DNV·GL



SOFTWARE

Sesam user course

HydroD Input

DNV GL

02 May 2016

Ungraded

1 DNV GL © 2016

SAFER, SMARTER, GREENER

About the presenter

- Name: Torgeir Kirkhorn Vada
- Position: Product Manager for floating structures

- Background:
 - PhD in Applied mathematics/Hydrodynamics from University of Oslo, 1985
 - Worked in DNV since 1985, with Sesam since 1997, with hydrodynamics since 1978
 - Worked as developer and in various line management roles
 - Member of technology leadership committee for hydrodynamics in DNV GL

Agenda

- Tuesday
 - 8.15 11.00 Presentations
 - Input to HydroD
 - Stability analysis
 - Wadam
 - 11.00 12.15 Lunch
 - 12.15 13.00
 - Wadam & HydroD
 - 13.00 16.00
 - Workshop stability analysis (Goliat)

- Wednesday
 - 8.15 10.00
 - Statistical post processing (Postresp)
 - -10.15 14.00
 - Workshop hydrodynamic analysis (Trym)

Scope of presentation

Describe commands needed for definition of environment and models, and their properties

- Environment modelling
- > Compartment properties
- > Analysis models
- Sectional loads
- ➤ Loading conditions



Sesam – a fully integrated analysis system



5 DNV GL © 2016 02 May 2016

DNV.GL

HydroD – Main modules



How to start the program

- From Sesam Manager:
 - Select the HydroD application
 - Drag and drop into a job
 - Or select New HydroD job
- From the Windows Start menu:





- Select licenses to use:
 - If not needed, a license can be left for other users



Wizard – A useful tool – H5

- Right-click Wizards to create a wizard
 - Right-click the created wizard to execute it
- Follow the steps for the required input
- Using this to set up a new workspace will save time

Workspace browser 🛛 👻 🕂 🗙	Properties	
🔺 藚 Workspace	💦 StabilityWizard1	
 Environment Properties StabilityProperties Models 	Concept steps Morison model Compartments	 ? ? ? ?
▷ 🛐 HydroModels	Damage case	@ V
▷ E Rules	Openings	♀ □
P Soft Analyses P Main Second Seco	Heeling force model	
🔟 Tables	Wind heeling moments	💡 🔘 Projected area wind heeling moments
Pictures		Shape coefficient wind heeling moments
🖺 Reports		Our User defined wind heeling moments
🛚 🚔 ViewSettings	Thruster	💡 🔲
🔺 📉 Wizards	Bilge	💡 🔲
X StabilityWizard1	Analysis store	
* Execute	Stability rule aback	2
📺 Rename	Stability rule check	4
V Cut	MaximumKG analysis	💡 🔽
	Strength analysis	💡 🔲

Wizard – Wadam – H4



- Start from toolbar or Tools pull-down menu
- A step by step guiding through the modelling
- Four main model types
 - Panel model
 - Morison model
 - Composite model
 - Dual model
- Individual information and settings for each model type

ľ	Ĵå v	Vadam	Wizard1		
	۲	(<<	First step		>>
►		Create	direction set	Ca	incel

Environment & location – H5

- Location
 - Water & air density and viscosities
 - Gravity
 - Water depth



Workspace browser 🗸 🗸 🗙	Properties			→ ₽ ×
🔺 🧮 Workspace	🚖 Location1			
🔺 🚢 Environment	1			
💼 Location1	Location	6	0.00000 / 10	
D 🚰 Properties	Gravity	Y	9,80665 m/s^2	
🛚 📥 StabilityProperties	Water depth	9	300 m	
🛛 🚢 Models	Water			
Image: Provide and Provide a state of the	Density	9	1025 kg/m^3	
Rules	Kinematic Viscosity	0	1,19E-06 m^2/s	
🛛 🖄 Analyses		1		
🛛 📈 Plots	Air	~		
▷ 🛄 Tables	Density	۷	1,222 kg/m^3	
Der Pictures	Kinematic Viscosity	9	1,462E-05 m^2/s	

Environment folder – H4



Na	ame
	Condition1
*	Location1.air
Ť	Location1.infinite
777	Location1.seabed
	Location1.water
	Location1.waterSurface
Ť	'SeaState1

- Locations, (one ore more objects)
 - Depth, density, gravity
 - Referring to frequencies, directions, spectrum etc., defined in Directions and Water (hydrodynamic analysis)
- Air
 - Wind profiles (hydrostatic analysis)
- Directions
 - Direction set, directions (hydrodynamic analysis)
- Water
 - Frequency set, spectrum, current, wave spreading etc. (hydrodynamic analysis)

Ungraded

11 DNV GL © 2016 02 May 2016

Create new Location



Models and their properties

Element models

≻Hydro models

- Panel, compartment, mass, Morison models

Models for HydroD/Wadam



14 DNV GL © 2016 02 May 2016

Element models

- Element models are imported into HydroD
 - Predefined Sesam T#.FEM files
- Use in analysis as
 - Panel model
 - Mass model
 - Compartment model
 - Heeling force model
- Models may have different length and mass units
- One model may be reused several times
- A model will be displayed when included
- Notice that an element model may be dragged into HydroD

workspace browser	T T O	riopenties		• T ^
🔺 🧮 Workspace		🔁 Panel_model		_
🔺 🚢 Environment				
💼 Location1		Source	Danal T1 EEM	
🛚 📷 Properties		File name		
🛚 📥 StabilityProperties		Copy to workspace	💡 🔽	
🛯 🛺 Models		Model units		
🚺 FEmodel	۲	Length unit	💡 m	•
🚺 Panel_model	Ο	Mass unit	💡 🗽	•
🛚 🛐 HydroModels				



Workspace browse



Hydro model

- The assembly of the models and loading conditions to be used in an analysis, including their properties
- Right-click HydroModels to add new concepts
 - Panel model
 - Mass model
 - Morison model
 - Compartment model
 - Loading conditions
 - Damage cases
 - Heeling force model
 - Load cross sections
 - Openings
 - Hydrostatic table
 - Etc.

Ungraded





Add Bilge

Add Deck

Add HydrostaticsTable

- ₽ ×

Properties

R HydroModel2

Coordinate system

Baseline z-coordinate

Workspace browser

Workspace

🔺 🕂 Environment

Properties

💼 Location1

• 4 ×

0 m

Panel model

- The panel model is selected from the imported element models
- Symmetry options may be used
 - The model must be defined on the positive side of the symmetry planes (positive x- and/or y-coordinate).
- Translation in x or y direction may be defined



View panel model



Hydro model – H4

- The assembly of all the models to be used in an analysis, including their properties
- Definition of models in a multi-body analysis
 - Reuse existing hydro models



Panel model – H4

	👪 Define Panel Model 🛛 🔀	
🖮 — 🎦 HydroModel2	Panel model: PanelModel1	
HydroProperties	File	
I had Cross New panel model	Type: T*.FEM file	
	Name: /WorkSpaces/Inputfiles/ship/T32.FEM 8?	
	Symmetry	
	I ✓ 22-plane I Y2-plane	
HydroStaticAnalysis	Translate model 8?	
🗄 🐵 🚰 StabilityAnalysis Information		
— 🚰 ViewSettings Save Report from Branch	Br	owser
WadamAnalysis Save Clean JS from Branch		
	OK Cancel	

- The default panel model is a Sesam model (T*.FEM)
 - Notice that a panel model on Wamit (GDF) format can also be used
- Symmetry is not valid for hydrostatic/stability analysis
- Translation in x or y direction is only valid for models without use of symmetry, i.e. the complete model must be created in the preprocessor

Ungraded

20 DNV GL © 2016 02 May 2016

View panel model



Compartment model

- The panel model is selected from the imported element models
 - Allows compartment modelling (mass modelling)
- No symmetry is permitted
- Notice options for Compartments, Style and Results

			LE DANK LEED
Workspace browser	- ₽ ×	Properties 👻 🕂 🗙	With the second s
🔺 🧮 Workspace		CompartmentModel1	Agazana garana
🛚 🏄 Environment			2.00
🛛 🌌 Properties			AND TANK
🛚 📥 StabilityProperties			Arriver .
🔺 🕌 Models		Translation 💡 🤽 FEmodel	
🚺 FEmodel	•	Panel_model	
🚺 Panel_model	•		
🔺 🛐 HydroModels			TITLE THE TOTAL
🔺 🖳 HydroModel1	•		
🔡 PanelModel1	Θ		
👗 MassModel1			
🔖 MorisonModel1	•		LO.Net Colore
🗄 CompartmentModel1	-	Model Compartments Style	
🛛 📥 LoadingConditions1		Properties Results	tai thur tai tai tai
raded			

Compartment properties

- Structure Reduction
 - Fluid capacity of intact compartments, in %
 - Total capacity = 1 SR
- Permeability
 - Total fluid capacity of damaged compartments, in %
- Contents
 - Density of contents
- Filling fractions, in %





Properties

StructureReductions1

23 DNV GL © 2016 02 May 2016

- □ ×

Additional adjustment of compartment volume

- When checking *Plate thickness correction* the volume of the compartments will be reduced using one half of the thickness of the plates defining the wall
 - Structure reduction and Permeability will be defined relative to this reduced volume
 - This is property of the Loading condition, not the compartment



Compartment model properties

- Defining general properties and visibility of compartments
 - Defined in separate load cases, starting with no. 2
 - Permeabilities and Structure reduction
 - Deck tanks

Permeabilities for damaged comp.

StructureReductions for intact comp.

1 2 3 4	2	LC2_TANK	Sub	ermeability	98 %	tureReduct	2 %	3	
2 3 4	3	LC3 TANK						10000	
3 4			Sub	ermeability	98 %	tureReduct	2 %	v	
4	4	LC4_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
	5	LC5_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
5	6	LC6_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
6	7	LC7_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
7	8	LC8_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
8	9	LC9_TANK	Sub	ermeability	98 %	tureReduct	2 %	1	
9	10	LC10_TAN	Deck	ermeability	98 %	tureReduct	2 %		1
10	11	LC11_TAN	Deck	ermeability	98 %	tureReduct	2 %		1
11	12	LC12_TAN	Deck	ermeability	98 %	tureReduct	2 %		1
12	13	LC13_TAN	Deck	ermeability	98 %	tureReduct	2 %		1
13	14	LC14_TAN	Deck	ermeability	98 %	tureReduct	2 %		-
14	4.5	LOTE TAN		1.225	00.0/		0.07		

Internal fluid in tanks – Definition – H4





- The tanks must be defined in the structural model by use of wet surfaces/hydro pressure load cases,
 - First tank is defined in the 2nd load case (e.g. LC 2), second tank in the 3rd load case etc.
- Deck tanks are only relevant for stability analysis of mobile offshore units

Ĵå d	efine Compa	rtments	;	
۲				
8 ?				
	Tank Lc No	Name	Permeability	Deck Tank
1	2	Cm_LC2	Permeability1	
2	3	Cm_LC3	Permeability1	
3	4	Cm_LC4	Permeability1	
4	5	Cm_LC5	Permeability1	
1)K Cancel

Internal fluid in compartments – Properties



Internal fluid in tanks – Contents



Mass model

- Several mass models may be defined for one hydro model
- A general, light-ship type, mass model in the hydro model
- Separate mass models for additional mass in the loading conditions, optionally together with compartment mass
- All mass model may be defined either
 - From element model
 - User specified
 - Point mass table

s model in the		۵.	MassModel1		— 4
		\checkmark	MorisonMode	: 1	
tional mass in the		\blacksquare	Compartment	:Model1	•
agothor with		4 📥	LoadingCond	itions1	
Sgemer with		4	监 LoadingCo	ndition1	
			🗄 Compai	tmentC	ontents1 🤇
Dronerties	- T X		👗 MassMo	odel1	
	• • •	4	🐜 LoadingCo	ndition2	2 🔳 <
MassModel1	_		🔣 Compai	tmentC	ontents1 🤇
Source					
Type 🢡 💿 From element model					
O User specified					
Point mass table					
Element model					
Element model 💡 🚺 FEmodel 🔹 🗸					
Translation 💡					
Model User specified Point mass table Options S	Style				
Properties Results					

🔺 🋐 HydroModels

▲ I HydroModel1

🚼 PanelModel1

Mass model – User specified

- Mass data defined by the user
 - Total mass
 - COG
- For a mass model in a loading condition, the mass can be computed from the buoyancy

🔺 📥 LoadingConditions1				
🔺 📥 LoadingCondition1				
CompartmentContents1				
👗 MassModel1				
🔺 📥 LoadingCon 📥	Fill from buoyancy			
🗄 Comparti 🧮	Change to user specified mass model			

 An existing mass from an element model may optionally be changed to a user specified mass

Properties	s – 🗆 ×
👗 Mass	Model1
Coordinat	te system
Mass	💡 🖲 Input
	Global
Mass —	
Mass	Ŷ
	A value is required.
Centre of	gravity
х	Ŷ
	A value is required.
Y	?
	A value is required.
Z	V
	A value is required.
Model (Jser specified Point mass table Options Style
Prope	erties 📰 Results

Mass model – Point mass table

- Mass data defined by the user
 - Mass points with coordinates
- For all mass models, the actual mass values can be seen in the results tab



Properties 👻 🗖 🗙										
👗 MassModel1										
	Mass	Х	Y	Z						
1	1000 kg	0 m	0 m	0 m						
2	2 1250 kg 10 m 0 m 10 m									
3	3 900 kg -15 m 13 m 3 m									
4	2500 kg	0 m	0 m	15 m						
+	+									
М	Model User specified Point mass table Options Style									
	Properties	Results								

Mass model – H4 - Option 1

Option 1: user defined mass data

- Data may be given in different coordinate systems
 - The Mixed system is reported in the print file from Wadam
- Mass data may be calculated from the panel model.
 - All data may be calculated by assuming a homogeneous density in the panel model (1)
 - The mass and COG (x, y only) may be calculated from the buoyancy (2)
 - Press (1) first, then (2)

Mass model:	MassModel1									
✓ Add mass of □ Update □ Incluce dyn	of compertman stiffness marrix amics of intern	t content with free sur al flu d			87					
C From File Coorcinate syst Mxed C Automatic com Fill from bud Homogene Mass: 7 Total mass:	User Specifie tem: 9? – cordinate Sys putation: – oyancy 9? (eous Dersity P 24978324.48 K	c C Matrix em 2 anel Model g [Kg]	C Mcrison	Vodel Jucya Certe	C D (Glob Input Mixe ancy vol	G Center al Coordi : Coordin <u>d Coordi</u> <u>d Coordi</u> yancy:	red Coordii inate Syste nate Syster nate Syste [24387. [1.5849	nate System m m 75833 m^3 56036e-016	n m, 0 m, -13.5320	
Center of gravi X: 1.58616 Padius of gyra	ty: 976c-01£ [m] tion: ੳ?	Y: Or	1	[m]	2:	-10.533	391829 m	[m]		
RX: 31.3148	1281 m [m]	RY: 28	72226168 m	[m]	RZ:	37.921	46316 m	[m]		
Specific produ RXY: 3.75696	ct of ntertia: 1587e-OC [m]	•?	69)82784∋-I	Di [m]	RYZ:	4.2004	10749e-00	[m]		
								OK	Cancol	ï

Mass model – Option 2



Mass model – Option 2 – Point mass file

Title				
Number of point masses	→ 5175_origi	nal_model		
	420	-		
Scaling factors	1.	1.	1.	1.
A a a a a a a a a a a a a a a a a a a a	8.70E+03	-91.43/5	8	0.02
M _i X _i Y _i Z _i	8.70E+03	-90.5625	8	0.02
	8.70E+03	-89.68/5	8	0.02
	8.70E+03	-88.8125	× ×	0.02
	8.70E+03	-87.9375	8	0.02
	8.70E+03	-87.0625	8	0.02
M Define Mass Model	8.70E+03	-86.18/5	8	0.02
MacsModel2	8.70E+03	-85.3125	8	0.02
Mass model: [Initiasiniouel2	8.70E+03	-84.43/5	8	0.02
	8.70E+03	-83.5625	8	0.02
Add mass of compartment content	2.52E+04	-82.68/5	8	0.02
Update stiffness matrix with free surface effects	2.52E+04	-81.8125	8	0.02
	2.52E+04	-80.93/5	8	0.02
Include dynamics of internal fluid V?	2.52E+04	-80.0625	8	0.02
	2.52E+04	-/9.18/5	8	0.02
・ From File C User Specified C Matrix C Morison Model	2.52E+04	-/8.3125	8	0.02
Type: Wasim mass-file 🔹	2.52E+04	-//.43/5	8	0.02
T*.FEM file	2.52E+04	-/6.5625	8	0.02
Name: Wasim mass-file 9?	2.52E+04	-/5.68/5	8	0.02
Translation	2.52E+04	-/4.8125	8	0.02
	4.09E+04	-/3.93/5	8	0.02
I Translate model ar	4.09E+04	-/3.0625	8	0.02
Vector3d(0 m,0 m,-13 m)	4.09E+04	-/2.18/5	8	0.02
	4.09E+04	-/1.3125	8	0.02
	4.09E+04	-/0.43/5	8	0.02
Can be used also for Wadam	4.09E+04	-69.5625	8	0.02
	4.09E+04	-68.6875	8	0.02
	4.09E+04	-6/.8125	8	0.02

Mass model – Option 3

Option 3: Specify mass matrix



Morison model – H5



Morison model – H4



Model name: MorisonModel1 Name: o/hydrod/dual2/T3.FEM 9? No symmetry is permitted on the 🚰 Wadam(🗄 — 📩 Wizards Paste Information OK Cancel Save Report from Bra Save Clean JS from Br Browser Ungraded

Morison section

- HydroD will list the cross-sectional data for the predefined Morison model
 - From the T-file
- The user must define additional data like drag and added mass coefficients
- Diameter (and mass) may be changed
 - Diameter must be specified for non-pipes
- Specify part of dual model
- Dry section: Used for transferring pressure from panels
 - No Morison load

Note the information symbols									
🎎 Defin	e Morison	Cro	ossection	\mathbf{X}					
🃚 👁 N	ew O Ed	it exis	sting	Allow edit					
PI	PE1								
🔲 Dry se	ection	8?							
🔲 Part o	f dual mode	8?							
🔲 Diame	eter:	83	10 m	[m]					
🔲 Distrib	uted mass:	8?	100 Kg/m	[Kg/m]					
No su	h elements:	00	1	-					
110 30	b cicilicitits.		[· [0.7						
	Cdy:	83	0.7						
	Cdz:	8?	0.7						
	Cau	92	1	-					
		<u> </u>	1	-					
	Caz	٨3]'						
Correspondi	ing section:	89	PIPE1 -]					
	Parameter	Γ	Value						
1 S	ection type	Pipe	•						
2 S	ection area	0.59	96902739 m^2						
3 D	inner	1.89	99999976 m						
4 D	outer	2 m							
<u>5</u> T	hickness	0.10	00000238 m						
		-	Cancel	Applu					
				Abbill					

Cross sectional loads

Ungraded

39 DNV GL © 2016 02 May 2016

Sectional loads

- Cross sections may be defined for calculation of still water cross sectional forces and moments.
 - Requires a mass model defined from element model
- The section is parallel with one of the planes XY, XZ, YZ
- Single or multiple sections





Sectional loads continued

 More than one load cross section concept may be added, in different directions and positions



Sectional loads – H4

- Cross sections may be defined for calculation of cross sectional forces and moments.
 - Requires a mass model defined "From File".
- The section is parallel with one of the planes XY, XZ, YZ



Sectional Loads – Multiple Sections

- A range of cross sections may be defined
- Only available from the browser
- Wadam has a maximum of 25 and Wasim 100 sections
- Stability has no limitation on number of sections



Loading conditions

- ➤ Draught
- ≻Trim & heel
- ➤ Compartment data
- Damaged case

Ungraded

44 DNV GL © 2016 02 May 2016

Loading condition

A loading condition is a place-holder for data that relates to a certain draft and Trim/Heel angles:

- Free surface position
- Optional Mass model
- Compartment fillings



Display of loading condition by displaying the mean free surface

Creating a loading condition



Creating a loading condition continued

- To obtain equilibrium between buoyancy and mass, either
 - Use the Balance option (right-click)
 - Use the advanced options:
 - Potential solver: Find the equilibrium condition by minimizing the hydrostatic potential energy.
 - Dynamic solver: Find the equilibrium by solving a set of equations of motion with artificial damping.
 - Auto Balance: Automatically balance the loading condition when a dependency is modified
 - Plate thickness correction
- Calculated data are found in the Results tab



Properties	+ □ ×
📥 LoadingCondition1	
Balancing ————Balancing method	
Tolerance	9 1E-04 %
Auto Balance	💡 💌
Plate thickness correction -	
Plate thickness correction	💡 🗖
Model Advanced Style	

Ungraded

47 DNV GL © 2016 02 May 2016

Compartments in loading condition

- Define contents and filling fractions
- Using predefined properties or direct input
- Definitions reflected in the display
 - Colours and fillings

ro	perties										
	Compartm	nentContents	L								
d	Selected	Name	Fluid	Fluid densityill	ing proper	illing fracti	otact fluid ma	Damaged	FreeSurface	Group)
		LC2_TANK	Oil	900 kg/m^3	Empty	0 %	0 kg		V	Sub	-
100	100	LC3_TANK	Oil	900 kg/m^3	Empty	0 %	0 kg		1	Sub	
		LC4_TANK	Oil	900 kg/m^3	Empty	0 %	0 kg		1	Sub	-
	1001	LC5_TANK		1000 kg/m ⁷		20 %	98337 kg		1	Sub	-
		LC6_TANK	Oil	900 kg/m^3	Half	50 %	,2126E+05 kg		1	Sub	
		LC7_TANK	Oil	900 kg/m^3	Full	100 %	,4252E+05 kg	1	1	Sub	
		LC8_TANK	Seawater	1025 kg/m^3	Full	100 %	,0398E+05 kg		1	Sub	
		LC9_TANK	Seawater	1025 kg/m^3	Full	100 %	,0398E+05 kg	1	1	Sub	
	4			4	.111				1 1		

Ungraded

Compartments – Balancing

- The compartment contents may be adjusted to the buoyancy
- Compartments are selected from the Options tab in the Property view
- Compartments may be grouped to keep the same filling fraction

				_						
			🔺 📥 Load	lingCondition1						
				🔳 C	ompartmentConte	nts1				
				 	🚛 🔛 Adjust fill	ing				
Proper	ties				nos 🖬 🦻	-				
Co	ompartmentConte	nts1			lind D Rename					
Min/M	lax filling fraction -					-				
Min	9 0%	8				1				
Max	100 %					2				
	filling									
Adjust Type	💡 💿 Adju	st by compartment								
Adjust Type Exhau Time	ustive 🤗 🔍 60	st by compartment st by group								
Adjust Type Exhau Timer Compa	out of 60	st by compartment st by group Eluid deprity	Filling fraction	Damaged	Adjustable					
Adjust Type Exhau Timed Compa	out Name	st by compartment st by group Fluid density 900 kg/m^3	Filling fraction	Damaged	Adjustable					
Adjust Type Exhau Time Compa 1	out Name LC2_TANK	st by compartment st by group Fluid density 900 kg/m^3 900 kg/m^3	Filling fraction 86,393 % 100 %	Damaged	Adjustable					
Adjust Type Exhau Timee Compa 1 2 3	out Name LC2_TANK LC4_TANK	st by compartment st by group Fluid density 900 kg/m^3 900 kg/m^3 900 kg/m^3	Filling fraction 86,393 % 100 % 0 %	Damaged	Adjustable					
Adjust Type Exhau Timee Compa 1 2 3 4		st by compartment st by group Fluid density 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3	Filling fraction 86,393 % 100 % 0 % 100 %	Damaged	Adjustable					
Adjust Type Exhau Timee Compa 2 3 4 5	out Vame C2_TANK LC2_TANK LC4_TANK LC5_TANK LC6_TANK LC6_TANK	st by compartment st by group Fluid density 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3	Filling fraction 86,393 % 100 % 0 % 100 % 100 %	Damaged	Adjustable					
Adjust Type Exhau Time Compa 2 3 4 5 6	Adju Stive O Adju Adju Adju Stive O Adju Stive O Adju Stive O Adju Stive O Adju Stive O Adju Stive O Adju Stive O	st by compartment st by group Fluid density 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3 900 kg/m^3	Filling fraction 86,393 % 100 % 0 % 100 % 100 % 0 %	Damaged	Adjustable					

🔺 📥 LoadingConditions1

Creating a damage case

- One or more damage cases may be defined in the hydro model
- Select one or more compartments as damaged







Creating a loading condition – H4



- The loading condition must have equilibrium between buoyancy and mass
 - Defined from the mass (model)
 - Given explicitly by the user
- A mass model is needed for all floating structures

👪 Define Loading Condition
Loading condition: LoadingCondition1
Compute from mass
● Z-waterline: ♀? 0 m [m]
Heel: 8? 6.2 deg [deg]
C Draft AP: 8? 0 m [m]
Draft FP: 9 ? 0 m [m] 9 ? AP = 0 m FP = 100 m Pareline = 0 m
OK Cancel
å Mass Characteristics
Water density: ? 1025 Kg/m^3 [Kg/m^3] Gravity: 9.80665 m/s^2 [m/s^2]
C Mass from mass model 9 ?
Mass: 9 ? [Kg] x
I. suite use use us

Ungraded

51 DNV GL © 2016 02 May 2016

Internal fluid in tanks – Balancing by properties

- Adjust the tank filling to match the loading condition
- For Auto Balance: select three or more filling fraction properties



Balancing vessel using many tanks

- Will try to have tanks full or empty
- Will try to maximize GM
- Need to tune three tanks at the end
- Required filling fractions are automatically created as properties
- Combinations are tried in "intelligent" order
- "All combinations" may need a very long time to finish

				LoadingCon - H Addition Compart Addition MassMo	dition1 alMatrices mentContents del1	Compartment	contents					
	OffbodyPoints1 Openings LoadingCondition1 1											
Ĵå a	LoadingLondition I_I											
۲	Fluid property	y:	Oil			~ -	- N					
	1		Location1				INOT	in u	se			
	Location:		Location									
	Maximum filli	ng fraction:	1									
	Tank Lc No	Compartment	Name	Intact Fluid	Damage Fluid	Flooded	Filling Fraction	Select	Filling Fraction			
1	2	Cm_LC2	Cm_LC2_C	Oil	SeaWater	J	FillingFraction4	ন	0.5868616384			
2	3	Cm_LC3	Cm_LC3_C	Oil	SeaWater		FillingFraction4	<u>.</u>	0.5868616384			
3	4	Cm_LC4	Cm_LC4_C	Oil	SeaWater		FillingFraction4	V	0.5868616384			
4	5	Cm_LC5	Cm_LC5_C	Oil	SeaWater		FillingFraction2	V	0.7757543291			
5	6	Cm_LC6	Cm_LC6_C	Oil	SeaWater		FillingFraction4	V	0.5868616384			
6	7	Cm_LC7	Cm_LC7_C	Oil	SeaWater		FillingFraction4	N	0.5868616384			
7	8	Cm_LC8	Cm_LC8_C	Oil	SeaWater		FillingFraction3	N	0.4			
8	9	Cm_LC9	Cm_LC9_C	Oil	SeaWater		FillingFraction3	N	0.4			
9	10	Cm_LC10	Cm_LC10_C	Oil	SeaWater		FillingFraction1		0			
10	11	Cm_LC11	Cm_LC11_C	Oil	SeaWater		FillingFraction1		0			
11	12	Cm_LC12	Cm_LC12_C	Oil	SeaWater		FillingFraction1		0			
12	13	Cm_LC13	Cm_LC13_C	Oil	SeaWater		FillingFraction1		0			
13	14	Cm_LC14	Cm_LC14_C	Oil	SeaWater		FillingFraction1		0			
14	15	Cm_LC15	Cm_LC15_C	Oil	SeaWater		FillingFraction1		0			
15	16	Cm_LC16	Cm_LC16_C	Oil	SeaWater		FillingFraction1		0			
16	17	Cm_LC17	Cm_LC17_C	Oil	SeaWater		FillingFraction1		0			
17	18	Cm_LC18	Cm_LC18_C	Oil	SeaWater		FillingFraction3		0.4			
18	19	Cm_LC19	Cm_LC19_C	Oil	SeaWater		FillingFraction2	V	0.7757543291			
19	20	Cm_LC20	Cm_LC20_C	Oil	SeaWater		FillingFraction2		0.7757543291			
20	21	Cm_LC21	Cm_LC21_C	Oil	SeaWater		FillingFraction4	V	0.5868616384			
21	22	Cm_LC22	Cm_LC22_C	Oil	SeaWater		FillingFraction5		0.5844056326			
22	23	Cm_LC23	Cm_LC23_C	Oil	SeaWater		FillingFraction4	V	0.5868616384			
C	Compute filling	fractions	🗆 Analyze	all combinations			ОК	Car	cel Apply			

Ungraded

The world-leading provider of software for a safer, smarter and greener future

DNV GL – Software software.support@dnvgl.com

www.dnvgl.com

SAFER, SMARTER, GREENER