48.00

Load Condition Detailed Specified Load Condition

LC No: 2
(Title 3): Full Load Arrival Condition (Tanks included as Fixed Weights without free surfa

Fixed Positioned Weights:	Name:	W (ton):	LCG:	TCG:	KG:	dens*lx (tonm):
W01:	Hold 01	800	126		11	
W02:	Hold 02	2500	104.25		8.5	
W03:	Hold 03	2500	74.5		8.5	
W04:	Hold 04	2500	47.625		8.5	
W05:	Hold 05	400	1		12	
W06:	Stores	80	19.5		6	
W07:	Cons.	42	19.5		4.3	
W08:						
W09:						
W10:						
W11:						
W12:						
W13:	FP WB	161.02	147.982	0	5.194	
W14:	DeepT WB	32.8	142.472	0	2.04	
W15:	T02S HFO	43.76	99.659	-2.987	0.154	
W16:	T02P HFO	43.76	99.621	3.007	0.154	
W17:	T03S HFO	0				
W18:	T03P HFO	0				
W19:	T04S HFO	48.4	48.404	-3.885	0.135	
W20:	T04P HFO	48.4	48.432	3.916	0.134	
W21:	T14S GO	17.54	20.498	-2	6.85	
W22:	DayTP HFO	24.98	16.997	2.003	6.85	
W23:	AP WB	0				
W24:						
Light Ship:		5430	65.738		7.12	
Fixed W Summary:	W (ton):	LCG:	TCG:	KG:	KG':	
	14672.7	72.868	0.001	8.035	8.035	

Include Tank Condition No:

Alternative 3; Tanks treated as fixed weights with free surface effect

very small angle of heel). The Load Condition input is shown below. The most significant effect from free surfaces comes from the two pair of wide bottom tanks.

We define a third Load Condition set similar to LC No2 but also including free surface effects for the tanks. These effects have been calculated by using the **Tank Condition** function (including the resulting trim, but not including the

The resulting LCdata after calculations is shown on the next page. With the free surface effects included, we reach at the same GM at equilibrium as we did when the tanks were directly calculated.

LOAD CONDITION DATA					
Hyss 2.00 Pro NB378 Cargo Vessel, L=150.000 Preliminary					
Full Load Arrival Condition (Tanks included as Fixed Weights without free surface effects) Load Condition Data					
Fixed Positioned Weights :	W (ton):	LCG:	TCG:	KG:	dens*Ix (tonm):
Hold 01	800.00	126.000	0.000	11.000	0.000
Hold 02	2500.00	104.250	0.000	8.500	0.000
Hold 03	2500.00	74.500	0.000	8.500	0.000
Hold 04	2500.00	47.625	0.000	8.500	0.000
Hold 05	400.00	1.000	0.000	12.000	0.000
Stores	80.00	19.500	0.000	6.000	0.000
Cons.	42.00	19.500	0.000	4.300	0.000
FP WB	161.02	147.982	0.000	5.194	0.000
DeepT WB	32.80	142.472	0.000	2.040	0.000
T02S HFO	43.76	99.659	-2.987	0.154	0.000
T02P HFO	43.76	99.621	3.007	0.154	0.000
T04S HFO	48.40	48.404	-3.885	0.135	0.000
T04P HFO	48.40	48.432	3.916	0.134	0.000
T14S GO	17.54	20.498	-2.000	6.850	0.000
DayTP HFO	24.98	16.997	2.003	6.850	0.000
Light Ship:	5430.00	65.738	0.000	7.120	0.000
Fixed Weight Summary :	W (ton):	LCG:	TCG:	KG:	KG':
	14672.66	72.868	0.001	8.035	8.035
Direct calculated Tanks :	W (ton):	LCG:	TCG:	KG:	liq.dens (ton/m^3): (+)PermVol:
Tank Summary :	W (ton):	LCG:	TCG:	KG:	
	0.00	0.000	0.000	0.000	
Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG)'
	14672.66	72.868	0.001	8.035	8.035
Floating Condition Dens SW = 1.025 ton/m^3 Draught mid at L/2 (m) : 6.514 Trim (pos aft) (m) : 0.635 Heel a (pos ps) (deg) : 0.02 dGZ/da' (=GM') (m/rad) : 2.782					
User: M Huss Naval Architect Date: 2003-09-27 Time: 21.28.01					

Load Condition						Detailed Specified Load Condition				
LC No: 3						(Title 3): Full Load Arrival Condition (Tanks included as Fixed Weights with free surface				
Fixed Positioned Weights:						dens*Ix				
	Name:	W (ton):	LCG:	TCG:	KG:	(tonm):				
W01:	Hold 01	800	126		11					
W02:	Hold 02	2500	104.25		8.5					
W03:	Hold 03	2500	74.5		8.5					
W04:	Hold 04	2500	47.625		8.5					
W05:	Hold 05	400	1		12					
W06:	Stores	80	19.5		6					
W07:	Cons.	42	19.5		4.3					
W08:										
W09:										
W10:										
W11:										
W12:										
W13:	FP WB	161.02	147.982	0	5.194	0				
W14:	DeepT WB	32.8	142.472	0	2.04	14				
W15:	T02S HFO	43.76	99.659	-2.987	0.154	755				
W16:	T02P HFO	43.76	99.621	3.007	0.154	755				
W17:	T03S HFO	0								
W18:	T03P HFO	0								
W19:	T04S HFO	48.4	48.404	-3.885	0.135	1311				
W20:	T04P HFO	48.4	48.432	3.916	0.134	1311				
W21:	T14S GO	17.54	20.498	-2	6.85	14				
W22:	DayTP HFO	24.98	16.997	2.003	6.85	20				
W23:	AP WB	0								
W24:										
	Light Ship:	5430	65.738		7.12					
Fixed W Summary:		W (ton):	LCG:	TCG:	KG:	KG':				
		14672.7	72.868	0.001	8.035	8.320				
Include Tank Condition No: <input type="text"/>										

Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.000
Preliminary

LOAD CONDITION DATA

1(1)

Full Load Arrival Condition (Tanks included as Fixed Weights with free surface effects)
Load Condition Data

Fixed Positioned Weights :	W (ton):	LCG:	TCG:	KG:	dens*x (tonm):	
Hold 01	800.00	126.000	0.000	11.000	0.0	
Hold 02	2500.00	104.250	0.000	8.500	0.0	
Hold 03	2500.00	74.500	0.000	8.500	0.0	
Hold 04	2500.00	47.625	0.000	8.500	0.0	
Hold 05	400.00	1.000	0.000	12.000	0.0	
Stores	80.00	19.500	0.000	6.000	0.0	
Cons.	42.00	19.500	0.000	4.300	0.0	
FP WB	161.02	147.982	0.000	5.194	0.0	
DeepT WB	32.80	142.472	0.000	2.040	14.0	
T02S HFO	43.76	99.659	-2.987	0.154	755.0	
T02P HFO	43.76	99.621	3.007	0.154	755.0	
T04S HFO	48.40	48.404	-3.885	0.135	1311.0	
T04P HFO	48.40	48.432	3.916	0.134	1311.0	
T14S GO	17.54	20.498	-2.000	6.850	14.0	
DayTP HFO	24.98	16.997	2.003	6.850	20.0	
Light Ship:	5430.00	65.738	0.000	7.120	0.0	
Fixed Weight Summary :	W (ton):	LCG:	TCG:	KG:	KG':	
	14672.66	72.868	0.001	8.035	8.320	
Direct calculated Tanks :	W (ton):	LCG:	TCG:	KG:	liq.dens (ton/m³):	(+)PermVol:
Tank Summary :	W (ton):	LCG:	TCG:	KG:		
	0.00	0.000	0.000	0.000		
Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG'):	
	14672.66	72.868	0.001	8.035	8.320	

Floating Condition
Dens SW = 1.025 ton/m³
Draught mid at L/2 (m) : 6.514
Trim (pos aft) (m) : 0.636
Heel a (pos ps) (deg) : 0.03
dGZ/da' (=GM') (m/rad) : 2.497

User: M Huss Naval Architect Date: 2003-09-27 Time: 00.01.12

Comparison between GZ-curves for the alternative treatment of tanks

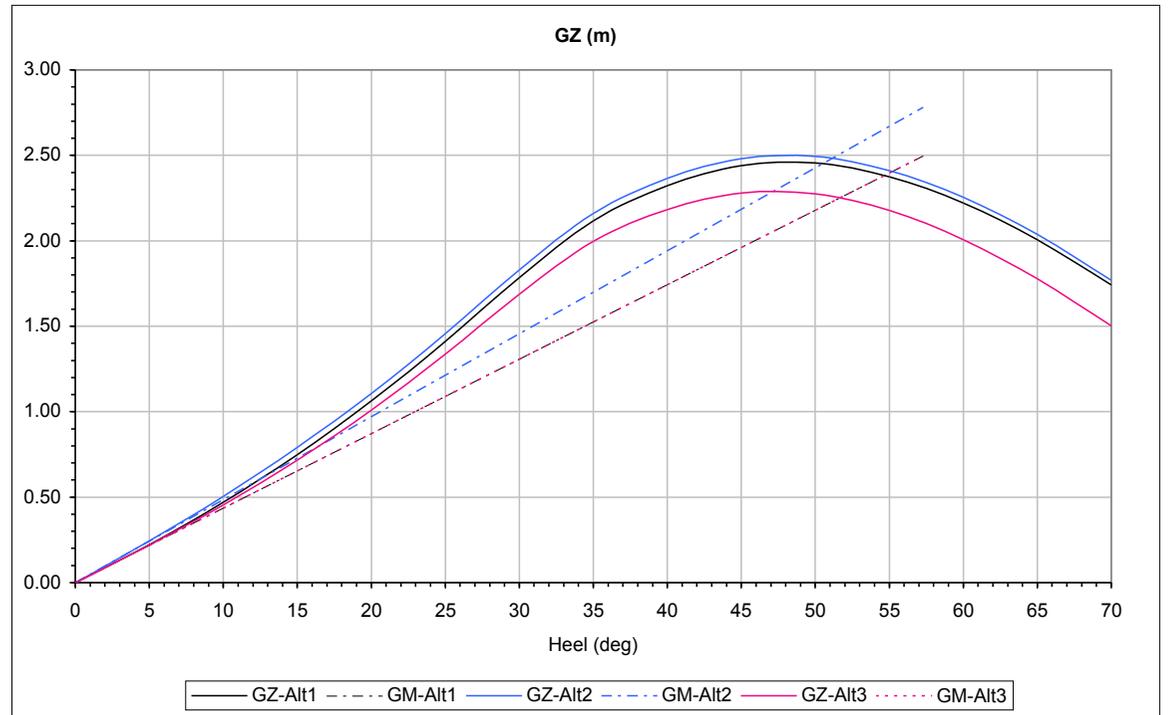
The previous results indicate that tanks could well be treated as fixed weights with free surface effects in upright (equilibrium) condition. But is this also valid for the full GZ-curve?

In the figure below, GZ-curves for all three alternatives are combined in one diagram. The black curves represent here the correct curve with direct calculated tank weights and centre of gravity for each angle of heel (Alt.1).

The blue curves represent Alt.2, with tanks included as fixed weights with constant properties irrespective of the heel. GM (or rather dGZ/da at upright condition) differs significantly but over 15° heel, the GZ-curve follows very close to the correct one.

The red curves represent Alt.3, i.e. tanks included as fixed weights with free surface correction on KG. In this case the GM is correct but over 15° the GZ-curve is significantly lower! The reason for this is that although the free surfaces in the wide bottom tanks initially are large, the total weight in these tanks is relatively small and when the liquid (after 15-20° heel) is gathered at the corner of the tanks, there will be no more decrease in the righting lever and the free surface effect diminish.

The simple lesson to be learnt from this example is that, when possible, tanks should be directly calculated!



Example 4.3 Damage stability calculations

Let us assume a collision damage from port side hitting the midship compartment 03 and breaching both the port side bottom tank T03P and the cargo Hold03. Let us further assume that the ship is in the same arrival load condition as used in the previous example where the tank T03P was empty.

Final flooded condition

To make stability calculations for the final flooded condition is very easy. We just have to add the two damaged compartments to the list of Calc Sheets defining the Hull and assigning them relevant negative permeability. Since the bottom tank T03P was empty in the

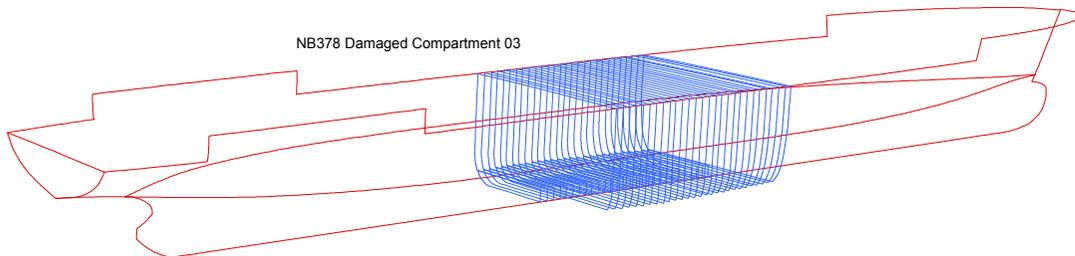
condition we don't have to make any changes to the Tank Condition.

The same Load Condition No1 with reference to Tank Condition No2 is calculated with the **Stab.loadcase** function but we add a new set of Criteria which includes some of the survival criteria from SOLAS Ch.II-1, B-1 for dry cargo ships.

The results are shown in the following three printouts.

Geom. Workbook:	NB378.xls	(Title 1):	
Output Workbook:	Pre/Stab03.xls	(Title 2):	Damaged Co
Hull & Compartments:			
No of Calc Sheets:	5	PermVol:	(Name:)
(Main)Sheet 01:	HullCalc	1	Hull
Sheet 02:	RudderCalc	1	Rudder
Sheet 03:	BowTCalc	-0.88	BowThruster
Sheet 04:	Hold03Calc	-0.6	Damaged Hold03
Sheet 05:	T03PCalc	-0.95	Damaged T03P
Sheet 06:			

LOAD CONDITION DATA						1(1)
Hyss 2.00 Pro NB378 Cargo Vessel, L=150.000 Damaged Comp. 03						
Full Load Arrival Condition Load Condition Data						
Fixed Positioned Weights :	W (ton):	LCG:	TCG:	KG:	dens*Ix (tonm)	Distribution
Hold 01	800.00	126.000	0.000	11.000	0.000	Hold 01
Hold 02	2500.00	104.250	0.000	8.500	0.000	Hold 02
Hold 03	2500.00	74.500	0.000	8.500	0.000	Hold 03
Hold 04	2500.00	47.625	0.000	8.500	0.000	Hold 04
Hold 05	400.00	1.000	0.000	12.000	0.000	Hold 05
Stores	80.00	19.500	0.000	6.000	0.000	Stores
Cons.	42.00	19.500	0.000	4.300	0.000	Stores
Light Ship:	5430.00	65.738	0.000	7.120	0.000	Light Ship
Fixed Weight Summary :	W (ton):	LCG:	TCG:	KG:	KG:	
	14252.00	72.023	0.000	8.186	8.186	
Direct calculated Tanks :	W (ton):	LCG:	TCG:	KG:	liq.dens (ton/m³)	(+)PermVol:
FP WB (100%)	161.02	147.982	0.000	5.194	1.025	1.000
DeepT WB (20%)	32.80	142.474	0.030	2.041	1.025	1.000
T02S HFO (15%)	43.76	102.316	-1.962	0.179	0.920	1.000
T02P HFO (15%)	43.76	97.935	4.302	0.206	0.920	1.000
T03S HFO						
T03P HFO						
T04S HFO (15%)	48.40	47.676	-2.415	0.183	0.920	1.000
T04P HFO (15%)	48.40	50.844	6.028	0.203	0.920	1.000
T14S GO (85%)	17.54	20.499	-1.946	6.852	0.860	1.000
DayTP HFO (85%)	24.98	16.999	2.057	6.852	0.920	1.000
AP WB						
Tank Summary :	W (ton):	LCG:	TCG:	KG:		
	420.65	101.787	0.703	2.924		
Total Summary :	W (ton):	LCG:	TCG:	KG:	(KG):	
	14672.65	72.876	0.020	8.036	8.036	
Floating Condition						
Dens SW = 1.025 ton/m³						
Draught mid at L/2 (m) :	7.581					
Trim (pos aft) (m) :	0.246					
Heel a (pos ps) (deg) :	3.95					
dGZ/da' (=GM') (m/rad) :	2.434					
User: M Huss Naval Architect	Date: 2003-09-28					Time: 02.32.34



Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.000
Damaged Comp. 03

LOAD CONDITION HYDROSTATICS 1(1)

Dens SW =1.025 ton/m³ Full Load Arrival Condition

Displacement SW (ton) : 14672.65
 LCG fw AP (m) : 72.876
 TCG ps CL (m) : 0.020
 KG' (m) : 8.036

Equilibrium at
 Draught mid at L/2 (m) : 7.581
 Trim (pos aft) (m) : 0.246
 Heel a (pos ps) (deg) : 3.95

Displacement vol (m³) : 14314.78
 LCB fw AP (m) : 72.870
 TCB ps CL (m) : 0.289
 KB (m) : 4.135

Waterplane Area (m²) : 2366.39
 LCF fw AP (m) : 70.451
 TCF ps CL (m) : 0.323
 KF (m) : 7.611

I - transv (m⁴) : 94340.7
 KN - transv (m) : 0.573
 dKN/da - transv (m/rad) : 10.449
 GZ - transv (m) : 0.000
 dGZ/da - transv (m/rad) : 2.434

I - longit (m⁴) : 3245423
 dKN/da - longit (m/rad) : 230.4
 GZ - longit (m) : 0.0
 dGZ/da - longit (m/rad) : 222.3

max WL Breadth (m) : 25.08
 max Section Area (m²) : 187.09
 Wetted Surface (m²) : 5965.7

TPcm (ton/cm) : 24.255
 MTcm (tonm/cm) : 217.43

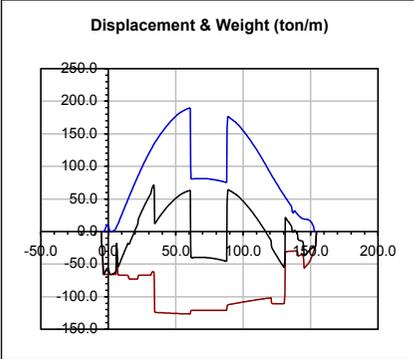
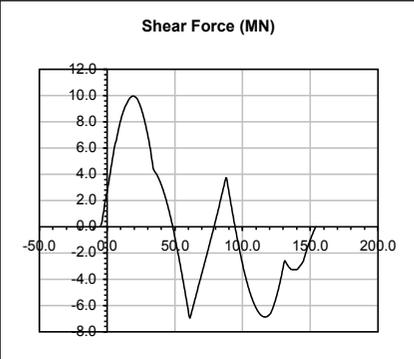
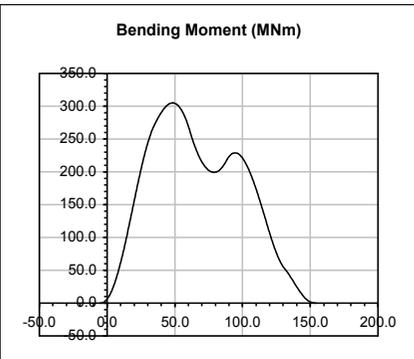
Distance above WL for
Critical points:

Pilot dr	4.907
Hatch 3a	6.315
Hatch 3f	6.352
Hatch 2a	6.359
Hatch 2f	6.397
Hatch 1a	6.403
Hatch 1f	6.441

Comp. Displacement (ton):

Hull(1.000)	17584.70
Rudder(1.000)	27.28
BowThruster(-0.880)	-9.64
Damaged Hold03(-0.600)	-2496.12
Damaged T03P(-0.950)	-433.57

No of iterations: 5, (3)
 User: M Huss Naval Architect Date: 2003-09-28 Time: 02.30.53

Hyss 2.00 Pro
NB378 Cargo Vessel, L=150.000
Damaged Comp. 03

STABILITY FOR LOADING CONDITIONS 1(1)

Loading condition : Full Load Arrival Condition
 Dens SW =1.025 ton/m³

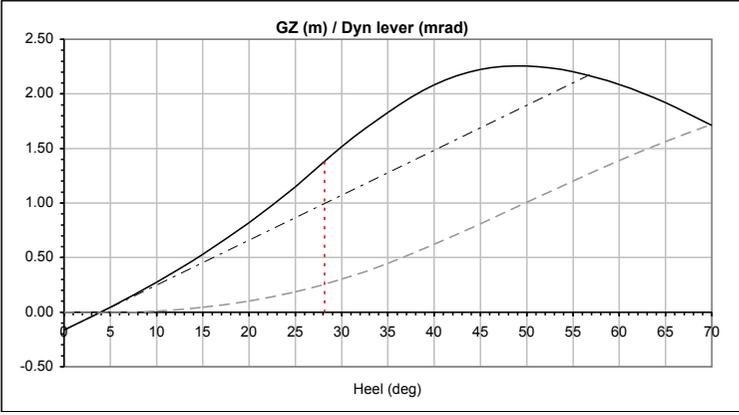
Displacement SW (ton) : 14672.65
 LCG fw AP (m) : 72.882
 TCG ps CL (m) : 0.001
 KG' (m) : 8.035

GMo' (m) : 2.360

Free trim stability :	Right. lever	Dyn. lever	Incr. stab	Draught	Trim
Heel a (°)	GZ (m)	GZa(0-a) (mrad)	dGZ/da (m/rad)	mid at L/2 (m)	at CL (m)
0	-0.165	0.000	2.360	7.591	0.275
5	0.045	-0.005	2.490	7.575	0.228
10	0.274	0.008	2.769	7.527	0.097
15	0.529	0.043	3.101	7.447	-0.102
20	0.818	0.102	3.537	7.331	-0.346
25	1.148	0.187	4.055	7.171	-0.622
30	1.515	0.303	3.996	6.970	-0.938
35	1.832	0.450	3.213	6.763	-1.322
40	2.081	0.621	2.341	6.517	-1.717
45	2.223	0.810	0.928	6.231	-2.123
50	2.255	1.006	-0.183	5.907	-2.547
55	2.204	1.201	-0.994	5.527	-3.035
60	2.088	1.388	-1.649	5.059	-3.631
65	1.920	1.564	-2.173	4.441	-4.426
70	1.712	1.722	-2.602	3.554	-5.601

GZmax at 49.2° : 2.257

Stability criteria :	Actual value / Compliance	Max KG' (m)	Crit. Points :	Subm.angle(°)
CrPts. subm. angle>25.0°	28.2 / OK			
CrPts.freeb.at.equil.>0.000m	4.911 / OK (P101)		Pilot dr	28.2
			Hatch 3a	39.2
			Hatch 3f	38.2
GZ(>25.0°)>0.100m	2.257 / OK	11.120	Hatch 2a	38.0
a(GZmax)>25.0°	49.2 / OK	10.532	Hatch 2f	37.0
a<25.0°/Upr.Mom. 0.00tonm	4.0 / OK	10.743	Hatch 1a	36.9
			Hatch 1f	36.0
Sum. Compliance, max KG' :	OK	10.532	Min.angle :	28.2



User: M Huss Naval Architect Date: 2003-09-28 Time: 02.14.18

Intermediate stages of flooding

In order to analyse intermediate stages of flooding, we have to redefine the damaged compartments as tanks and assign different levels of filling in different Tank Conditions.

The Tank Condition No2 is edited and the two damaged compartments are added. At the same time, the other tank fillings are set to weight in ton instead of %. With the the damaged bottom tank T03P filled and with the weight of the damaged Hold03 set to zero, the condition is saved as Tank Condition No10.

Based on No10 we define a Tank Condition No11 with the bottom tank T03P filled and with Hold03 filled with 10% of the weight that was calculated for the final equilibrium condition, see the figure below. Subsequently we define in the same way Tank Conditions No12-20 with 20%-100% of the final filling weight. We also make copies of Load Condition No1 and save them as Load Conditions No10-20 each referring to the same Tank Conditions No(10-20). Finally we delete the two compartments Hold03Calc and T03PCalc from the list of hull compartments (or set their permeability to zero). Otherwise they will be filled twice (both as tanks and as damaged compartments).

After this all we have to do is to initiate calculations of ten intermediate stages in just one press on the button **Stab.loadcase**.

Tank Condition	Detailed Specified Tank Condition							
TC No: 11	Weight in %? (Y/N): <input type="checkbox"/> N							
Tanks:	Name:	W(ton/%):	(upright LCG):	(upright TCG):	(upright KG):	liq.dens (ton/m ³):	Calc Sht: (+)Perm/vol:	
Tank 01:	FP W/B	161.02				1.025	FP Calc	1
Tank 02:	DeepT W/B	32.8				1.025	DeepT Calc	1
Tank 03:	T02S HFO	43.76				0.92	T02S Calc	1
Tank 04:	T02P HFO	43.76				0.92	T02P Calc	1
Tank 05:	T03S HFO	0				0.92	T03S Calc	1
Tank 06:	T03P HFO	0				0.92	T03P Calc	1
Tank 07:	T04S HFO	48.4				0.92	T04S Calc	1
Tank 08:	T04P HFO	48.4				0.92	T04P Calc	1
Tank 09:	T14S GO	17.54				0.86	T14S Calc	1
Tank 10:	DayTP HFO	24.98				0.92	DTTP Calc	1
Tank 11:	AP W/B	0				1.025	AP Calc	1
Tank 12:								1
Tank 13:	Damaged Ho	249.612				1.025	Hold03 Calc	0.6
Tank 14:	Damaged T0	433.57				1.025	T03P Calc	0.95
Tank 15:								1
Tank 16:								1
Tank 17:								1
Tank 18:								1
Tank 19:								1
Tank 20:								1
Prel. Tank Summary:		W(ton):	(LCG):	(TCG):	(KG):			
		1103.8	0.000	0.000	0.000			
Note: preliminary LCG, TCG, VCG are only available if Tank Weight is given in ton								

There are some rather interesting questions that can be made with reference to the diagram.

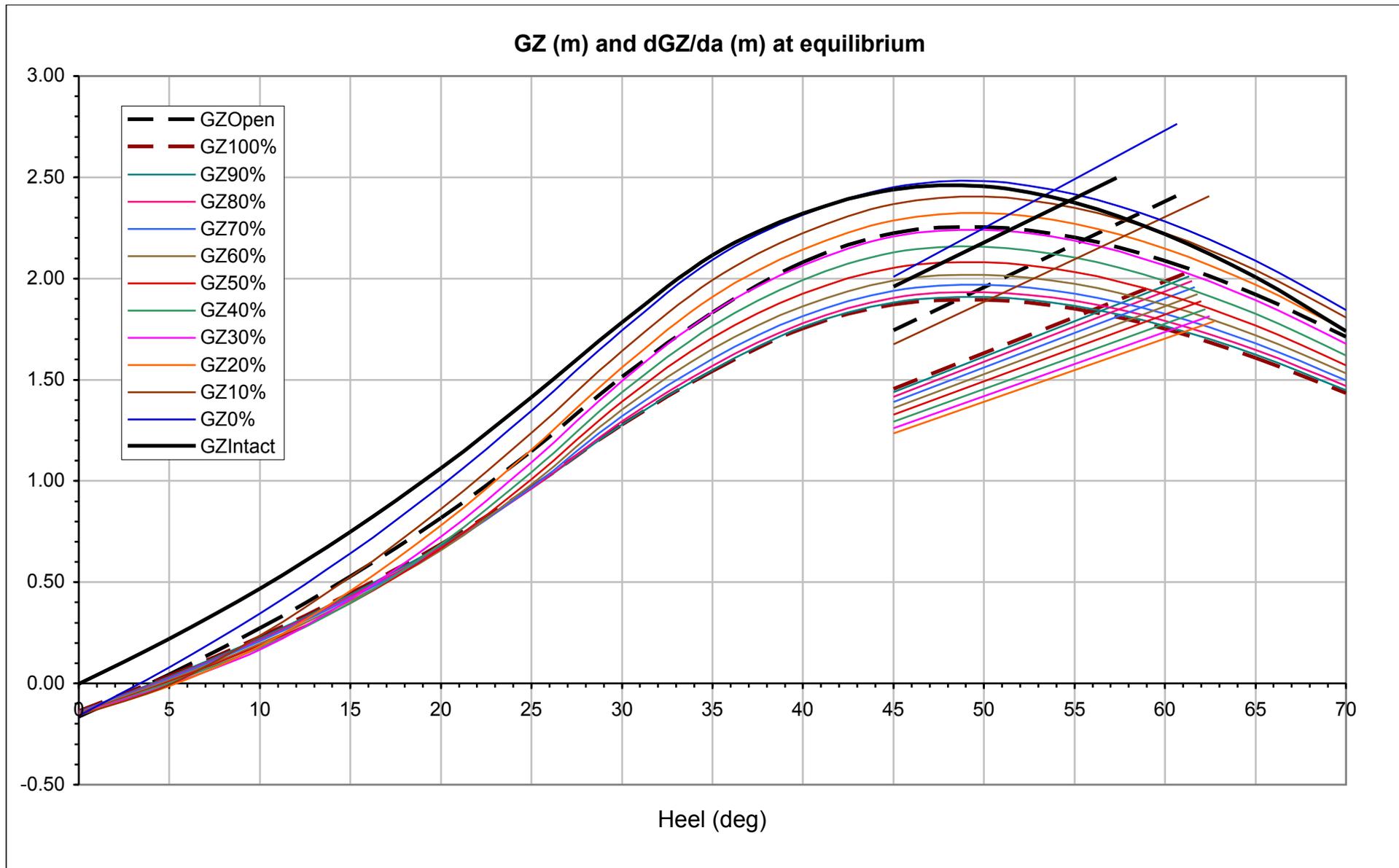
First note that the intermediate stages with the higher GM values (high filling rates) have lower GZ-curves in general. Which one is more safe?

Secondly let us look at the two dashed curves. They both represent some sort of final condition. The upper (black) dashed curve has been calculated with the compartments open, i.e. they have been modelled as a (negative) open part of the hull geometry. The lower (brown) dashed curves represent the compartments modelled as tanks with weights equal to 100% of the weights of the water in damaged compartments in the equilibrium condition. How comes there is such a large difference? The reason for this difference is that when modelling a damaged compartment as a tank, the assigned weight is kept constant at all angles of heel but when it is modelled as a damaged part of the hull, the filling rate varies dependent on the floating condition. Which one is more correct?

The last question is rather philosophical. If the breach is very large so that water easily may run in or out of the compartments, then the higher open curve is more correct. If the breach is small so that water only slowly may pass through, then the lower curve may better represent the actual stability behaviour during transient motions such as roll in waves. However, the latter can never be used for finding static equilibrium.

The physics of damage stability is indeed complex and rule based methods are for sure not always rational or physical. With Hyss it is possible to analyse complex situations in many different ways to enhance the fundamental understanding of the phenomena. However, this also require a good fundamental understanding of the physics of hydrostatics by the user.

GZ-curves for intermediate stages of flooding. Port side bottom tank fully flooded in all damage conditions.



Example 5.1 Power prediction

The power prediction method developed by Holtrop et al. is based on regression analysis of model and full scale data from a large number of different ship types.

Like all such methods, the results must be judged carefully and a perfect precision is not to be expected. The (limited) experience of the author as well as of some other colleges, is that the predicted shaft power for many type of ships is somewhat underestimated with the method. Anyhow, it still is a useful tool for making preliminary design estimates and studies of the influence of different hull and propulsive characteristics.

In this example we will use the method for studying the influence of propeller diameter and rpm on the required power for the same sample ship as used previously.

Propeller optimization

As the method is implemented in Hyss, propeller optimization may be directly performed by specifying a design point; i.e. a design speed and rpm where the propeller pitch ratio is to be optimized for the best efficiency.

We start by repeating the calculations shown in Part 1 of the manual, page 1.27-28. The resulting best propeller that fulfill the design speed and rpm was found to have a pitch ratio of 0.850 and a blade area ratio (avoiding cavitation) of 0.691. After the calculation has been performed, the empty fields are filled in with the data obtained from the hydrostatic calculations for the given draught and trim. The input fields before and after calculations are shown in the following two figures.

Let us now vary the propeller diameter to examine if the 5.2 m given initially is an optimum diameter.

Since all data now are available, we don't have to recalculate hull data anymore and can thus enter N in the Calc. General Hull Data? (Y/N) field. All we have to do is to enter another propeller diameter and delete the Pitch ratio and Blade area ratio fields.

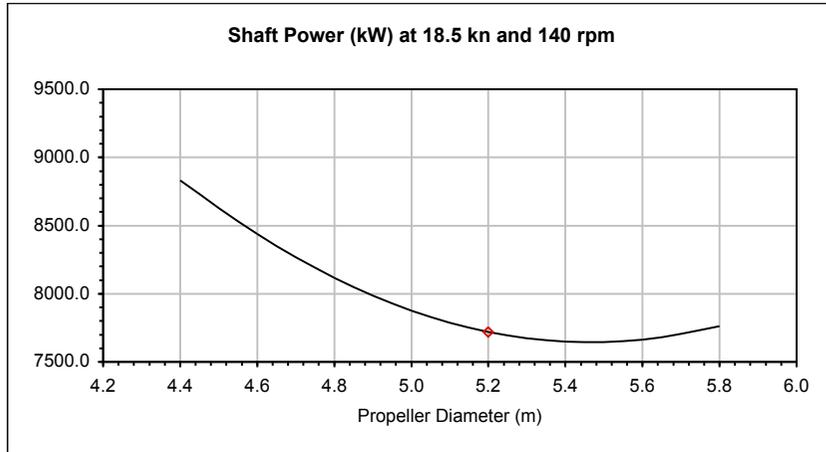
We initiate repeated calculations in this way with a systematic variation of diameter from 4.0 m to 6.0 m, each time optimizing the pitch ratio.

When the propeller diameter is so small that the optimum pitch ratio is over 1.4, an error message occurs and similar when the diameter is so large that the pitch ratio goes below 0.5. (These are the boundaries for the present propeller curve description).

The diagram on the next page shows a summary of the results. The red mark is the initial design condition which we find is very close to the optimum for the given shaft speed of 140 rpm.

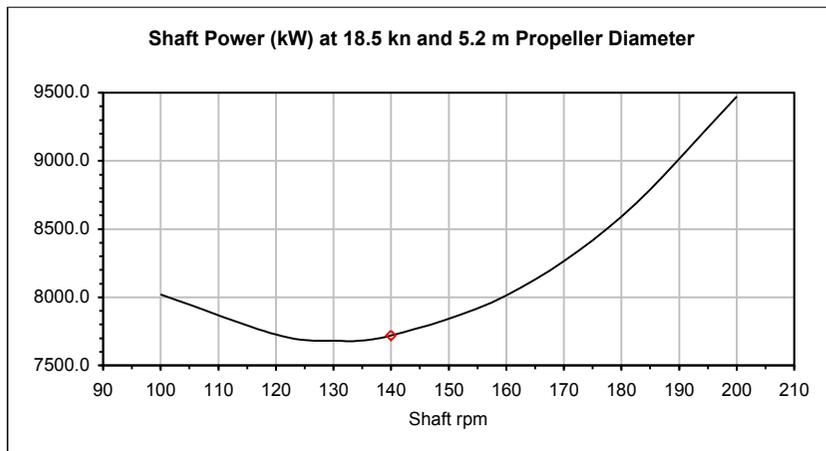
Calc. General Hull Data? (Y/N):	Y	
Displacement vol (m ³):		
Waterline length, LWL (m):		
LCB %LWL fwd LWL (m):		
max WL Breadth (m):		
Midship section coeff. CM (-):		
Waterpl. Area coeff. CWA (-):		
Wetted Surface (m ²):		(Optional)
<hr/>		
Wetted Area of Appendices (m ²):	120.0	(Default) ▼
Appendices Form Coeff., 1+k2 (-):		Info ▼
Bulb Sect. Area (m ²):	14	(Default) ▼
Center of Bulb above KL (m):	4.2	(Default) ▼
Submerged Transom Area (m ²):		(Default) ▼
Stem coefficient (-):		Info ▼
<hr/>		
Propulsion Type (-):		Info ▼
No of Propellers:		(Default) ▼
Propeller Diameter (m):	5.2	(Default) ▼
Propeller clearance from KL, (m):	0.2	(Default) ▼
No of blades (-):	4	(Default) ▼
Pitch ratio, P/D (-):		(Optimized) ▼
Blade area ratio, Ae/Ao:		(Optimized) ▼
MCR Power (kW):	8500	Info ▼
Design speed for opt. Propeller (kn):	18.5	Info ▼
Shaft rpm att design speed (rpm):	140	Info ▼
Spec. FC at design speed (g/kWh):	170	(Optional) ▼

Calc. General Hull Data? (Y/N):	Y	
Displacement vol (m ³):	16890.2	
Waterline length, LWL (m):	149.89	
LCB %LWL fwd LWL (m):	-2.69	
max WL Breadth (m):	25.02	
Midship section coeff. CM (-):	0.984	
Waterpl. Area coeff. CWA (-):	0.727	
Wetted Surface (m ²):	4176.2	(Optional)
<hr/>		
Wetted Area of Appendices (m ²):	120.0	(Default) ▼
Appendices Form Coeff., 1+k2 (-):	1.5	Info ▼
Bulb Sect. Area (m ²):	14	(Default) ▼
Center of Bulb above KL (m):	4.2	(Default) ▼
Submerged Transom Area (m ²):	0	(Default) ▼
Stem coefficient (-):	0	Info ▼
<hr/>		
Propulsion Type (-):	0	Info ▼
No of Propellers:	1	(Default) ▼
Propeller Diameter (m):	5.2	(Default) ▼
Propeller clearance from KL, (m):	0.2	(Default) ▼
No of blades (-):	4	(Default) ▼
Pitch ratio, P/D (-):	0.850	(Optimized) ▼
Blade area ratio, Ae/Ao:	0.691	(Optimized) ▼
MCR Power (kW):	8500	Info ▼
Design speed for opt. Propeller (kn):	18.5	Info ▼
Shaft rpm att design speed (rpm):	140	Info ▼
Spec. FC at design speed (g/kWh):	170	(Optional) ▼



Now we may do a similar study on the influence from shaft rpm. In this case we keep the propeller diameter constant at 5.2 m and instead varies the rpm at design speed 18.5 kn and optimize the pitch ratio for each condition.

The results are shown in the next diagram. Also this indicates that the initial chosen condition was very close to the optimum.

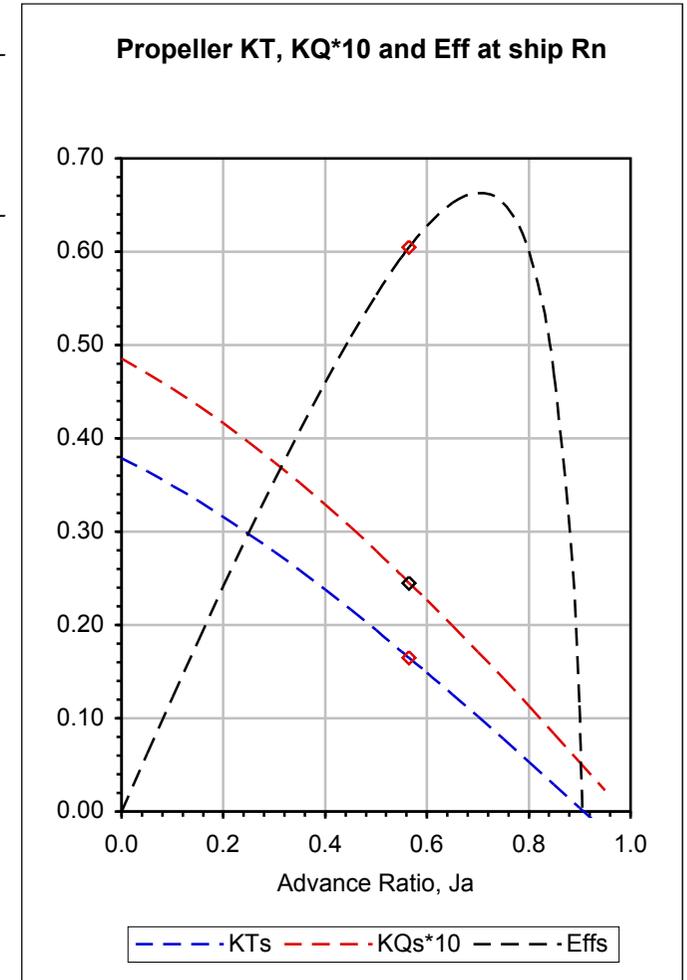


Finally we may check the propeller curve and see if the result for the 5.2 m propeller at design condition is suitable with margins for light and heavy running.

The advance ratio J_a for the design speed 18.5 kn/140 rpm is found in the table outside the print area in the Power printout Sheet.

Looking at the propeller curve (for ship Reynolds number) we find the design point rather well placed.

prop eff:	J_a :	tot eff:	N (rpm):
0.619	0.586	0.689	72.6
0.619	0.586	0.689	76.1
0.620	0.587	0.689	79.8
0.620	0.587	0.689	83.4
0.620	0.587	0.689	87.0
0.620	0.587	0.689	90.7
0.620	0.587	0.688	94.4
0.619	0.586	0.688	98.1
0.619	0.585	0.687	101.9
0.618	0.584	0.686	105.8
0.617	0.583	0.684	109.8
0.616	0.581	0.683	113.8
0.614	0.579	0.681	118.0
0.613	0.576	0.679	122.2
0.611	0.574	0.677	126.5
0.609	0.571	0.675	130.8
0.607	0.568	0.672	135.3
0.605	0.564	0.670	140.0
0.602	0.560	0.666	144.8
0.598	0.556	0.662	150.0



And this example also ends the exercises for this time. The ambition with the later examples has been to show both the practical use of the program and the advantage of having all results available for postprocessing in Excel. Hopefully it has contributed to some inspiration for the tool and for naval architecture in general.
