NAUTICUS HULL
RELEASE DOCUMENT

NAUTICUS HULL

NAUTICUS 3D BEAM

CONTAINER SECURING

FPSO PACKAGE

PULS

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Contents

1 Introduction

1.1 Purpose

The purpose of this document is to inform the users about system requirements, new programs and functionalities, enhancements and bug fixes that are implemented in Nauticus Hull since previous release.

Details about the implementations in all programs are not fully covered in this document, and for more information the user should consult the program documentations being a part of the local installations.

For details about rule implementations in the programs, the user should consult the approval engineers for information about how to use the program for specific ship structures.

For information on how to install the program, please consult the **Nauticus Hull Installation Guide.pdf**, which can be found on the root of the installation CD.

1.2 CSR-Tank and CSR-Bulk

CSR-Tank is in this document used as an abbreviation for "IACS Common Structural Rules for Double Hull Oil Tankers". CSR-Tank is applicable for double hull oil tankers with length $L \geq 150$ m.

CSR-Bulk is in this document used as an abbreviation for "IACS Common Structural Rules for Bulk Carriers". CSR-Bulk is applicable for bulk carriers with length $L \geq 90$ m.

2 Programs and versions

The following Nauticus Hull programs are available in the January 2009 release:

Program	Version
Rule Check	11.0
3D Beam	11.0
PULS	2.0.9
GeniE	4.0-21
Sesam Manager	5.3-05
Presel	7.4-02
Sestra	8.4-01
Cutres	1.5-01
Submod	3.2-01
Xtract	2.1-00
Waveship	6.2-04
Wasim	4.2-01
Wasim_setup	2.2-04
Wasim_solve	3.5-01
Wasim_fourier	3.5-01
Wasim_stru	3.4-02
Wasim_mass	2.3-01
Postresp	6.2-04

New and old releases of the different programs are available for download on our web site
http://www.dnv.com/software/support/index.asp

3 System Information

3.1 Minimum software requirements

Microsoft Office 2000, Excel + Word, Internet Explorer 5.01, or later versions, Microsoft .NET Framework 2.0.

3.2 Minimum hardware requirements

Package	Processor CPU/Mhz	Memory MB	Storage GB	Display and Graphics card
Nauticus Hull	1500	2048	10	1024x768 resolution OpenGL hardware accelerator recommended
GeniE	1500	1024		OpenGL

3.3 Operating system requirement

Windows 2000 with Service Pack 4 or Windows XP. File system should be NTFS. Nauticus Hull must be installed and executed with administrative privileges under Windows Vista.

3.4 Decimal Separator

Decimal separator (symbol)

It is required to use **.** (dot) as decimal separator for some of the Nauticus Hull programs (e.g. Word and Excel report from Section Scantlings).

Open Control Panel → *Regional Settings* to inspect and modify the separator symbols.

If changing Decimals Symbol sign given in regional setting from what is default for selected country, change Decimal Symbol both for numeric and *currency* values. Otherwise, the RCXL spreadsheets may produce wrong result.

List separator

List separator sign must be different from the decimal separator used. Use comma **,** or semicolon **;**

4 New Functionality

Hull Geometry

A new tool for Hull Geometry is included. In this tool DXF files can be imported and enable automatic generation of outer shell geometry within Section Scantlings. This new tool can also export PLN file for use in HydroD.

CSR Bulk - Relative Displacements

Relative displacements for use in fatigue calculations of stiffeners according to the CSR-Bulk rules can now be extracted directly from the cargo hold model and used in the cross sectional analysis.

CSR Bulk - Requirements Outside the Cargo Hold Area

The requirements outside the cargo hold area have been included in Section Scantlings with the following exceptions:

- *Bow flare reinforcement* (Ch 9, Sec 1, [4.1])
- *Strengthening of flat bottom forward area* (Ch 9, Sec 1, [5]).

CSR-Bulk - Buckling strength of curved plates

The buckling strength requirements of curved plates according to Ch 6, Sec 3, Table 3 have been included in Section Scantlings.

Note: The rule formulas are limited to single curved panels. Plates with a varying curvature (or having both flat and curved parts) should be specially considered.

CSR Tank - Cross Section Analysis Report

The input and results from multiple cross section analyses can now be documented in one report. The report is similar to the Section Scantlings report, but is generated directly from the result view in *Cross Section Analyses* in Microsoft Word format.

IACS Unified Requirements for Polar Ships

A spreadsheet for calculating loads and strength requirements according to the IACS Unified Requirements for Polar Ships (URI1 to URI3) has been added.

DNV Rules - Bow Impact

A new *Bow Impact* spreadsheet complying with the January 2008 Rules has been added.

DNV Rules - FE Analyses using GeniE

Loads and corrosion additions according to the DNV rules can now be generated in Nauticus Hull and transferred to GeniE for finite element analysis. Limitations in GeniE 4.0-21:

- Corrosion additions are transferred, but the model thicknesses have to be reduced manually.
- Boundary conditions have to be applied manually in GeniE

5 Error Corrections and Limitations

5.1 General

Error Corrections

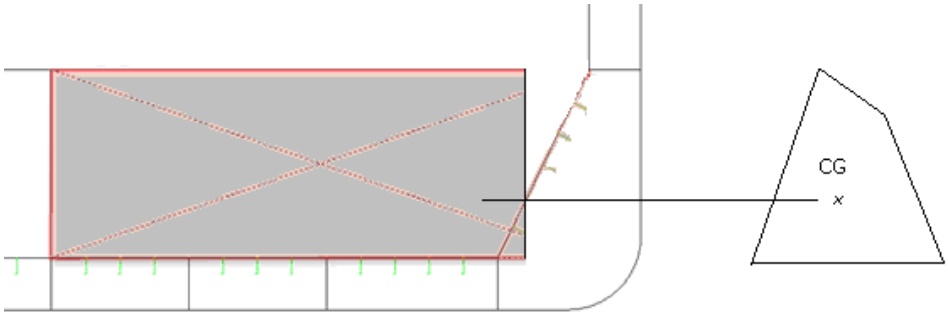
- Problems related to 64-bit operating system have been corrected.
- Copy/paste of data between grids (compartment data grid and load grids) in Nauticus Hull and Excel is implemented (IM1289).

5.2 Compartments and Loads

Error Corrections

- When compartments were regenerated after changes in Cross Section geometry or Transverse bulkhead geometry or changes in bulkhead positions, this often caused the compartment list to contain old compartments with number of cell equal to 0. The only way to obtain a correct compartments list was to push ”Regenerate” which again resulted in loss of all changes to compartment properties made by the user prior to the “Regenerate”. Several bug fixes are implemented to solve these errors and to avoid the necessity to push “Regenerate”.
- When corrugated transverse bulkheads with stool tanks were used, sometimes the generated list of compartments contained too many compartments. Some compartments were duplicated. This often happened when the Cross Section had a complex geometry, i.e. there were longitudinal corrugated bulkheads with longitudinal stool tanks intersecting the transverse stool tanks. These errors are corrected.
- If a model contained corrugated transverse bulkheads with stool tanks, then volume, COG and bounding boxes for the tanks limited by the bulkheads were not adjusted by the volume of the transverse corrugation and the volumes of the stool tanks. Also the insertion point of the bulkheads(insertion point in front of the corrugation or insertion point aft of the corrugation) is taken into account when calculating the mass properties of the compartments. The mass properties for the corrugations and stool tanks are calculated this way:

  Volume of stool tanks is calculated by multiplying the exact area of the stool tank cross section with the breadth of the stool at the height of the stool tank cross section COG. See figure below:



The part of the stool tank volume from the insertion point of the bulkhead and into the cargo tank is used to adjust the cargo tank mass properties.

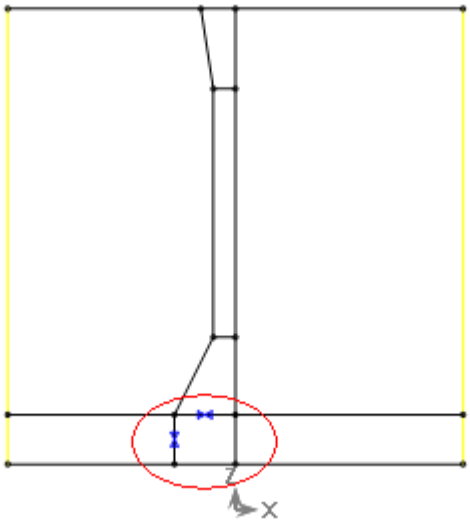
The mass properties for the cargo tank are adjusted by the corrugation of the transverse bulkhead in this way: The volume is calculated by multiplying the breadth of the cargo tank with the height of the bulkhead which is corrugated and multiplying with the corrugation height. The product is then divided by 2. The result is added to or subtracted from the cargo tank properties depending on the position of the insertion point.

- Sometimes when entering the tank plan tool, the graphic view of the profile of the vessel did not have correct scaling compared to the waterline view. To get correct view, the user had to click once in the transverse cross section view to the left. This error is corrected.

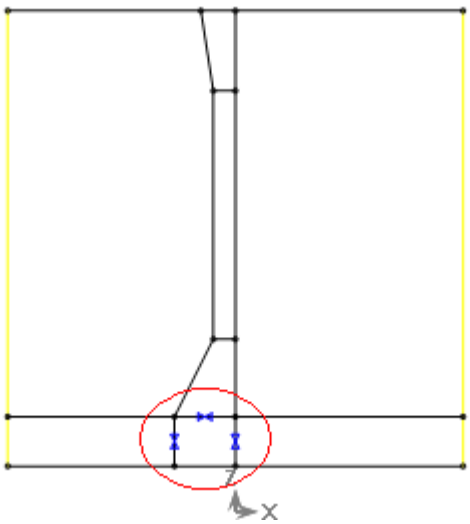
Limitations

- Nauticus Hull generates compartments by linear extrusion of cross sections. Transverse stool tanks are generated similarly by linear extrusion of transverse bulkhead cross sections. Because of this, longitudinal structures which are present in the transverse bulkhead(i.e. inner bottom) cannot have varying z co-ordinate along y direction. It must match the constant z co-ordinate in the transverse bulkhead. If this is not the case, a warning will be generated during compartment generation.
- Cut-outs used in transverse bulkheads can be used to automatically merge compartments made by longitudinal structures and compartments in transverse stool tanks. However, if cutouts are inserted in transverse bulkheads in such a way that the bulkheads become not water tight, this will not work. So, if compartments from more than one cargo hold should be merged, this has to be done by joining them manually. Se figure below:

This is supported:



This is not supported:



- If the bounding geometry for a compartment was changed by the user in the compartment data grid the Frame No aft and Frame No fwd attributes for the compartment were not updated, and incorrect values were printed in the Section Scantlings report. This is now corrected (IM1303).

5.3 Hull Girder Loads

- The fatigue wave bending moments given in *Hull Girder Loads* were shown as 10^{-8} probability level values. These are now shown as 10^{-4} probability level values. (IM1318).

5.4 Cross Section Analyses - Section Scantlings

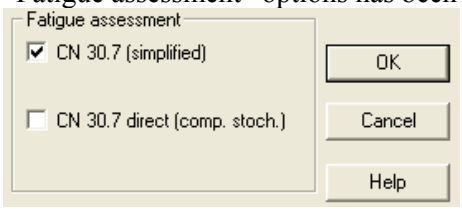
Error Corrections

- **Fatigue strength requirements according to Class Note 30.7 (IM1157)**
  DNV Rules only.
  The default Kr, GM and fraction of the lifetime in different loading conditions are updated according to the January 2008 rules. Fatigue strength calculations are now made available for all vessels with length above 100 metres.

  Note:
  Bulk cargo loads are not included in the calculations.

- **Heavy bulk cargo with a filling height lower than the hopper tank top (IM1242)**
  CSR-Bulk only.
  If the top of the heavy bulk cargo is lower than the hopper tank top, the calculated filling height became incorrect. The error has been corrected.

- **The section modulus of "tilted" longitudinals was incorrect (IM 823)**
  The error was related to the actual section modulus of side longitudinals, and would occur under the following conditions in combination:
  - DNV Rules is applied
  - the angle between the web and plate is less than 75 degrees
  - calculation of the fatigue strength assessment of stiffeners is specified. That is, if one of the two "Fatigue assessment" options has been checked in the "Report options" dialog:



  Description of the requirements for "tilted" stiffeners:
  If the angle between the web and flange is less than 75 degrees, the actual and required section modulus of stiffeners are to be calculated as follows:
  a) The section modulus requirement is to be divided by sin(α), where α is the angle between the web and the plate (DNV Rules Pt.3 Ch.1 Sec.3 C 1002).
  b) The actual section modulus is to be calculated as if the web is perpendicular to the plate.

  The error and when it occurred
  In the Results Report, consider the table "Local Rule Requirements – Stiffeners" as shown below. The actual section modulus of the stiffener is shown as the second item in the second "ACT" line (949 cm3).

Local Rule Requirements - Stiffeners

Stiff. No	ACT ACT	Pos Z_a cm^3	K c	Type Type	h t (mm)
	LOC		Z_r cm^3	excess (%)	t_{min} (mm)
	FAT/BUC		Z_{rf} cm^3	excess (%)	p_d kN/m^2
	FAT hotspot 1				D, full non-corr
	FAT hotspot 2				D, full non-corr

25	ACT	Side	2.50	43	439
	ACT	949	1.0	Tbar	11.0
	LOC	*	1993	-52	11.1
	FAT/BUC	*	1539	-38	55.8
	FAT hotspot 1				0.1466
	FAT hotspot 2				0.3269

i) If no "Fatigue assessment" option has been selected: No errors.
ii) If one of the two "Fatigue assessment" options has been selected:
The actual section modulus Za is based on the true angle between the web and plate.
That is incorrect, it should have been as described in a) above.

The error has been corrected.

- **Flange width of the corroded profile (IM 1261)**
  CSR-Tank and CSR-Bulk.
  Reference is made to the sketches of the corroded profile in the Rules:
  CSR-Tank: Sec.4/2.1.2 (Fig. 4.2.12)
  CSR-Bulk: Ch 3, Sec 2, [3.1.4] (Fig. 1)

  In Section Scantlings, the flange width of the corroded profile did not conform to the sketches mentioned above. That is, the flange width was not reduced by the corrosion addition.
  This has now been corrected, so that the flange width of the corroded profile conforms to the sketches.
  The discrepancy concerning the flange width did affect the section modulus by less than 1 per cent, though.

- **Corrosion addition for SUS (stainless steel) plates (IM 1326)**
  CSR-tank only.
  The extra corrosion addition in heated tanks was applied also for stainless steel plates.
  Now the corrosion addition for stainless steel plates is 0.5 mm for both heated and non-heated tanks.

- **Special requirements concerning the unstiffened bilge plate (IM 1331)**
  DNV Rules: Pt.3 Ch.1 Sec.6 C 307.
  CSR-Tank: Section 8/2.2.3.
  Consider a cross section where the inner bottom ends up in the "mid region" of the curved bilge. In such cases, the program would consider the bilge as unstiffened, and the special Rule requirements referred to above were applied.
  The error has been corrected.

- **Incorrect double bottom stresses for inner bottom longitudinals (IM 1422)**
  DNV Rules 1A1 only.
  Double bottom stresses: Refer to Pt.3 Ch.1 Sec.6 C 801 in the Rules.

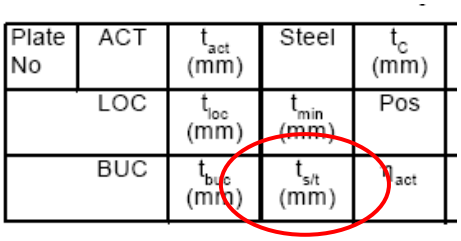
In some cases the calculated double bottom stresses for the inner bottom longitudinals on the starboard side (y < 0) became incorrect.
The error has been corrected.

- **Incorrect coefficient Cr for transversely stiffened curved plates (IM 1425)**
  CSR-Bulk only.
  For curved plates, the stiffening direction was not taken into account when calculating the coefficient Cr (Ch 6, Sec 1).
  Now Cr = 1 is applied for transversely stiffened curved plates.

- **Incorrect requirements concerning the bilge plate (IM1337)**
  CSR-Bulk only.
  The lateral requirement for the bilge plate was taken as the smallest of those in Ch 6, Sec 1, [2.3.1] and [2.3.2] for both longitudinally and transversely stiffened plates. The error has been corrected.
  Now the following requirements in the CSR-Bulk Rules are applied:
  a) Longitudinal stiffening:
     Ch 6, Sec 1, [2.3.1].
  b) Transverse stiffening:
     The smallest of the requirements in b1 and b2, taken over all loading conditions:
     b1) Ch 6, Sec 1, [2.3.1], for all loads.
     b2) Ch 6, Sec 1, [2.3.2], for sea pressure only.

  Note:
  Some requirements concerning the bilge plate are not included. See 4.2.3, "Limitations" below.

- **The s/t based thickness requirement has been removed (IM 1426)**
  CSR-Bulk only.
  Since the buckling strength requirement for the plate is calculated, checking the thickness requirement based on the maximum s/t ratio is not necessary.
  Therefore the requirement t_s/t shown below has been removed from the local requirements table for plates.

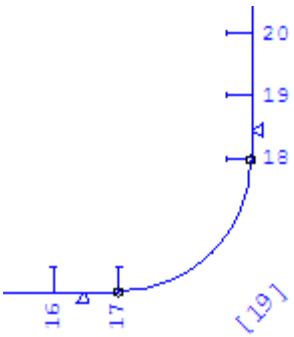


Limitations

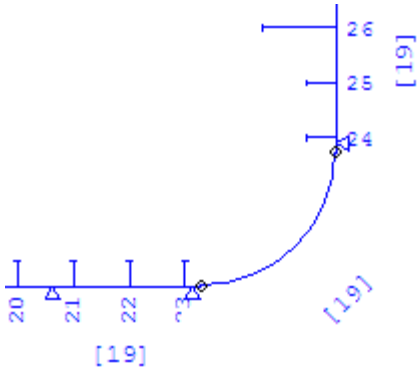
CSR-Bulk Rules

- The specific requirements for ships with length less than 150 metres are not included.
- Bilge plate requirements, Ch 6, Sec 1, [2.3]:
  For the transition zone between the flat bottom and the curved bilge, the bilge plate requirements are not specifically considered in the Rules. Thus the calculated requirements are limited to cases where the curved bilge area is modelled with a longitudinal stiffener at the transition point

between the flat bottom ant the curved bilge.
The same limitation applies to the transition zone between the curved bilge and the flat ship side.



Supported configuration:
Stiffener at transition point.



Not supported configuration:
Stiffener not at transition point

- Buckling strength of curved plates:
  Plates with a varying curvature (or having both flat and curved parts) are not covered by the rules and should be specially considered.

DNV Rules 1A1 – fatigue strength requirements for bulk carriers

- Loads from bulk cargos are not included in the fatigue calculations.

5.5 Rule Check Analyses

Error Corrections

- Calculations in the Beam buckling spreadsheet according to Class Note 30.1 have been corrected.

5.6 FE Analyses - GeniE

Error Corrections

- Default boundary conditions are updated according to the proposed *Rule Changes 4* of Common Structural Rules for Bulk Carriers, July 2008.
  I.e. Rx for the independent point on aft end of the model is changed from Free to Fixed (IM1428).

Limitations

DNV Rules

- Calculation of net scantlings is not implemented in GeniE 4.0-21.

- Internal members and plate boundaries for ballast tanks and cargo oil tanks have to be split manually in GeniE at 1.5 m below weather deck tank top in order to get correct corrosion additions.
- Plates and stiffeners that span over compartments with different corrosion additions have to be split manually in GeniE at the compartment boundaries in order to get correct corrosion additions.
- Import of spring elements along support curves are not implemented in GeniE 4.0-21. I.e. spring elements at transverse bulkhead positions have to be added manually in GeniE.
- Import of boundary conditions at the end planes and the CL symmetry plane of the model is not implemented in GeniE 4.0-21, and must be added manually in GeniE.

5.7 FE Analyses - Modelling and Analysis

Error Corrections

- Bulk cargo loads. The name of the loading condition has been used to determine if a bulk cargo load should be calculated as "Bulk cargo filling part of hold" or "Bulk cargo expanded to fill hold". This is now changed so that the compartment load type is used instead. Loads of type "Bulk" will be calculated as "Bulk cargo expanded to fill hold" while loads of type "Hbulk" or "Ore" will be calculated as "Bulk cargo filling part of hold" (IM1427).

5.8 PULS

PulsComClasses is updated to version 2.0.9.

The update of the PulsComClasses in version 2.0.9 is almost similar to the update in version 2.0.8 in which some unexpected results occurred due to "numerical instabilities" in the numerical solver. These instability problems seem to be very rare, and in version 2.0.8 the problems were reduced by using a smaller incremental step size in the equilibrium equation solver. In the version 2.0.9, the incremental step size is also reduced in the procedure in which the most unfavourable imperfection is found.

More specifically, in the previous version 2.0.8 for biaxially loaded plates, two initial analyses with different imperfection were performed with a large incremental step size, and the most unfavourable imperfection were used in a new refined analysis with a small step size. In the new version 2.0.9, a small step size is also used to find the most unfavourable imperfection, and consequently there is no need for a new analysis since an analysis with a small step size already is performed. The results can simply be taken from the analysis obtained for the most unfavourable imperfection. The computational efficiency will be as before since the total number of increment steps will not be increased.

5.9 Other

Import and export – Settings and Tools

- "Export job" could fail if the job contained large files (>800MB). This is fixed and a progress bar is added.
- The *vessel ID* within old Brix packages (*BxPkg* files) will now be updated when importing a job to a new Vessel ID. (IM1306)
- *Import job* could fail when the original vessel folder included *Vessel ID* more than once, e.g. T:\3914\ships\3914\.

Finite element and wave load analysis programs

Please visit our website for latest status and updates

http://www.dnv.com/services/software/support/downloadUpdates.asp

6 Known Issues

The status of known issues, program errors and limitations are continuously updated on the online status list:

http://exchange.dnv.com/NauticusHull/STATUS%20LIST.pdf