



Tutorial

Plate Buckling DNV

Updated on: February 6th 2024

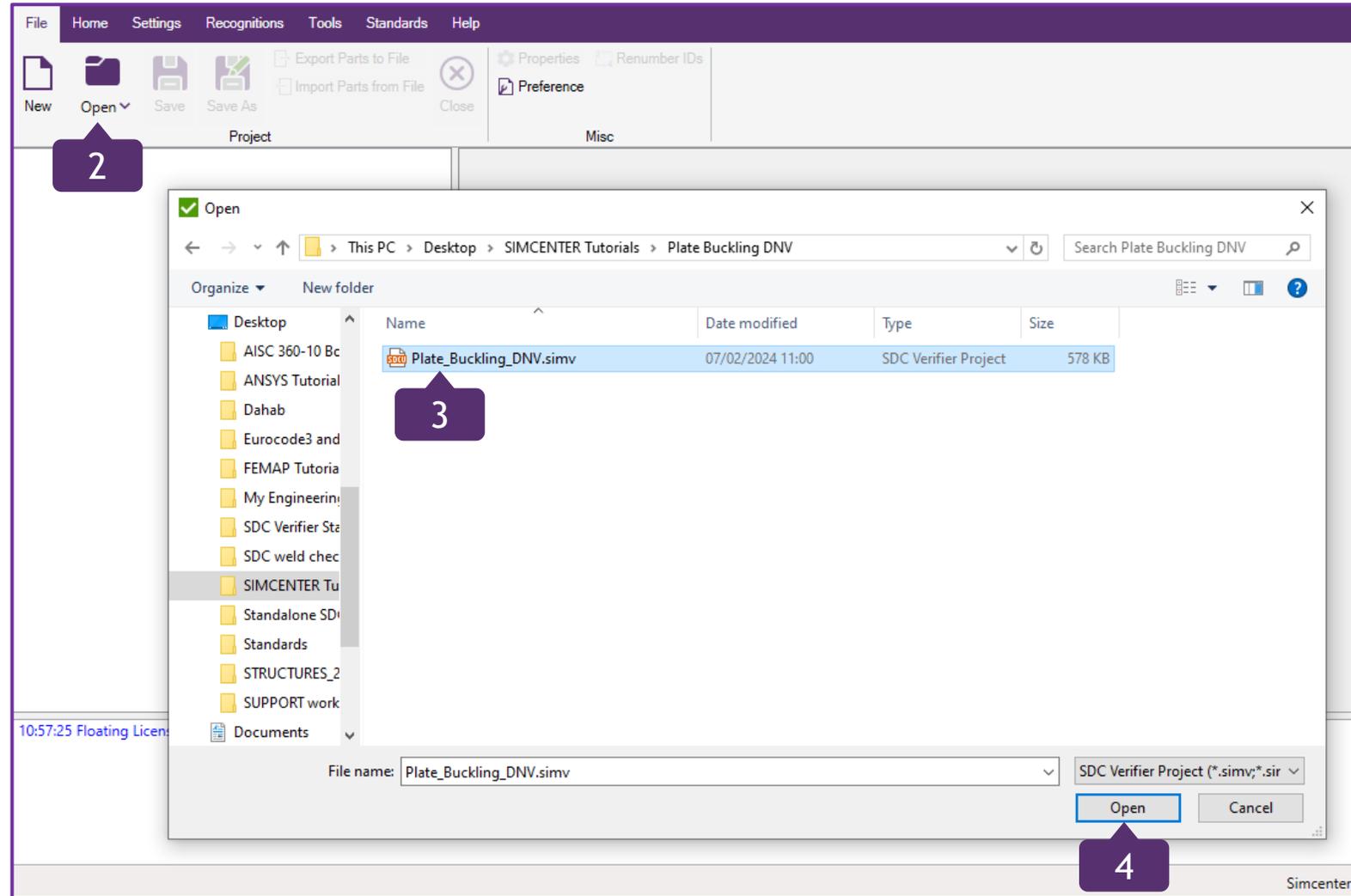
Tested with: SDC Verifier 2023 R2

Simcenter3D 2306

- In this tutorial, DNV Plate Buckling and Stiffener Buckling Checks are reviewed in details;
- A part of plate model of the ship has been used as a start FEM model;
- Individual Loads, Load Sets and Load Group (Envelope) are created;
- Recognition of Plates, using Panel Finder Tool is carried out;
- To elicit failing Panels, Custom Copy of DNV Buckling Strength of Plated Structures (2010) for Panel Check has been created;
- Plate Buckling and Stiffener Buckling Tables and Plots are created;
- The functionality of SDC Verifier Report Designer can be checked via the link to a separate tutorial (Slide 41).

Open the Starter Model

- 1 Launch SDC Verifier for Simcenter 3D
- 2 In *File* section, press *Open*
- 3 Select a project *Plate_Buckling_DNV.simv*
- 4 Press *Open*



1

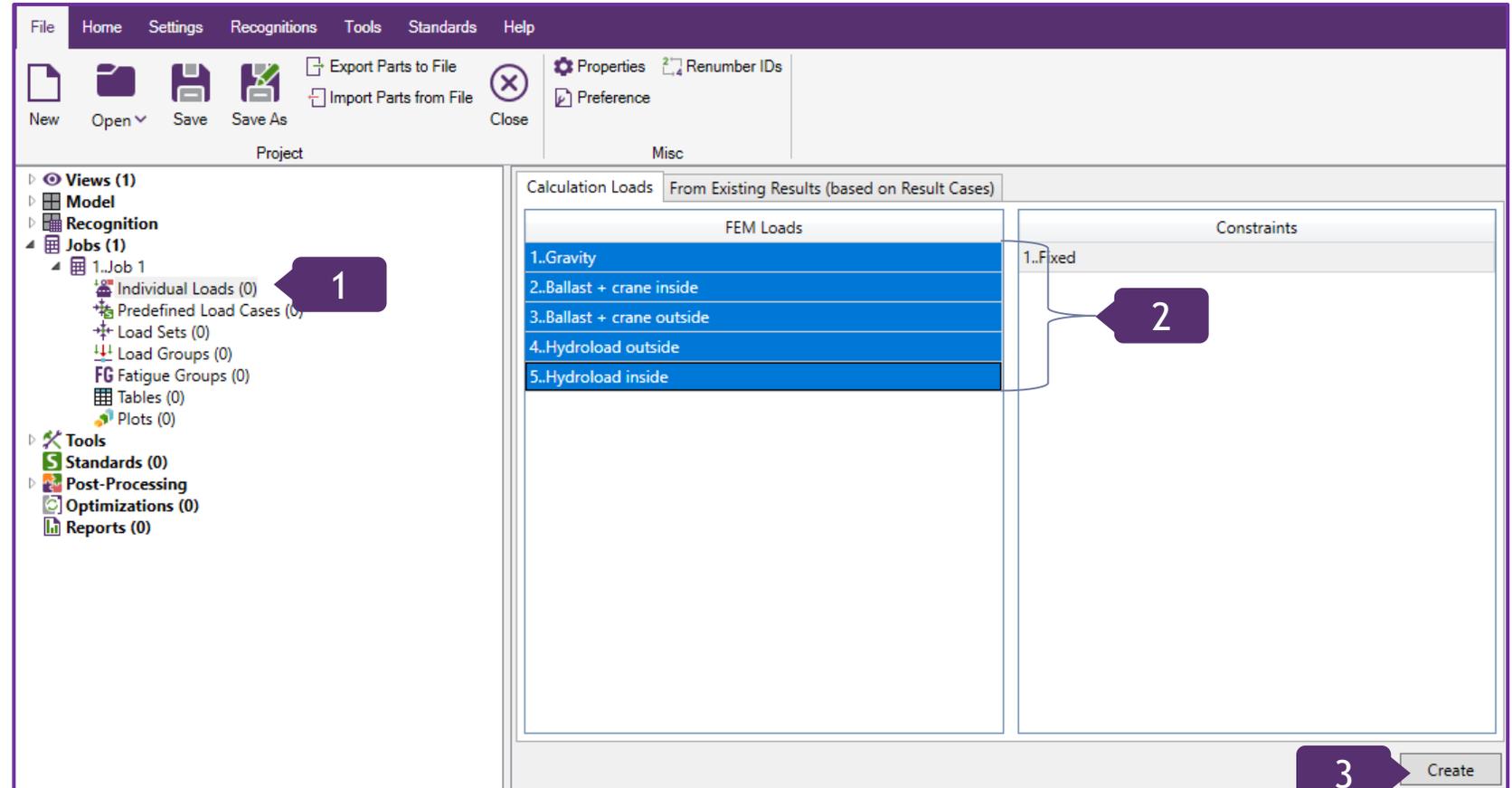
Select *Individual Loads* in Jobs (1) =>
1..Job 1 in the *Model Tree*

2

Select 5 *FEM Loads*

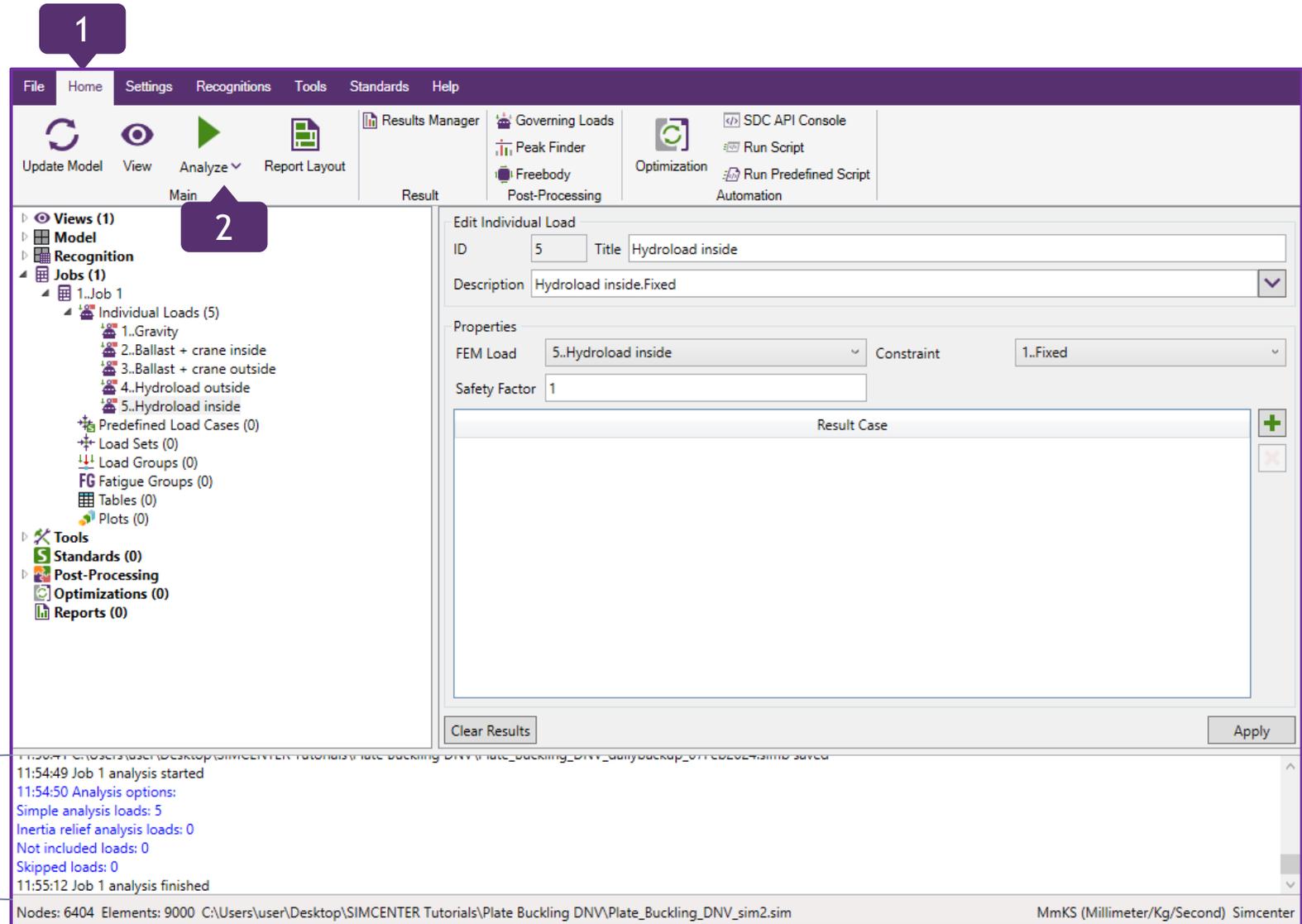
3

Press *Create*



1 Go to *Home* section on the Ribbon

2 Press  on the toolbar to analyze Job



The screenshot shows the SDC Verifier software interface. The ribbon is set to the 'Home' section, and the 'Analyze' button is highlighted with a callout '2'. The 'Edit Individual Load' dialog box is open, showing details for 'Hydroload inside'. The status bar at the bottom displays the following information:

```
11:54:49 Job 1 analysis started
11:54:50 Analysis options:
Simple analysis loads: 5
Inertia relief analysis loads: 0
Not included loads: 0
Skipped loads: 0
11:55:12 Job 1 analysis finished

Nodes: 6404 Elements: 9000 C:\Users\user\Desktop\SIMCENTER Tutorials\Plate Buckling DNV\Plate_Buckling_DNV_sim2.sim MmKS (Millimeter/Kg/Second) Simcenter
```

Job 1 analysis started and finished.

1

Right click on *Load Sets* => *Create/Edit multiple*

2

Fill in “4” into *Count* and press  to add four Load Sets

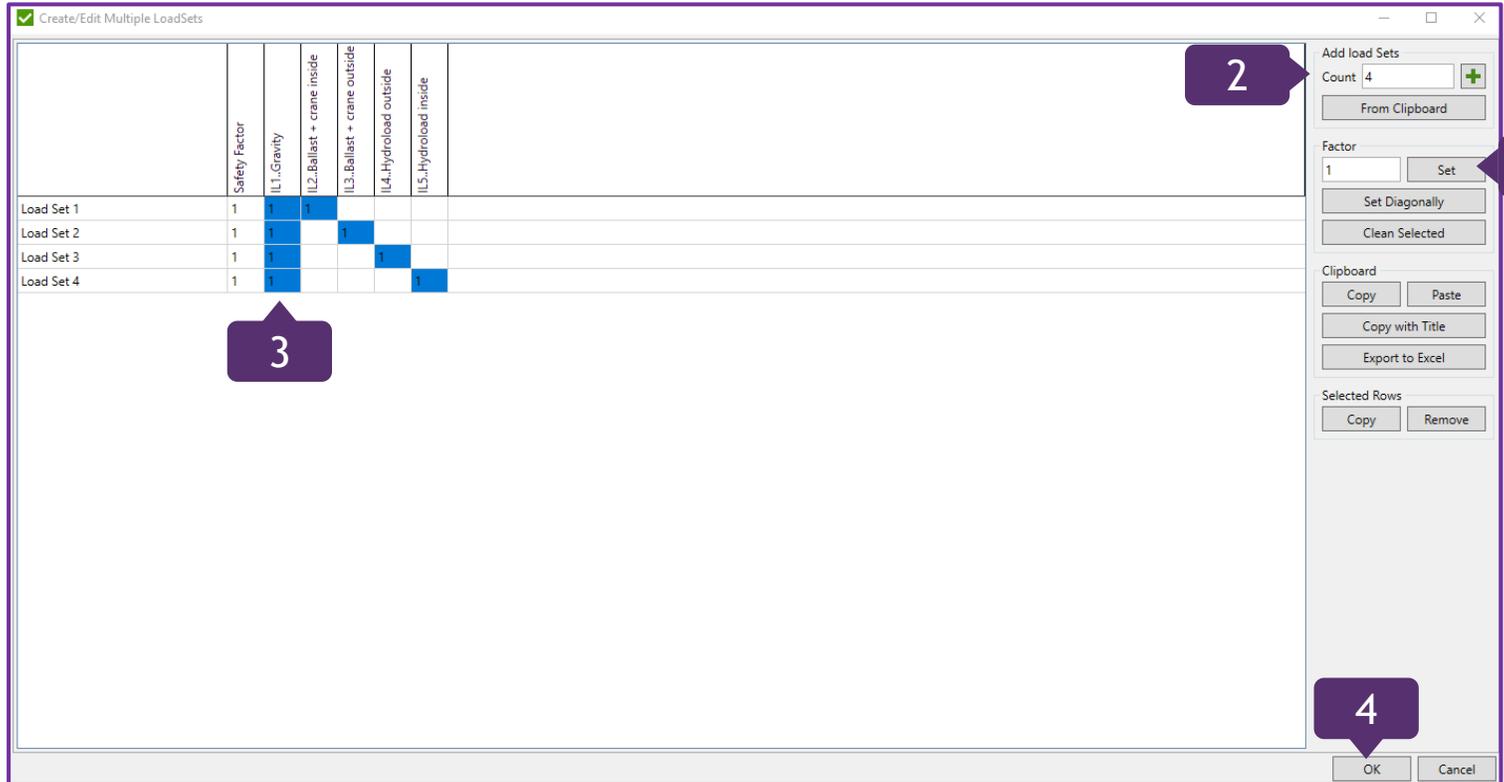
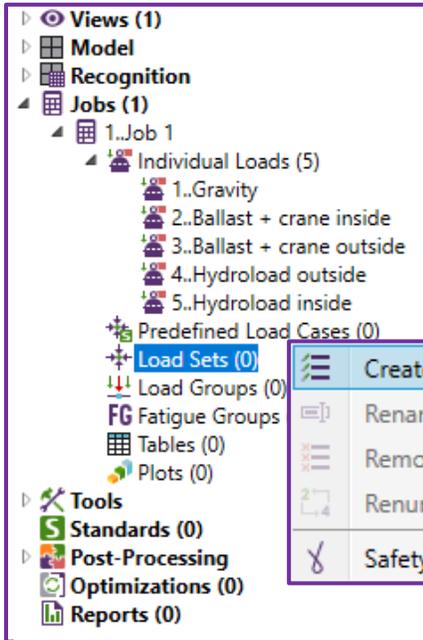
3

Select highlighted cells in table like shown on the picture and press *Set* to define Factors of Load Sets

4

Press *OK*

Note: Load Sets are created with default titles “Load Set #”. It is possible to rename them.
Alternatively, titles and factors can be pasted from Clipboard using *Paste* button.



1 Click on *Load Groups (0)*

2 Press  to select *All Load Sets*

3 Title: *Envelope*

4 Press *Create*

Count : 5

Title (4)	Sf
1..Load Set 1	1
2..Load Set 2	1
3..Load Set 3	1
4..Load Set 4	1

Note: Load Sets and Load Groups are analyzed by SDC Verifier.

1

In the Model Tree, expand *Recognition* and select *Panel Finder*

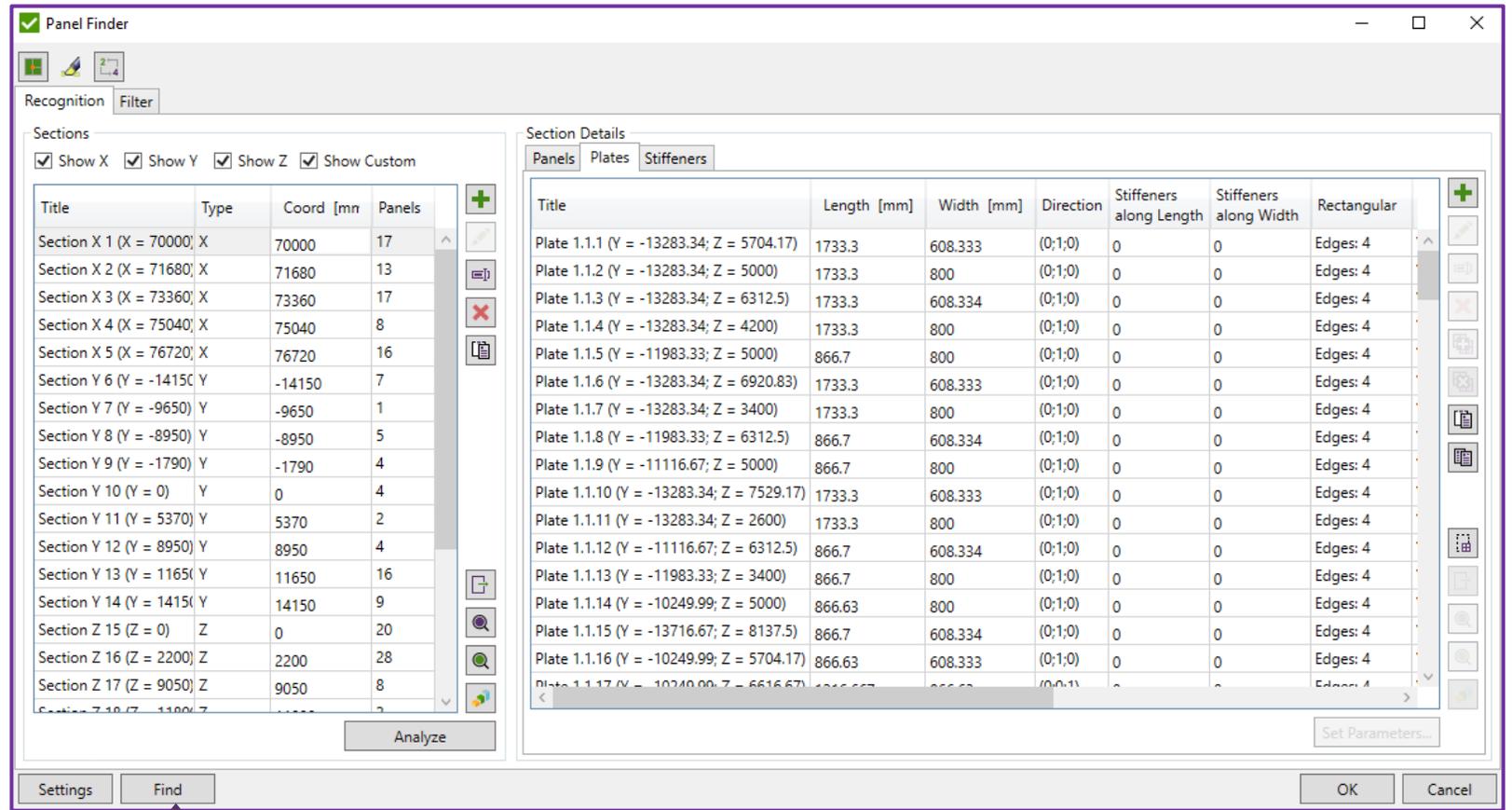
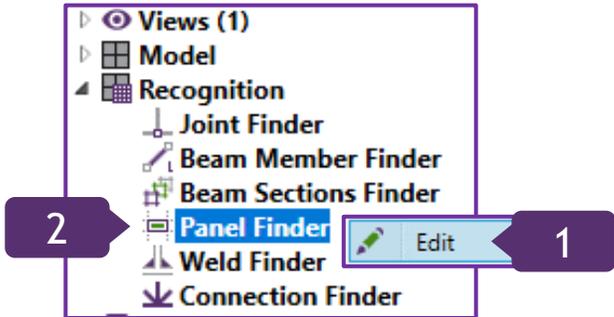
2

Execute right click on *Panel Finder* and press *Edit*

3

Click on *Find*

All Frames, Longitudinals and Decks are recognized automatically.



3

Custom Section should be used for inclined/curved sections and selections like hull.

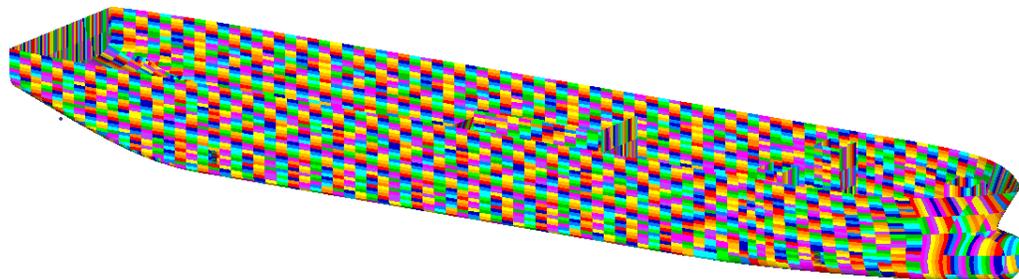
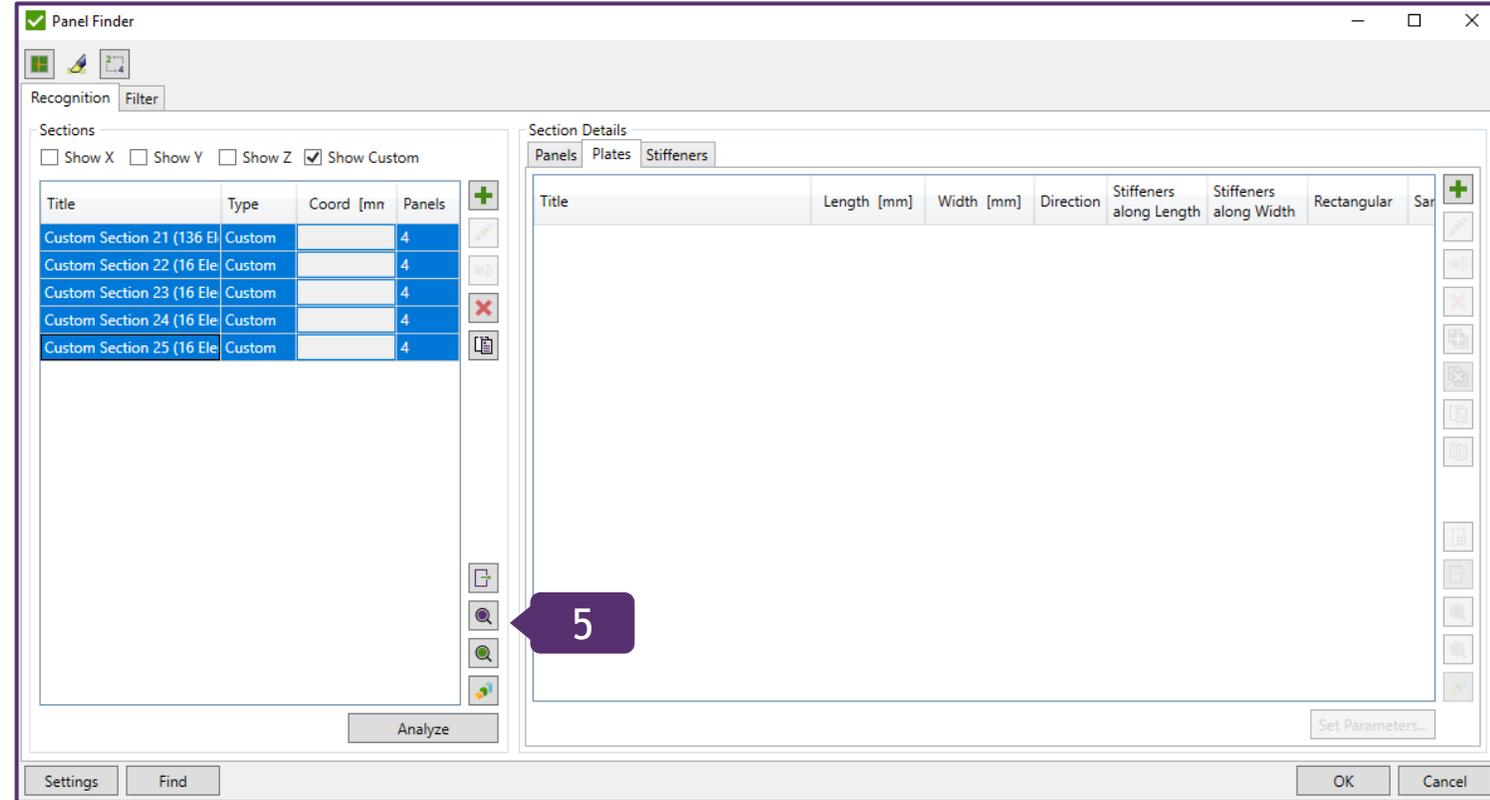
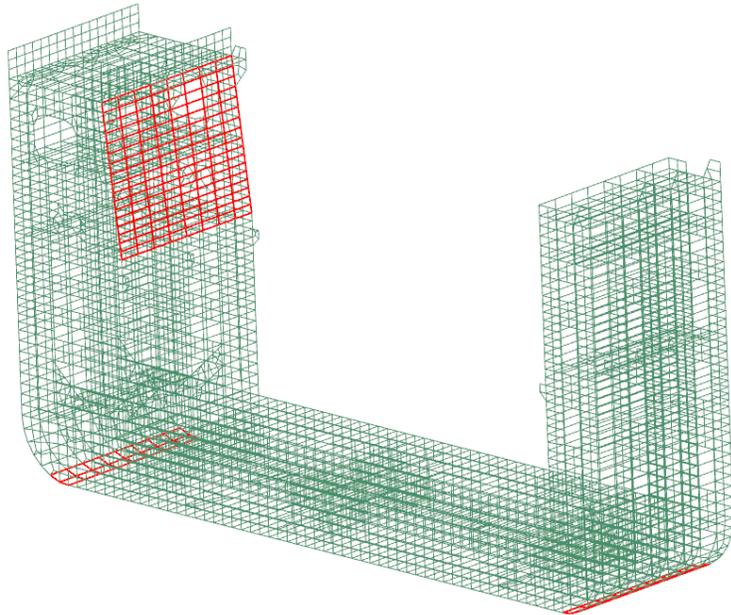
- 1 Show Custom: *ON* (the rest is *OFF*)
- 2 Select all Sections in the list
- 3 Press and select *Each Section as Group* to export sections to Groups
- 4 Press *OK*

The screenshot shows the 'Panel Finder' application window. The 'Recognition' tab is active, and the 'Filter' section has 'Show Custom' checked. The 'Sections' table lists five custom sections, each with 4 panels. The 'Section Details' panel is open, showing the 'Panels' tab. A context menu is open over the table, with 'Each Section as Group' selected. A dialog box titled 'SDC Verifier' displays the message '5 sections were exported to groups' and has an 'OK' button.

Title	Type	Coord [mn]	Panels
Custom Section 21 (136 Ele)	Custom		4
Custom Section 22 (16 Ele)	Custom		4
Custom Section 23 (16 Ele)	Custom		4
Custom Section 24 (16 Ele)	Custom		4
Custom Section 25 (16 Ele)	Custom		4

5

Press



Example: It is possible to create custom section, based on hull selection.

Note: Before Plates Recognition, the model should be checked on free edges. Incorrect plate dimensions/direction, plates with undefined dimensions and, as result, wrong buckling factor may result in possible consequences of free edges.

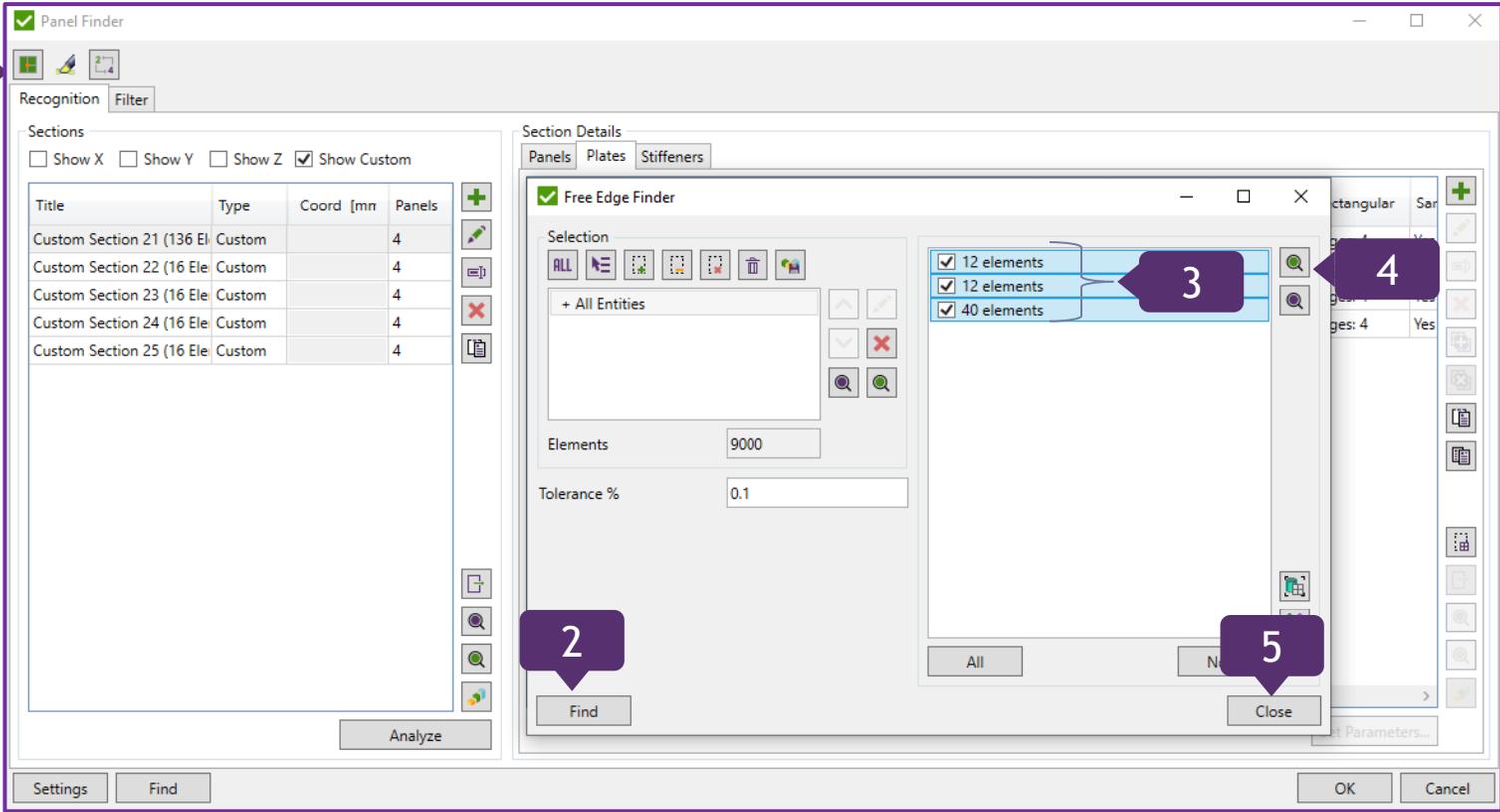
1 Click to detect Free edges

2 Press *Find*

3 Select the elements from the list

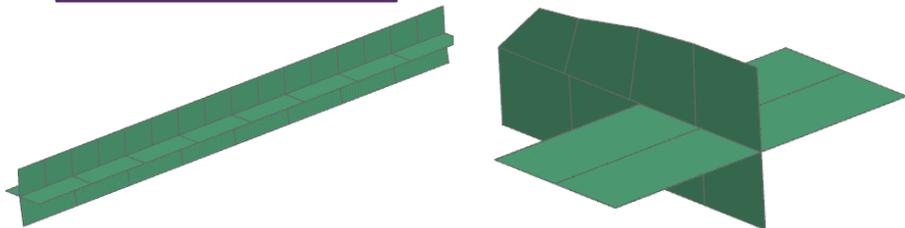
4 Press to preview elements with Free edges

5 Press *Close*



Two elements, connected to one

Mesh does not coincide



Note: Free edges should be fixed by remeshing the model and run recognition of plates. (In tutorial we skipped the step with remeshing, but for commercial project, it is a crucial step to do).

Panel Finder. Recognize plates

1 In Selection Details press *Plates*

2 Show X: *ON* (the rest is *OFF*)

3 Select *Section X3*

Tip: If it is necessary to recognize plates only for one section, press *Analyze*

Title	Length [mm]	Width [mm]	Direction	Stiffeners along Length	Stiffeners along Width	Rectangular	Same Material	Thickness [mm]	Related Panel	C1	C2	Psi X	P:
Plate 3.1.2 (Y = -9816.66; Z = 8441.67)	1733.3	1216.667	(0;1;0)	0	0	Edges: 4	Yes	16	Panel 3.1	1	1.1	1	1
Plate 3.1.3 (Y = -11988.81; Z = 9559.48)	2136.113	866.7	(0;0;1)	0	0	Edges: 4	Yes	Min = 16	Panel 3.1	1	1.1	1	1

Section ID. Panel ID. Plate ID

Plate is rectangle with all corners = 90°

Plate has elements more than from one property

Dimensions: Results depend on plate dimensions and direction. Therefore, it is important to understand how Panel Finder performs recognition. Length is considered the longest edge of plate, and width is the longest perpendicular to the longest edge:

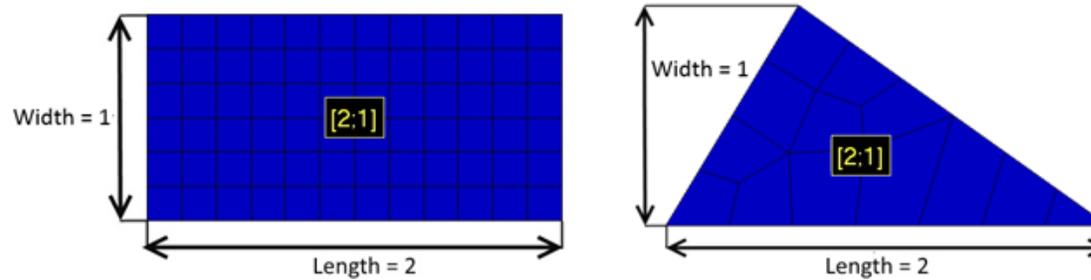
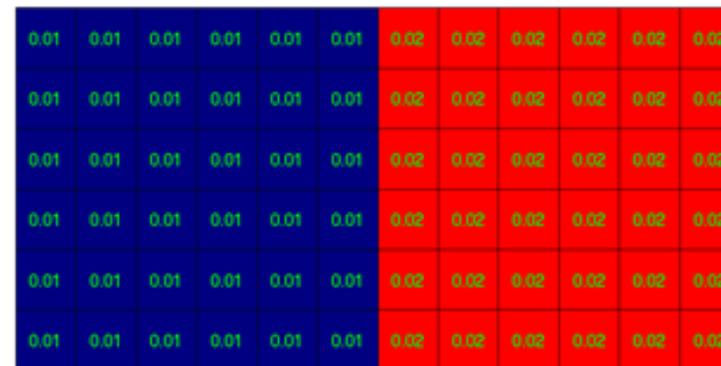
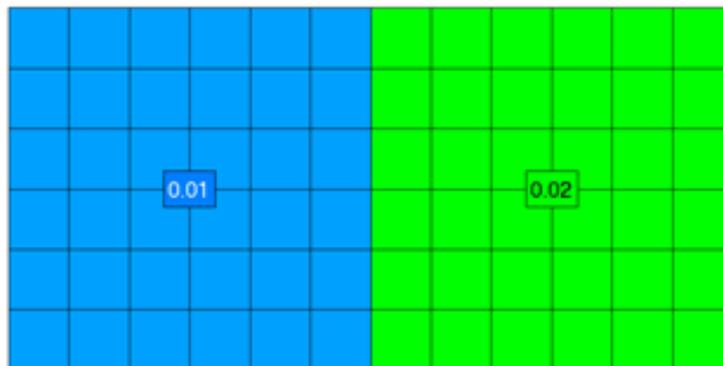


Plate Thickness: Calculations are performed on every element, and thickness is taken directly from each element. It is possible to set thickness manually for plate. In this case, element thickness will be ignored and a user defined thickness will be used.

Example: a plate with 2 properties 0.01 and 0.02 thicknesses. Left picture displays property labels with property thicknesses and the right one presents plate buckling plot of thickness parameter:



Editing plates manually

1

In Section X 1 (X = 70000), select Plates and press *Set Parameters*

2

Make the required modifications and press *OK*

When modifying Plates, it is possible to edit Length / Width / Thickness / Coefficients / Direction.

Also, there is possibility to define parametric Stiffeners along the Length and Width.

If thickness is changed, in the table below you can see the original thickness that was recognized from model:

Thickness [mm]
12
12
12
17 (Original: 16)
17 (Original: 12)
17 (Original: 12)

Title	Length [mm]	Width [mm]	Direction	Stiffeners along Length	Stiffeners along Width	Rectangular	Same Material
Plate 1.1.1 (Y = -13283.34; Z = 5704.17)	1733.3	608.333	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.2 (Y = -13283.34; Z = 5000)	1733.3	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.3 (Y = -13283.34; Z = 6312.5)	1733.3	608.334	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.4 (Y = -13283.34; Z = 4200)	1733.3	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.5 (Y = -11983.33; Z = 5000)	866.7	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.6 (Y = -13283.34; Z = 6920.83)	1733.3	608.333	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.7 (Y = -13283.34; Z = 3400)	1733.3	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.8 (Y = -11983.33; Z = 6312.5)	866.7	608.334	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.9 (Y = -11116.67; Z = 5000)	866.7	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.10 (Y = -13283.34; Z = 7529.17)	1733.3	608.333	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.11 (Y = -13283.34; Z = 2600)	1733.3	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.12 (Y = -11116.67; Z = 6312.5)	866.7	608.334	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.13 (Y = -11983.33; Z = 3400)	866.7	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.14 (Y = -10249.99; Z = 5000)	866.63	800	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.15 (Y = -13716.67; Z = 8137.5)	866.7	608.334	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.16 (Y = -10249.99; Z = 5704.17)	866.63	608.333	(0;1;0)	0	0	Edges: 4	Yes
Plate 1.1.17 (Y = -10249.99; Z = 6616.67)	1216.667	866.63	(0;0;1)	0	0	Edges: 4	Yes
Plate 1.1.18 (Y = -11983.33; Z = 7529.17)	866.7	608.333	(0;1;0)	0	0	Edges: 4	Yes

2

Dimensions

Set Length/Width Value

Length [mm]

Width [mm]

Set Stiffeners Amount along Plate's:

Length

Width

Thickness [mm]

Coefficients

C1

C2

Psi X

Psi Y

Direction

Swap Direction for

Plates where Width > Length

All Plates

Set Direction

Direction

X

Y

Z

2

If the direction of plate should be modified, define global axis or custom vector and press *Set Direction*.

1 Select Section X3

2 Select All Plates

3 Press

4 Click on *Colors + Labels of Ids*

Title	Type	Coord [mm]	Panels
Section X 1 (X = 70000)	X	70000	17
Section X 2 (X = 71680)	X	71680	13
Section X 3 (X = 73360)	X	73360	17
Section X 4 (X = 75040)	X	75040	8
Section X 5 (X = 76720)	X	76720	16

Title	Length [mm]	Width [mm]	Direction	Stiffeners along Length	Stiffeners along Width	Rectangular	Se
Plate 3.1.1 (Y = -8502.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.1.2 (Y = -7607.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.1.3 (Y = -6712.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.1.4 (Y = -5817.5; Z = 1833.33)	895	733.333	(0;-1;0)	0	0	Edges: 4	Ye
Plate 3.1.5 (Y = -4922.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.1.6 (Y = -5817.5; Z = 366.67)	895	733.3333	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.1.7 (Y = -4027.5; Z = 1833.33)	895	733.333	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.1.8 (Y = -3132.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.1.9 (Y = -4027.5; Z = 366.67)	895	733.3333	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.1.10 (Y = -2237.5; Z = 1100)	2200	895	(0;0;-1)	0	0	Edges: 4	Ye
Plate 3.2.1 (Y = 12752.94; Z = 6259.72)	2500	608.334	(0;1;0)	0	0	Edges: 6	Ye
Plate 3.2.2 (Y = 12900; Z = 5704.17)	2500	608.333	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.2.3 (Y = 12066.67; Z = 6920.83)	833.33	608.333	(0;-1;0)	0	0	Edges: 4	Ye
Plate 3.2.4 (Y = 12900; Z = 5000)	2500	800	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.2.5 (Y = 13733.33; Z = 6616.67)	833.33	486.667	(0;1;0)	0	0	Edges: 4	Ye
Plate 3.2.6 (Y = 12066.67; Z = 7529.17)	833.33	608.333	(0;-1;0)	0	0	Edges: 4	Ye
Plate 3.2.7 (Y = 12066.67; Z = 4200)	833.33	608.333	(0;-1;0)	0	0	Edges: 4	Ye



- Colors Only
- Colors + Labels of Ids
- Colors + Labels of Corners Count
- Colors + Labels of Dimensions
- Length Values (no labels)
- Width Values (no labels)
- Coordinate Systems
- Draw Stiffeners along Length/Width

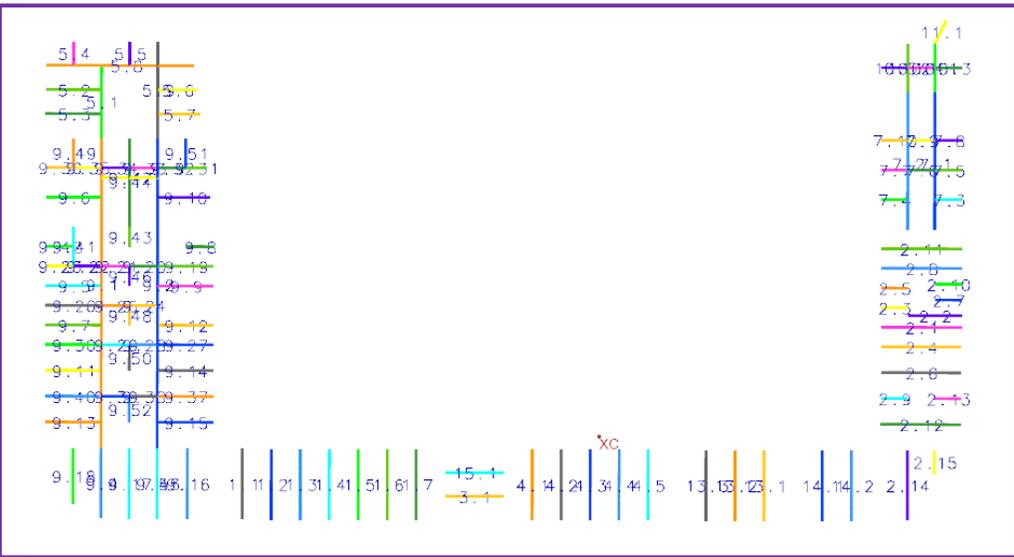
1 Select *Stiffeners* section

2 Select All *Stiffeners*

3 Press

4 Click on *Colors + Labels of Ids*

Title	Type	Coord [mm]	Panels	Length [mm]	Width [mm]	Lg [mm]	Lt [mm]	Is Same Y Axis	Is Curved	F
Section X 1 (X = 70000)	X	70000	17							
Section X 2 (X = 71680)	X	71680	13							
Section X 3 (X = 73360)	X	73360	17							
Section X 4 (X = 75040)	X	75040	8							
Section X 5 (X = 76720)	X	76720	16							
Stiffener 3.1.1 [73360; -10683.3; 1100]				2200	888.9	0	2200	Yes	No	
Stiffener 3.1.2 [73360; -11550; 8745.83]				608.333	866.7	0	608.333	Yes	No	
Stiffener 3.1.3 [73360; -9383.33; 8441.67]				866.67	12345678	0	866.67	Yes	No	
Stiffener 3.1.4 [73360; -12416.7; 1107.6]				2164.543	829.3763	0	2164.543	Yes	No	
Stiffener 3.1.5 [73360; -10683.3; 1100]				2200	888.9	0	2200	Yes	No	
Stiffener 3.1.6 [73360; -9750; 1100]				2200	866.65	0	2200	Yes	No	
Stiffener 3.1.7 [73360; -11550; 1100]				2200	865.541	0	2200	Yes	No	
Stiffener 3.1.8 [73360; -13283.3; 1332.65]				1734.703	725.4012	0	1734.703	Yes	No	
Stiffener 3.1.9 [73360; -10683.3; 7264.17]				9600	1287.5969	0	9600	Yes	No	
Stiffener 3.1.10 [73360; -11550; 10450.62]				2750	866.7	0	2750	Yes	No	
Stiffener 3.1.11 [73360; -11550; 7833.33]				5200	782.1429	0	5200	Yes	No	
Stiffener 3.1.12 [73360; -12416.7; 7264.17]				9600	1348.1333	0	9600	Yes	No	
Stiffener 3.1.13 [73360; -9816.66; 7225]				1733.3	912.5	0	1733.3	Yes	No	
Stiffener 3.1.14 [73360; -11550; 7529.17]				608.333	866.7	0	608.333	Yes	No	
Stiffener 3.1.15 [73360; -13283.3; 8441.67]				1216.667	866.6667	0	1216.667	Yes	No	
Stiffener 3.1.16 [73360; -13716.67; 8441.67]				866.7	608.3335	0	866.7	Yes	No	
Stiffener 3.1.17 [73360; -12416.67; 6616.67]				2167	608.3333	0	2167	Yes	No	



4

- Colors Only
- Colors + Labels of Ids
- Colors + Labels of Lengths
- Colors + Labels of Widths
- Length Values (no labels)
- Width Values (no labels)
- Max Girder Length, Lg (no labels)
- Torsional Length, Lt (no labels)
- Sniped or Continuous

Note: It is very important to check if all plates dimensions were recognized. If in the model there are coincidental nodes, elements or free edges, Panel Finder will not be able to recognize plate dimensions.

1 Click on *Filter* tab

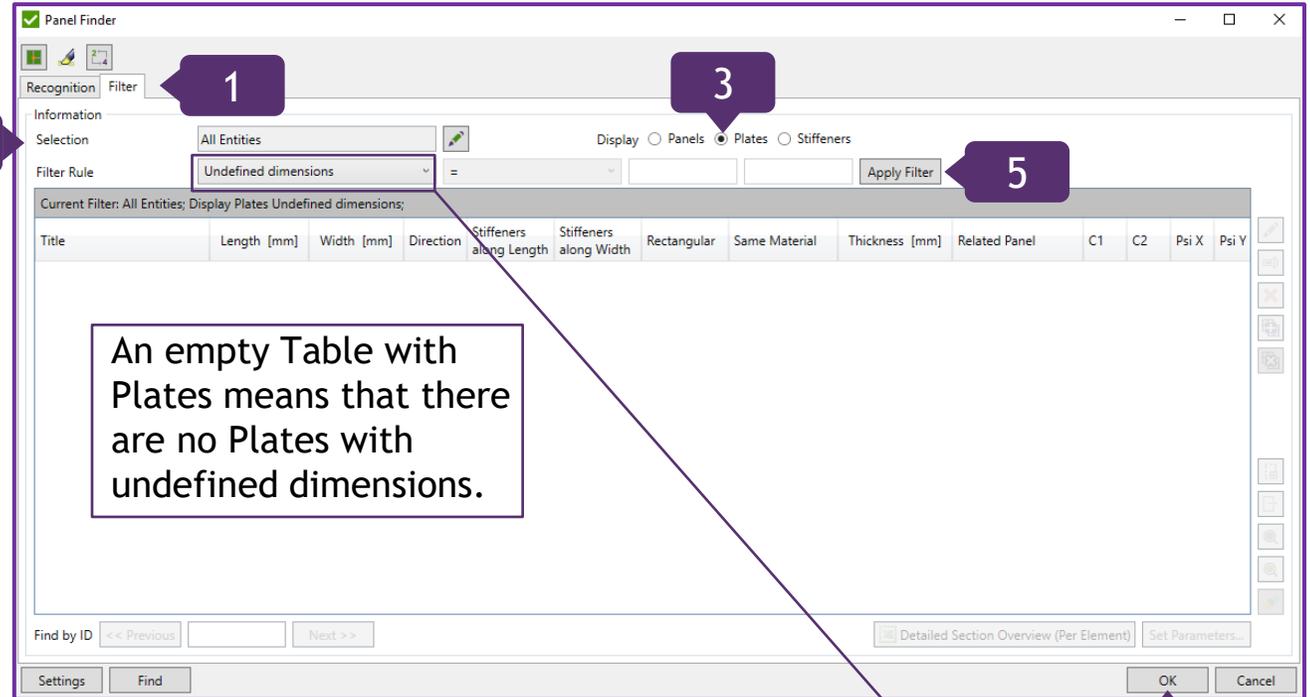
2 Selection: *All Entities*

3 Display: *Plates*

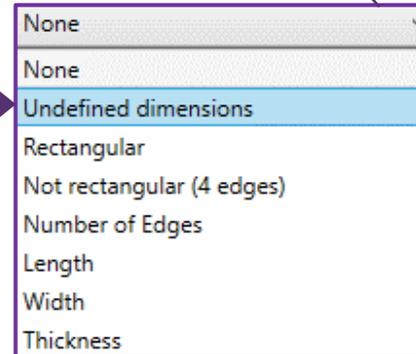
4 Filter Rule: *Undefined dimensions*

5 Press *Apply Filter*

6 Press *OK*



An empty Table with Plates means that there are no Plates with undefined dimensions.



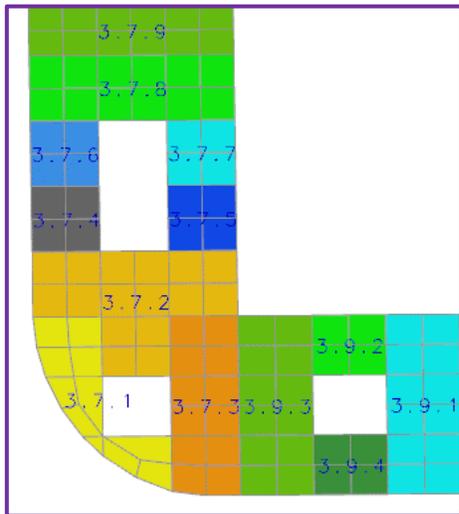
Tip: It is also possible to filter Plates by shape (triangle, rectangular) or number of edges parameters.

E.g. Plates with numbers of edges > 4 can be displayed. Control, using Selection plates from which Sections should be filtered.

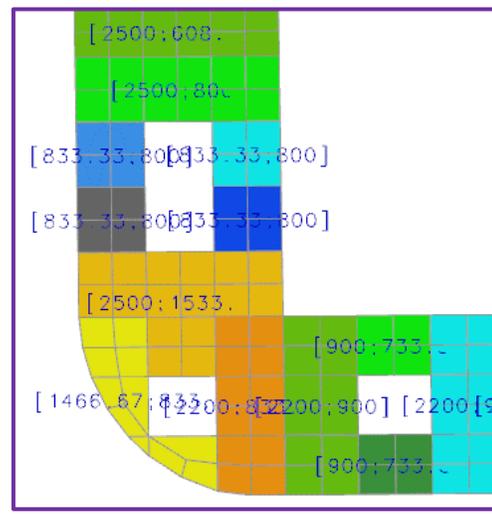
Note: Plate Plot can be displayed with different Colors Labels (Labels of Ids, Labels of Corners Count or Labels of Dimensions). Also, it is possible to show Plates in length and width, coordinate systems etc.

- Colors Only
- Colors + Labels of Ids
- Colors + Labels of Corners Count
- Colors + Labels of Dimensions
- Length Values (no labels)
- Width Values (no labels)
- Coordinate Systems
- Draw Stiffeners along Length/Width

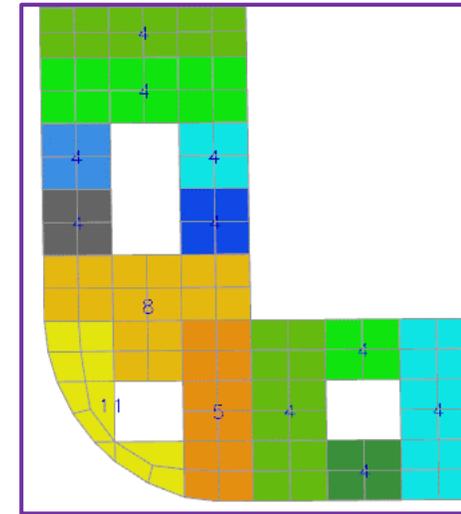
Labels of Ids



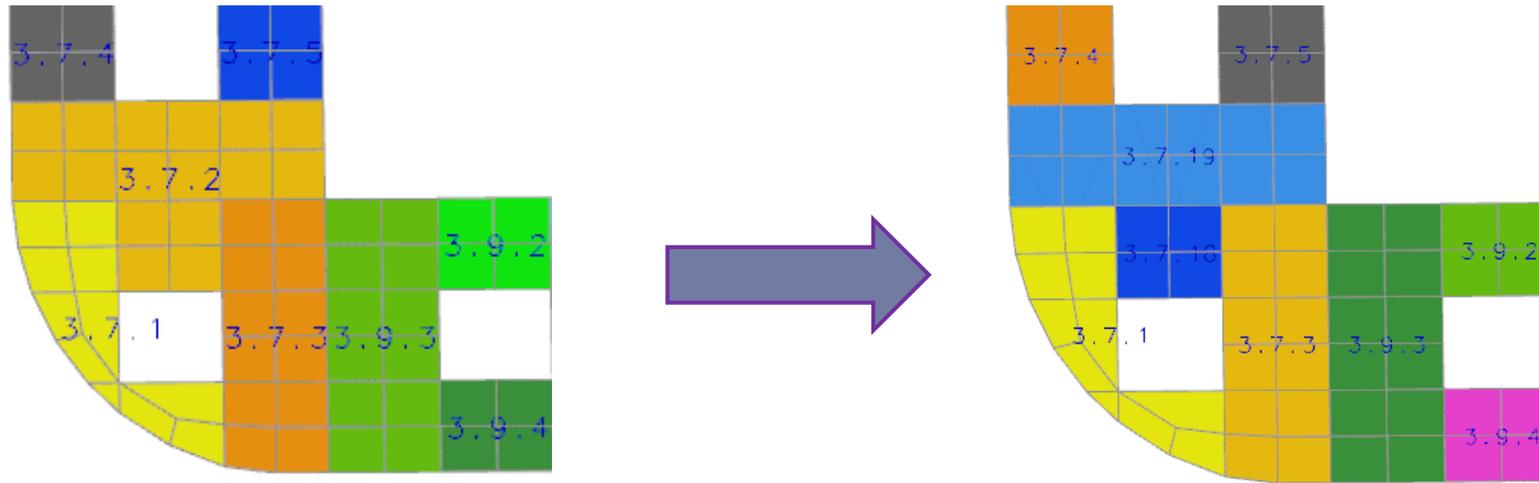
Labels of Dimensions



Labels of Corners Count

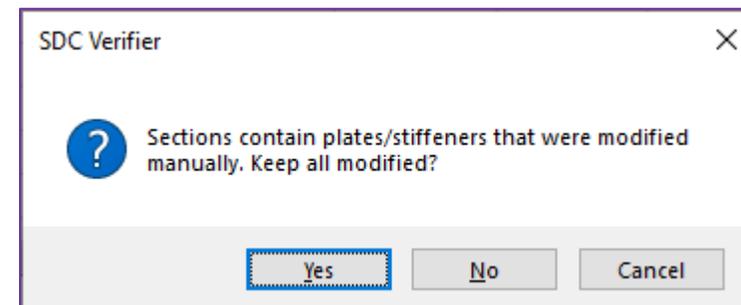


In some cases (e.g. Stiffener is not modeled), when a Plate is recognized incorrectly, dimensions are bigger than in reality. Consequently, it leads to wrong results. A Plate has to be updated manually. In Section X3 plate with Id = 3.7.2 should be split in two Plates.



Note: if Plates were modified manually, but then a user decides to run recognition of Plates - Panel Finder will ask what to do with modified Plates:

- Keep Plates that were modified;
- Clear everything and start recognition from scratch;



Panel Finder. To Split a Plate

1

In Recognition page, select *Section X1 (X = 70000)*

2

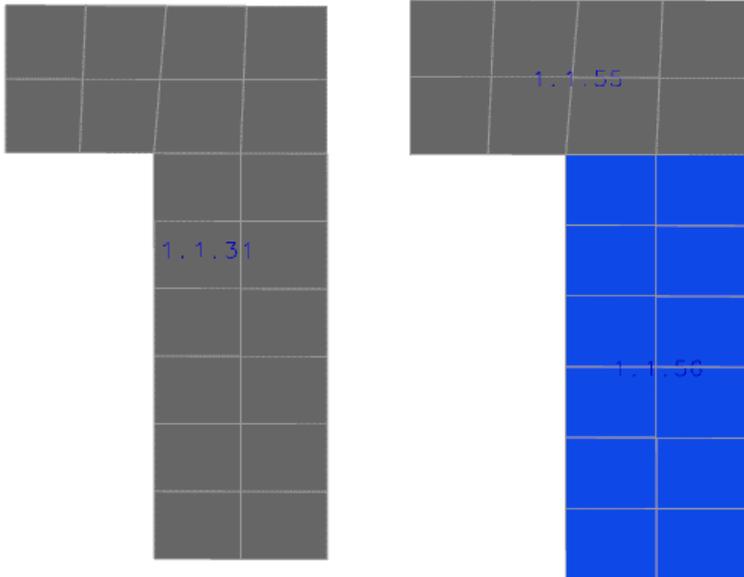
Select *Plate 1.1.31*

3

Press  select *Split by Elements*

4

Selected plate is displayed in Simcenter. Select elements for one plate; Press *OK*



Title	Type	Coord [mm]	Panels
Section X 1 (X = 70000)	X	70000	17
Section X 2 (X = 71680)	X	71680	13
Section X 3 (X = 73360)	X	73360	17
Section X 4 (X = 75040)	X	75040	8
Section X 5 (X = 76720)	X	76720	16

Title	Length [mm]	Width [mm]	Direction	Stiffeners along Length	Stiffeners along Width	Rectangular
Plate 1.1.28 (Y = -9383.33; Z = 4200)	866.67	800	(0;1;0)	0	0	Edges: 4
Plate 1.1.29 (Y = -10249.99; Z = 7529.17)	866.63	608.333	(0;-1;0)	0	0	Edges: 4
Plate 1.1.30 (Y = -11988.81; Z = 9559.48)	2136.113	866.7	(0;0;1)	0	0	Edges: 4
Plate 1.1.31 (Y = -10028.78; Z = 1681.82)	3000	1733.3	(0;0;1)	0	0	Edges: 6
Plate 1.1.32 (Y = -9383.33; Z = 7529.17)	866.67	608.333	(0;1;0)	0	0	Edges: 4
Plate 1.1.33 (Y = -10249.99; Z = 8441.67)	1216.667	866.63	(0;0;1)	0	0	Edges: 4
Plate 1.1.34 (Y = -11116.67; Z = 8745.83)	866.7	866.7	(0;0;1)	0	0	Edges: 4
Plate 1.1.35 (Y = -13283.34; Z = 9508.33)	1733.3	1733.3	(0;0;1)	0	0	Edges: 4
Plate 1.1.36 (Y = -11116.67; Z = 1833.33)	866.7	866.7	(0;0;1)	0	0	Edges: 4
Plate 1.1.37 (Y = -9383.33; Z = 8137.5)	866.67	866.67	(0;0;1)	0	0	Edges: 4
Plate 1.1.38 (Y = -11116.67; Z = 9872.54)	1527.78	866.7	(0;0;1)	0	0	Edges: 4
Plate 1.1.39 (Y = -9350; Z = 1100)	2200	800	(0;-1;0)	0	0	Edges: 4
Plate 1.1.40 (Y = -11983.47; Z = 1102.53)	2200	866.7	(0;-1;0)	0	0	Edges: 5
Plate 1.1.41 (Y = -9383.33; Z = 8745.83)	866.67	608.333	(0;1;0)	0	0	Edges: 4
Plate 1.1.42 (Y = -9833.4; Z = 9508.33)	1733.3	916.667	(0;-1;0)	0	0	Edges: 4
Plate 1.1.43 (Y = -13283.39; Z = 10425.03)	1733.3	916.663	(0;-1;0)	0	0	Edges: 4
Plate 1.1.44 (Y = -11116.67; Z = 266.67)	866.7	733.333	(0;-1;0)	0	0	Edges: 4

Plate 1.1.31 is replaced with Plates 1.1.55 and 1.1.56. Dimensions and directions are updated automatically.



Title
Plate 1.1.55 (Y = -9803.33; Z = 2600)
Plate 1.1.56 (Y = -10216.67; Z = 1100)

Add DNV RP-C201 Plate/Stiffener Buckling 2010 Standard

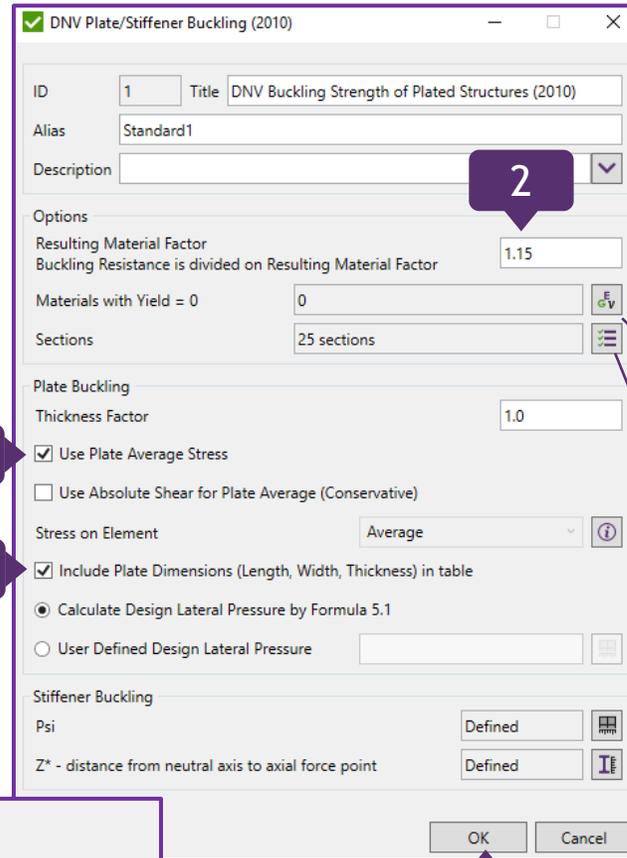
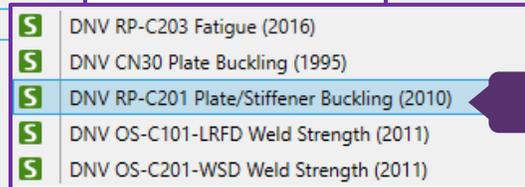
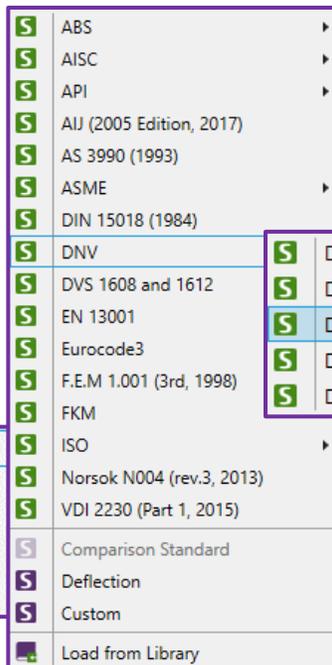
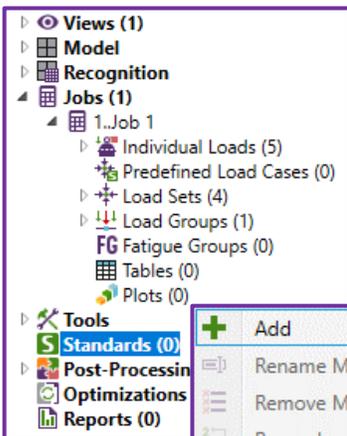
1 In the *Model tree*, in Standards execute *Add => DNV => DNV RP Plate/Stiffener Buckling (2010)*

2 Utilization Factor (Eta) = 1.15

3 Use Plate Average Stress: *On*

4 Include Plate Dimensions (Length, Width, Thickness) in the table: *On*

5 Press *OK*



Thickness factor gives a possibility to increase / decrease all plates thicknesses without reanalyzing the model. E.g. 1.2 means to increase thickness on 20% and decrease stresses.

Materials with Yield Stress = 0 shows how many materials have yield equal to 0. If value is > 0 press to define yield.

By default, all sections will be checked. Click to modify them.

Plate Buckling transforms stresses automatically into Plate direction.
Options about element stresses and Plate stresses are described in the next slide.

✓ Plate Buckling Stresses

Average Element Stress:
 $Sel = (S1+S2+S3+S4+S5+S6+S7+S8) / 8$

Minimum Element MidPlane:
 $Sel = \text{Min}((S1+S5) / 2, (S2+S6) / 2, (S3+S7) / 2, (S4+S8) / 2)$

S1 - S8 - translated element stresses into Plate Direction

Use Plate Average Stress

On

Sel1 (avg)	Sel2 (avg)	Sel3 (avg)
------------	------------	------------

$Spl = (Sel1 \cdot A1 + Sel2 \cdot A2 + Sel3 \cdot A3) / (A1 + A2 + A3)$

One Buckling Factor for plate

Off

Sel1	Sel2	Sel3
------	------	------

Sel1, Sel2, Sel3 - Average or min MidPlane

Plate Buckling Factor = $\text{Max}(BF1, BF2, BF3)$

Close

Convert to Custom Standard

Note: There are three separate checks for Plate Buckling, Dimensions and Limits and Stiffener Buckling. In order to add an additional Check, which will combine Stiffener and Plate Buckling (for demonstrative purposes in Plots and Tables), DNV Buckling Strength of Plated Structures (2010) Standard is supposed to be converted to Custom.

1

Execute right click on *1..DNV Buckling Strength of Plated Structures (2010)* and select *Convert to Custom*

2

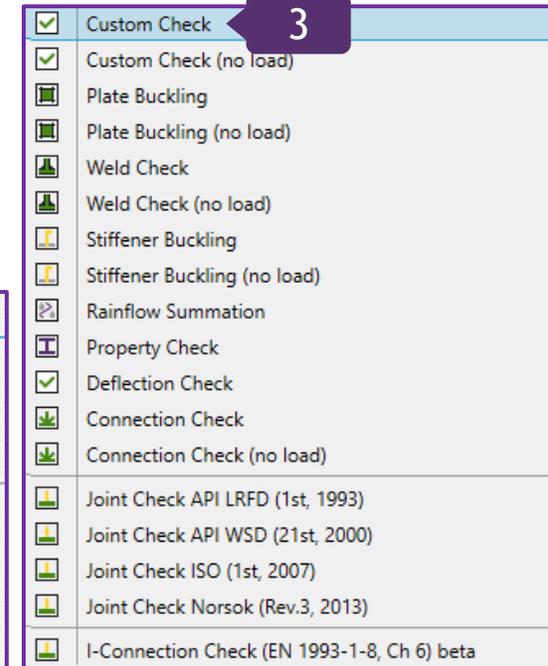
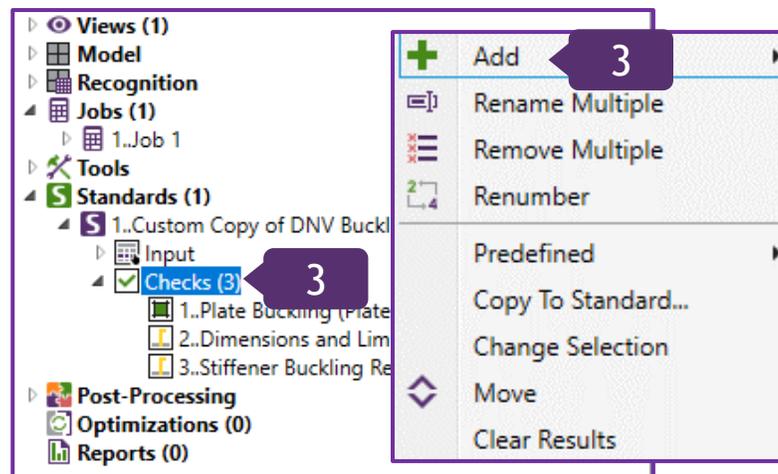
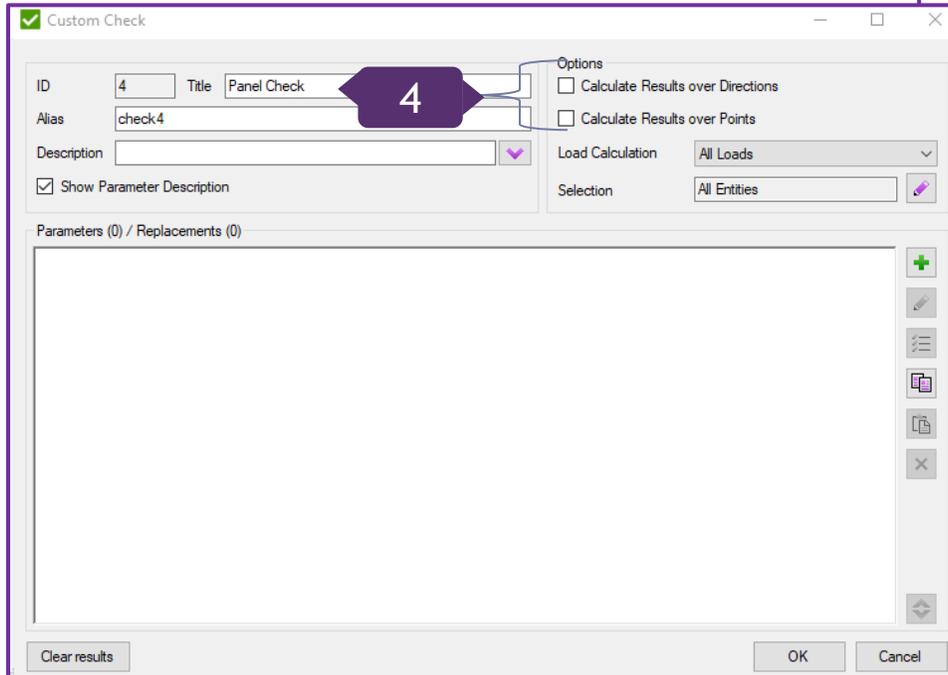
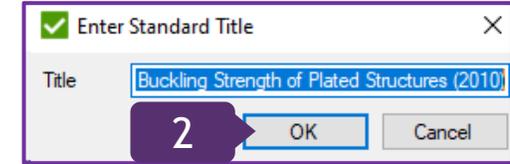
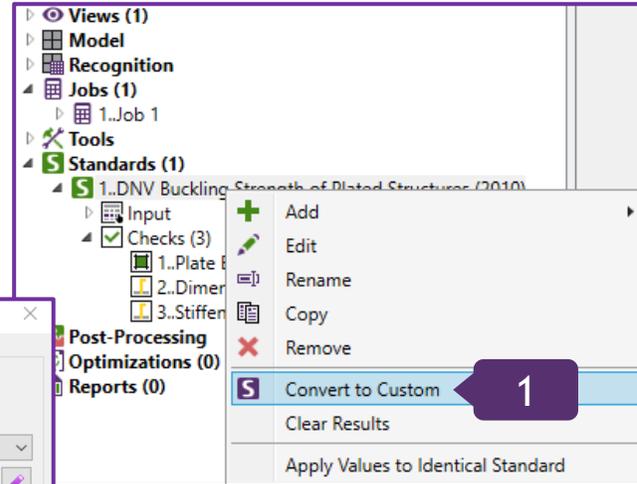
Enter Standard Title and press *OK*

3

Execute right click on *Checks (3)* => *Add* => *Custom Check*

4

Title: *Panel Check*;
Options: *OFF*



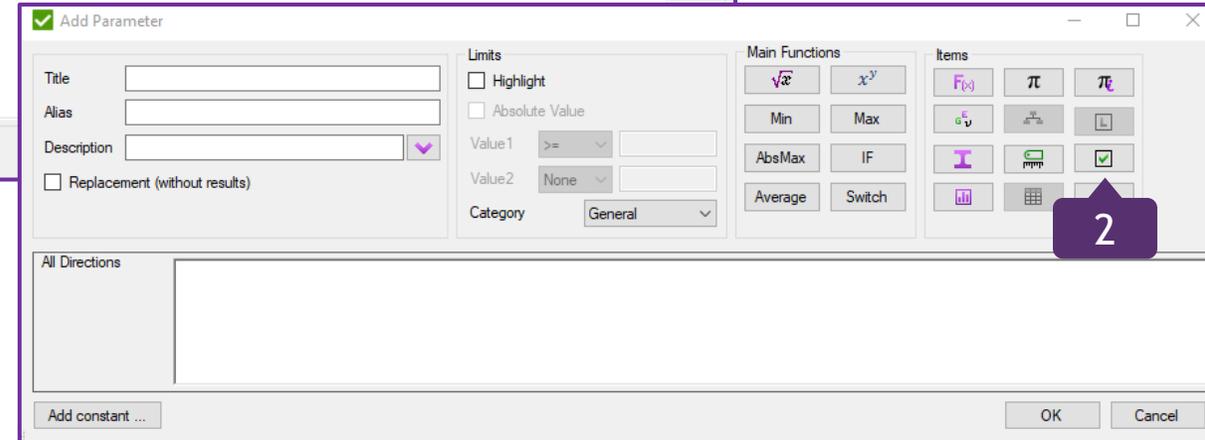
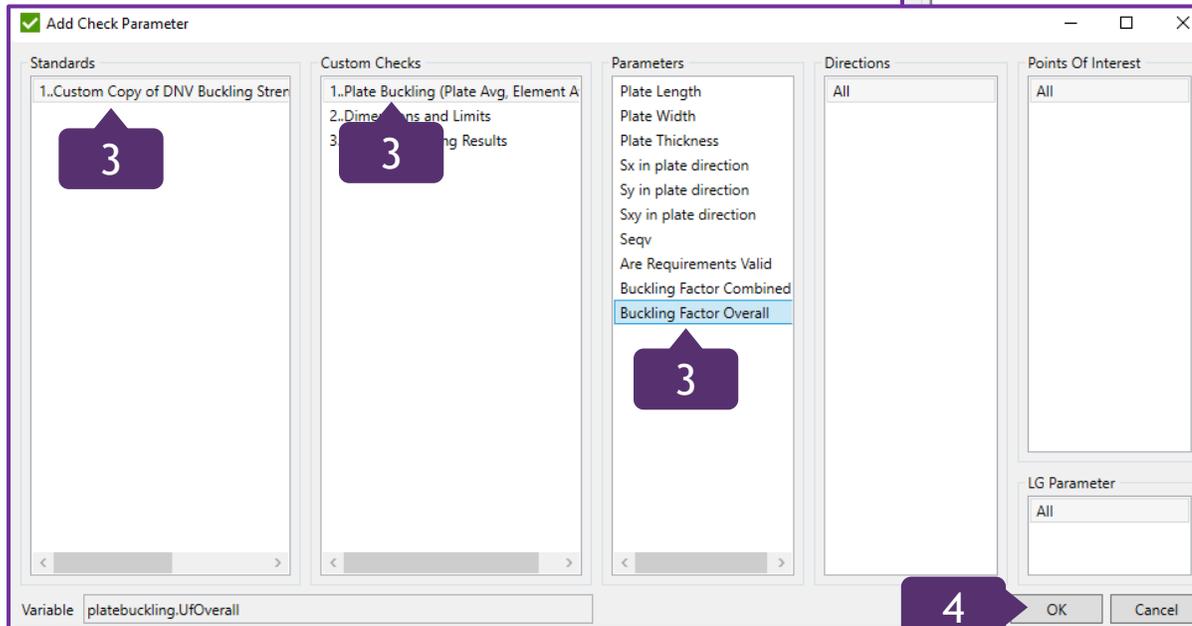
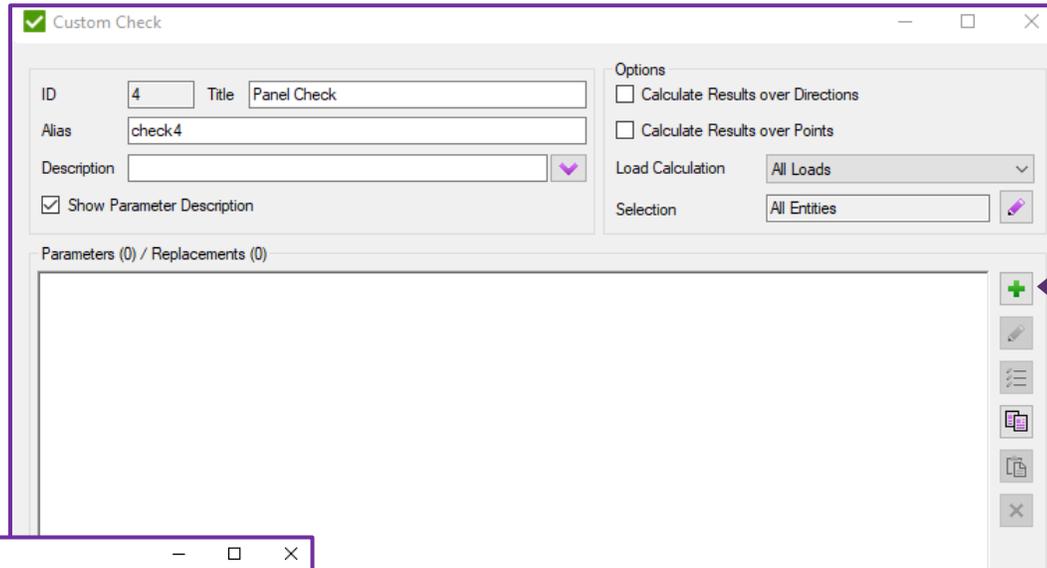
Extract Utilization Factor from Previous Calculation

1 Press  to add Parameter

2 Press  to add *Check Result Variable*

3 Select *1..Custom Copy of DNV Buckling Strength => 1..Plate Buckling => Buckling Factor Overall*

4 Press *OK*



Extract Utilization Factor from Previous Calculation (Continuation)

5

Title: *Plate check*;
Alias: *Plate_check (without gaps)*;
Press OK

6

Press to add Parameter

7

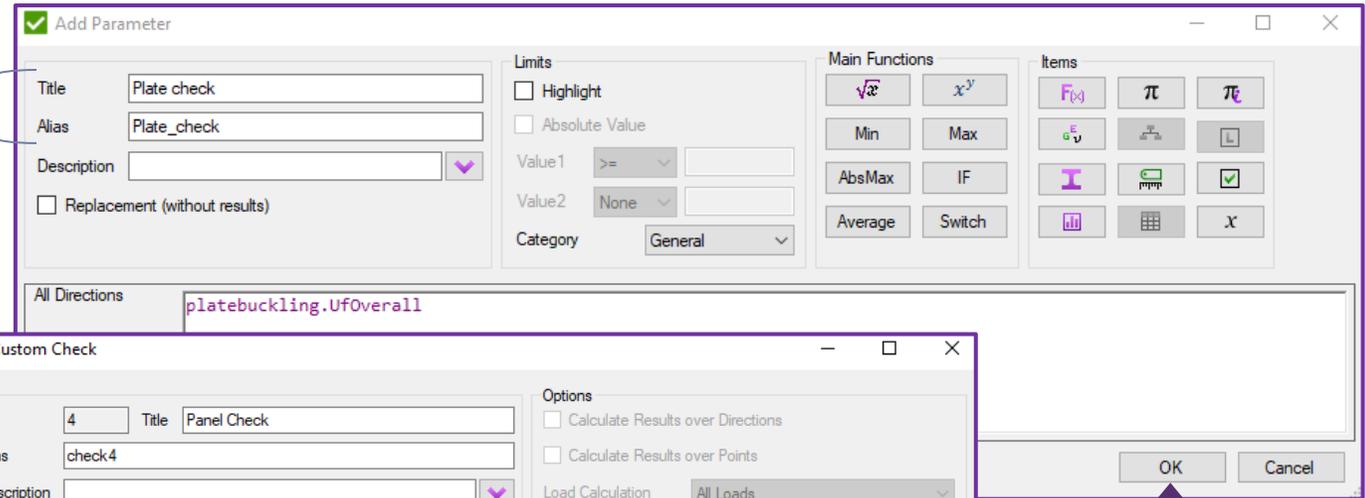
Press to add Check Result Variable

8

Select 1..Custom Copy of DNV Buckling Strength => 3..Stiffener Buckling Results => *Uf Overall*, and press OK

9

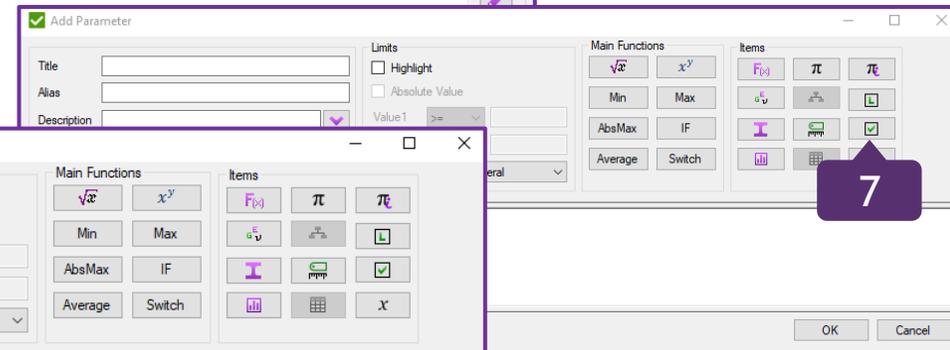
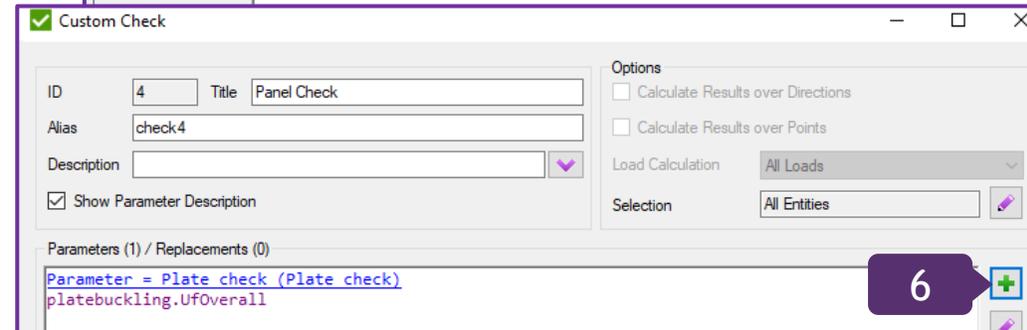
Title: *Stiffener check*;
Alias: *Stiffener_check (without gaps)*;
Press OK



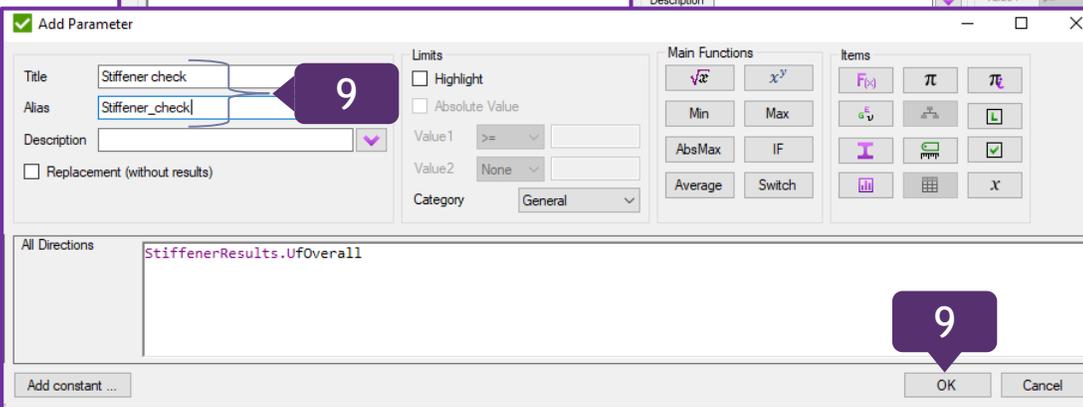
5

5

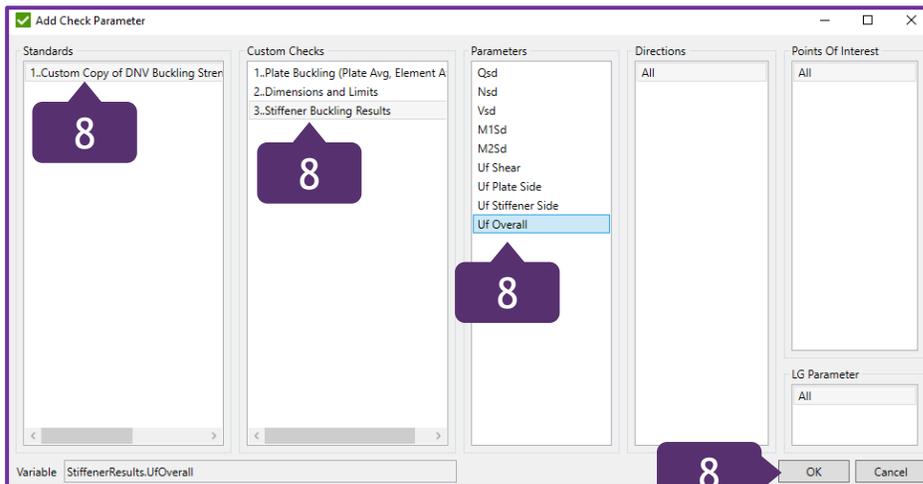
6



7



9



8

8

8

8

Utilization Factor of Panel Buckling

1 Press to add Parameter

2 Title: *Panel check*;
Alias: *Panel_check (without gaps)*;

3 All Directions: *absmax(Plate_check,Stiffener_check)*
by pressing Enter;
Press *OK*

Present Failed Panel Structure

- 1 Press  to integrate Panel Uf formula
- 2 Title: *Panel Uf*;
Alias: *Panel_Uf (without gaps)*;
- 3 All Directions: `if(Panel_check>=1,1,0)` by pressing Enter;
- 4 Press *OK*

Custom Check

ID: 4 Title: Panel Check

Alias: check4

Description:

Show Parameter Description

Options

Calculate Results over Directions

Calculate Results over Points

Load Calculation: All Loads

Selection: All Entities

Parameters (3) / Replacements (0)

Parameter = Plate check (Plate check)
platebuckling.UfOverall

Parameter = Stiffener check (Stiffener check)
StiffenerResults.UfOverall

Parameter = Panel check (Panel check)
absmax(Plate_check,Stiffener_check)

1 

OK Cancel

Add Parameter

Title: Panel Uf

Alias: Panel_Uf

Description:

Replacement (without results)

Limits

Highlight

Absolute Value

Value 1: >=

Value 2: None

Category: General

Main Functions

\sqrt{x} x^y

Min Max

AbsMax IF

Average Switch

Items

$F(x)$ π $\frac{\pi}{2}$

G^E  

I  

  X

All Directions

`if(Panel_check>=1,1,0)`

2

3

4 OK Cancel

Add constant ...

Edit Multiple Parameters

1 Press  to *Edit Parameters Multiple*

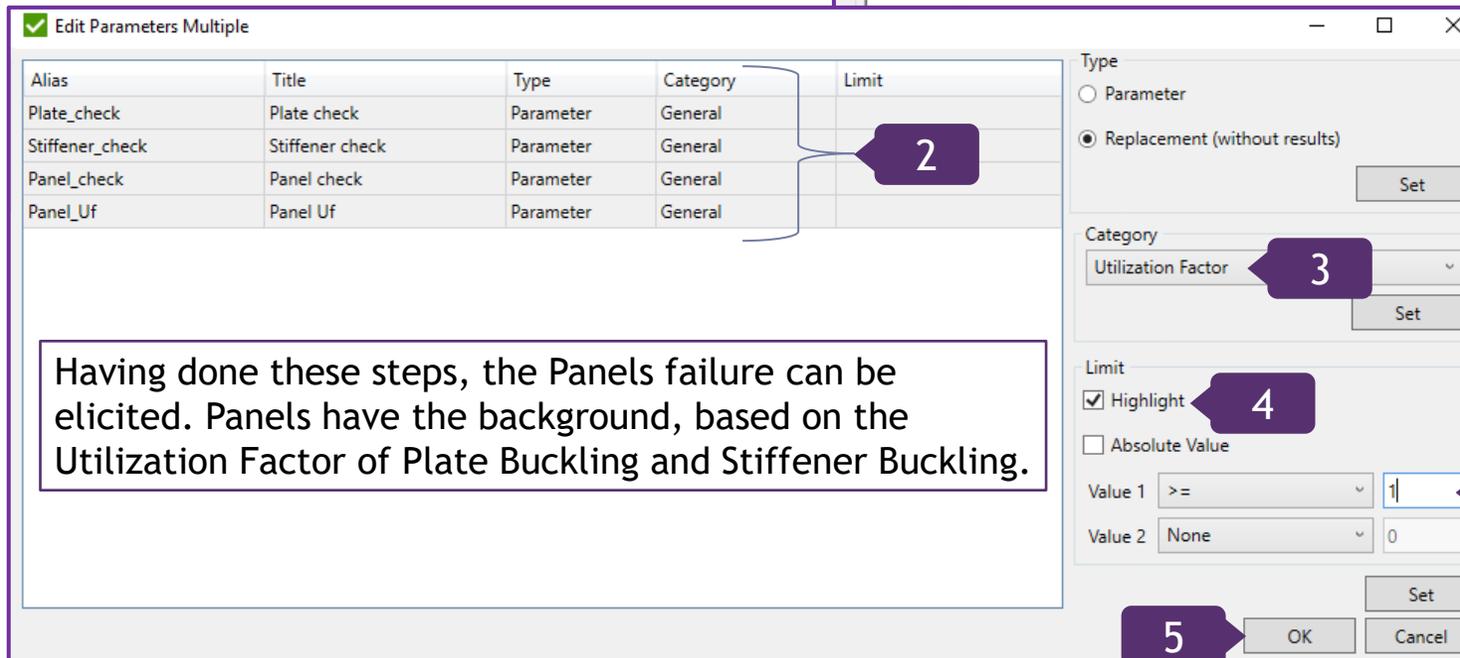
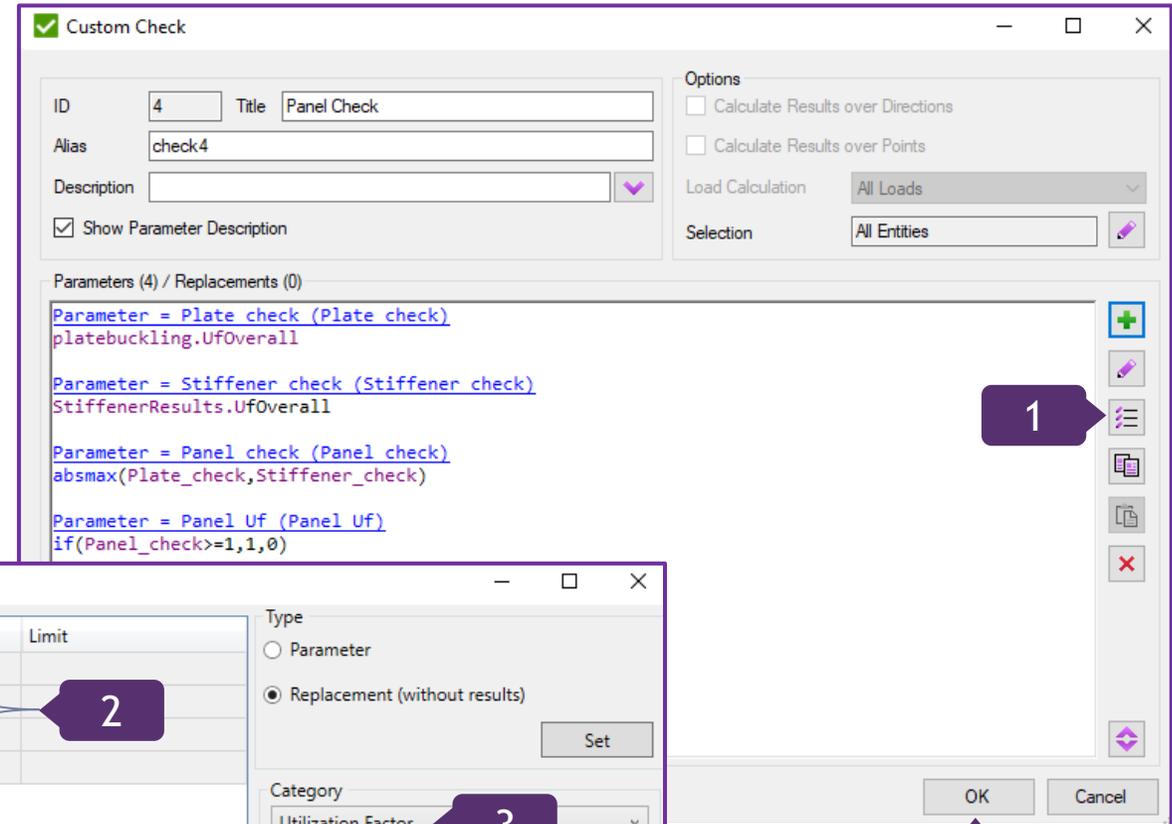
2 Select all of them

3 Category: *Utilization Factor*

4 Limit: Highlight is ON;
Value 1 ≥ 1

5 Press OK

6 Press OK



Export Panels as Separate Components

- 1 In Model Tree, in Recognition, execute right click on *Panel Finder*; Press *Edit*
- 2 Select *Filter* section
- 3 Display: *Panels*
- 4 Press *Apply Filter*
- 5 Select all Panels, using CTRL+A; Press  to export them to Components as separate Components
- 6 Export Panels (211): *ON*; Separate Components: *ON*; Press *Export*
- 7 Press *OK*
- 8 Press *OK*

The screenshot shows the SDC Verifier software interface. The Model Tree on the left shows the 'Recognition' folder expanded, with 'Panel Finder' selected. The 'Panel Finder' window is open, showing the 'Filter' tab. The 'Display' section is set to 'Panels'. The 'Apply Filter' button is highlighted. The main window displays a table of panels with columns for 'Title', 'Plates Count', and 'Stiffeners Count'. The 'Export Panel Finder Entities' dialog is open, with 'Export Panels (211)' checked and 'Separate Components' selected. The 'Export' button is highlighted. A confirmation message box is displayed, stating '211 Component(s) and 0 Groups were created.' The 'OK' button is highlighted.

Title	Plates Count	Stiffeners Count
Panel 1.1	10	7
Panel 1.2	18	16
Panel 1.3	1	1
Panel 1.4	7	5
Panel 1.5	12	13
Panel 1.6	1	0
Panel 1.7	12	13
Panel 1.8	1	0
Panel 1.9	54	55
Panel 1.10	5	5
Panel 1.11	1	1
Panel 1.12	1	0
Panel 1.13	5	3
Panel 1.14	4	2
Panel 1.15	1	1
Panel 1.16	1	0

Build Components Extreme Table (over selections)

1

In Standards => 1..Custom Copy of DNV Buckling Strength of Plated Structures => Checks, select 4..Panel Check

2

Execute right click on 4..Panel Check and select Components Extreme Table (over selections)

3

In Load Group, press ; Select Load Group => 1..Envelope; Press OK

4

Direction/Parameter: All; Extreme Options: Absolute

5

Press  and select From List

6

Press All and press OK

7

Press Fill Table

1

2

3

3

3

2

3

6

6

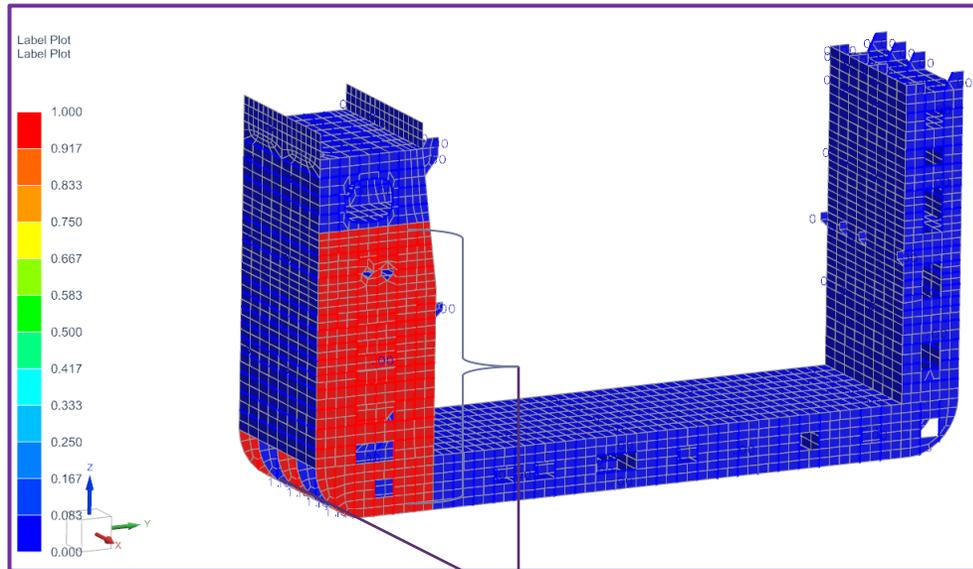
7

Build Panel Uf Plot

1 Select all *Components*, using CTRL + A

2 Press  and select *Panel Uf*

3 Press *OK*



These sections do not pass the verification in the calculation.

Components Extreme Table

ID: 1 Title: []

Default Title: All (LG1, 211 Selections)

Description: []

Options

Load Group: 1..Envelope

Check: 4..Panel Check

Direction/Parameter: All

Extreme Options

Minimum

Maximum

Absolute

Selections (211) (Elements)

ALL [] [] [] []

Component '1..Panel 1.1'

Component '2..Panel 1.2'

Component '3..Panel 1.3'

Component '4..Panel 1.4'

Component '5..Panel 1.5'

Component '6..Panel 1.6'

Component '7..Panel 1.7'

Component '8..Panel 1.8'

Component '9..Panel 1.9'

Component '10..Panel 1.10'

Component '11..Panel 1.11'

Component '12..Panel 1.12'

Component '13..Panel 1.13'

Component '14..Panel 1.14'

Table Info: 211 Selections, LG1..Envelope, Direction: X, Extreme Types: Abs

Components	Plate check	Stiffener check	Panel check	Panel Uf
Component '1..Panel 1.1'	0.34	0.29	0.34	0.00
Component '2..Panel 1.2'	0.31	0.34	0.34	0.00
Component '3..Panel 1.3'	0.27	0.19	0.27	0.00
Component '4..Panel 1.4'	0.28	0.25	0.28	0.00
Component '5..Panel 1.5'	0.25	0.32	0.32	0.00
Component '6..Panel 1.6'	0.03	0.00	0.03	0.00
Component '7..Panel 1.7'	0.31	0.56	0.56	0.00
Component '8..Panel 1.8'	0.03	0.00	0.03	0.00
Component '9..Panel 1.9'	0.39	6.56	6.56	1.00
Component '10..Panel 1.10'	0.65	0.29	0.65	0.00
Component '11..Panel 1.11'	0.04	0.01	0.04	0.00
Component '12..Panel 1.12'	0.02	0.00	0.02	0.00
Component '13..Panel 1.13'	0.29	0.28	0.29	0.00
Component '14..Panel 1.14'	0.21	0.18	0.21	0.00
Component '15..Panel 1.15'	0.19	0.08	0.19	0.00
Component '16..Panel 1.16'	0.03	0.00	0.03	0.00
Component '17..Panel 1.17'	0.01	0.00	0.01	0.00
Component '18..Panel 2.1'	0.10	0.10	0.10	0.00
Component '19..Panel 2.2'	0.17	0.08	0.17	0.00
Component '20..Panel 2.3'	0.06	0.06	0.06	0.00
Component '21..Panel 2.4'	0.07	0.08	0.08	0.00
Component '22..Panel 2.5'	0.34	0.17	0.34	0.00
Component '23..Panel 2.6'	0.15	0.05	0.15	0.00
Component '24..Panel 2.7'	0.35	0.23	0.35	0.00

Displaying 211 of 211 rows and 5 of 5 columns

Fill Table

OK Cancel

To make relevant Plots, in the first place Views should be created (a set of settings of how to display a Plot).

1

Execute right click on *Views* and select *Add*

2

In Simcenter, orient the model as shown on picture (ZY plane)

3

Title: *Frames*

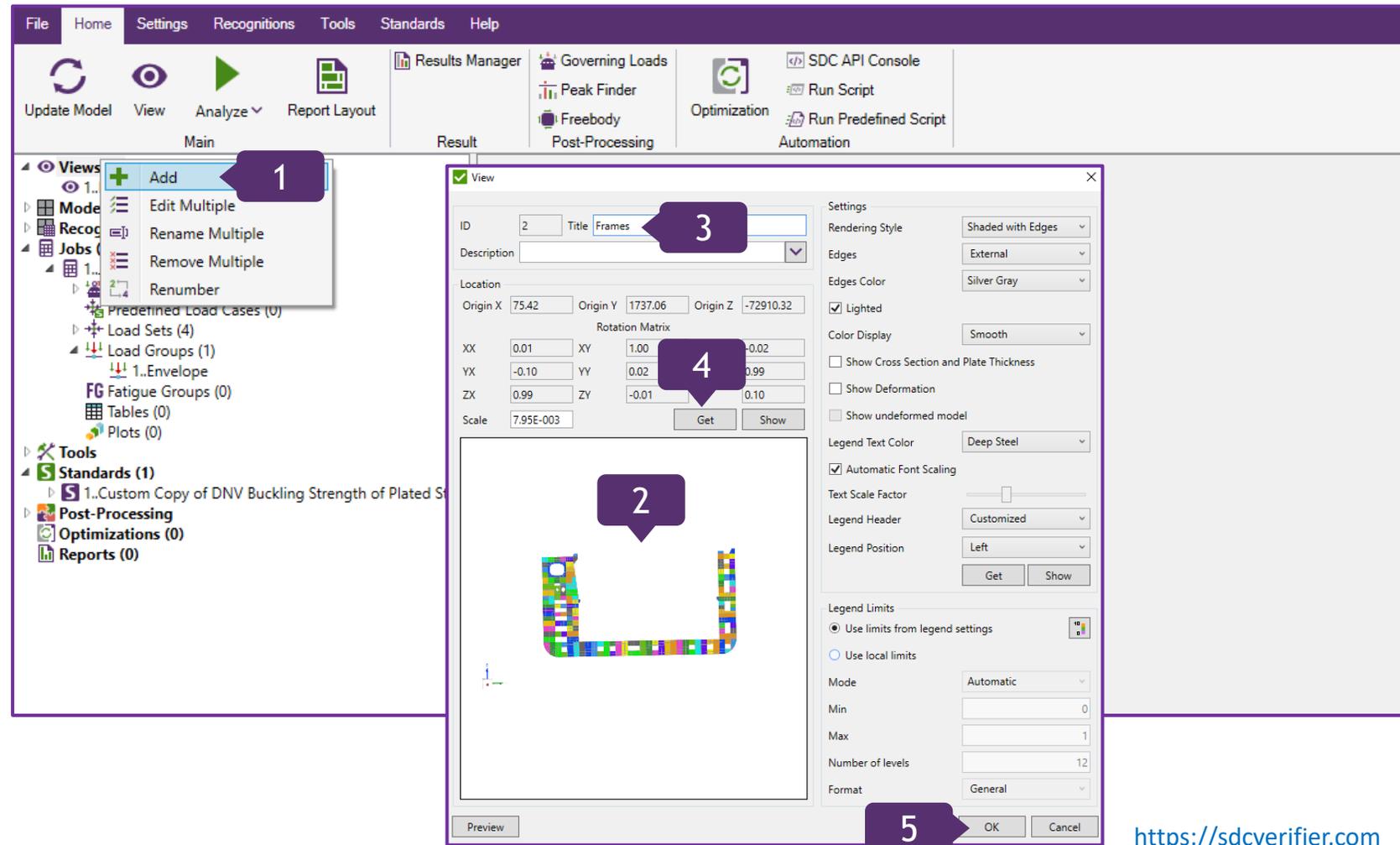
4

Press *Get*

5

Press *OK*

Repeat Steps 1-5 two times to create Views for Longitudinals (plane ZX) and Decks (plane XY)



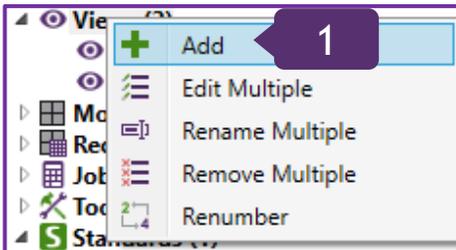
1 Execute Views => Add

2 In Simcenter, orient model as shown on picture (ZY plane)

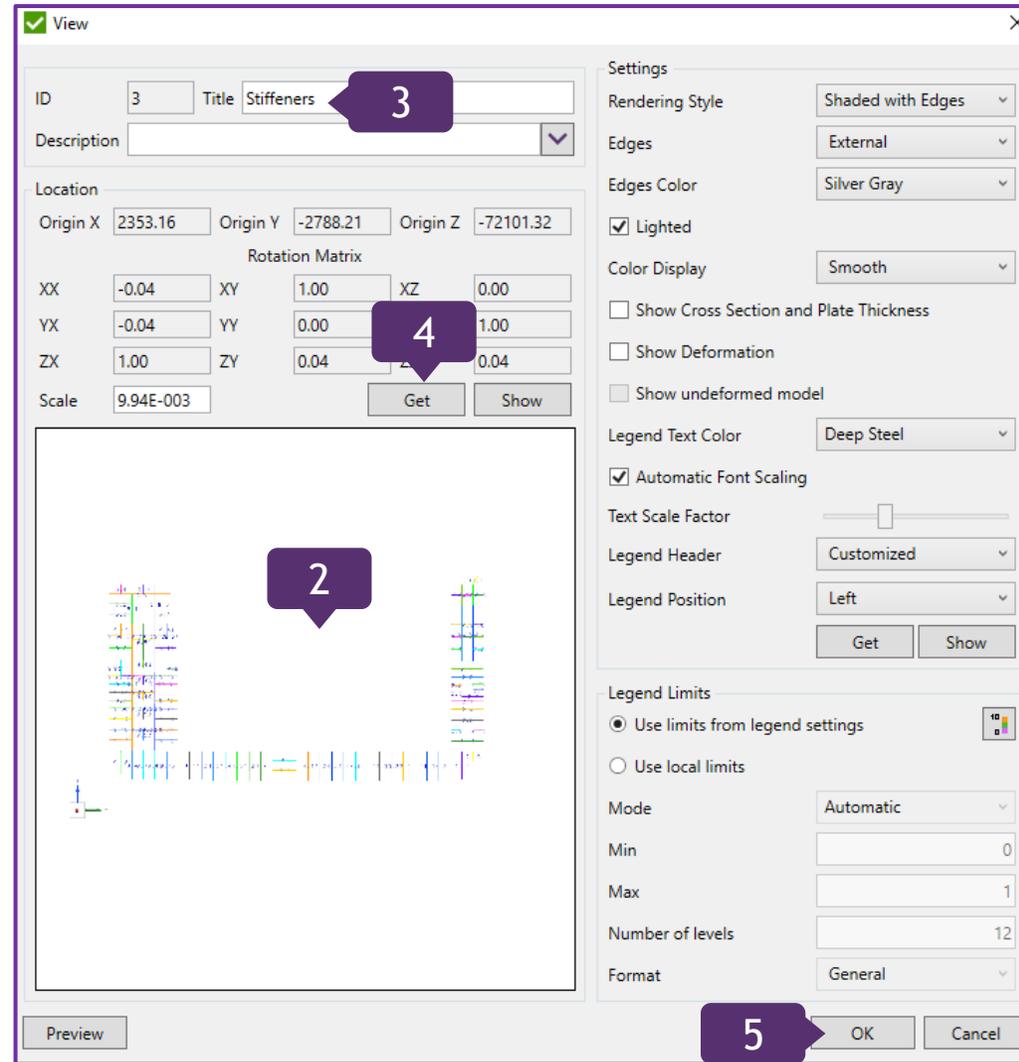
3 Title: *Stiffeners*

4 Press *Get*

5 Press *OK*



To make relevant Plots, in the first place Views should be created (a set of settings of how to display a Plot).



1

In *Checks* section, execute right click on *1..Plate Buckling* and select *Table (expand/extreme)*

2

In Load Group, press

3

Select *Load Group* => *1..Load Group 1* and press *OK*

4

Show plates results: *OFF*

5

Press *Fill Table*

Standards (1)
1..Custom Copy of DNV Buckling Strength of Plated Struc
Input
Checks (4)
1..Plate Buckling (Plate Avg, Element Avg)
2..Dimensions and Limits
3..Stiffener Buckling
4..Panel Check
Post-Processing
Optimizations (0)
Reports (0)

- Add
- Edit
- Rename
- Copy
- Remove
- Copy To Standard...
- Move
- Clear Results
- Table (expand/extreme)
- Flow Table (over loads)
- Criteria Plot

Plate Buckling Table

ID: 1 Title: []
Default Title: Table (LG1, 25 Sections)
Description: []

Options

Check: 1..Plate Buckling (Plate Avg, Element Avg)
Load Group: 1..Envelope
Table Type: Expand (results on each node/element)
Search Type: Related To Last

Show Plates Results
 Display Governing Loads Short Title

Filter by
Parameter: None
Value >: 1

Sort by
Parameter: Buckling Factor Overall
Order: Descending

Sections on Selection
+ 25 Sections

Elements: 8818

Fill Table

Select Load

Load Type
 Individual Load
 Load Set
 Load Group
 Fatigue Group

Jobs
1..Job 1

Load Group
Search: []
1..Envelope

OK Cancel

Plate Buckling Table (Continuation)

Section Title	Plate Length [m]	Plate Width [mr]	Plate Thickness	Sx in plate direc	Sy in plate direc	Sxy in plate dire	Seqv [kPa]	Are Requiremer	Buckling Factor	Buckling Factor	Load
8..Section Y 8 (Y = -8950)	9050.00	3360.00	12.00	-35302.00	-1830.18	1970.75	34592.24	1.00	0.80	0.90	LS4

6

Press OK

All results (Dimensions, Stresses) are from the Plate, which causes the highest BF=0.90, because Search Type = Related to Last Parameter.

It is advised to use Show Plates results for detailed table with results for all Plates. Otherwise, only the worst results over Sections will be shown.

Plate Buckling Table

Table Info: 25 Sections, LG1..Envelope, Search Type: Related To Last, Filter by: Parameter: None Value: 1, Table Type: Expand

Sectit	Plate	Plate	Plate	Sx in	Sy in	Sxy in	Seqv	Are R	Buckl	Buckl	Load
8..Section	9050.00	3360.00	12.00	-35302.00	-1830.18	1970.75	34592.24	1.00	0.80	0.90	LS4
15..Section	3360.00	895.00	14.00	-2043.74	-49127.24	-760.12	48155.93	1.00	0.64	0.80	LS4
5..Section	833.33	750.00	12.00	0.00	0.00	-64968.95	150850.13	1.00	0.52	0.72	LS1
13..Section	2200.00	1680.00	6.00	-28291.03	-2507.60	522.20	27139.38	1.00	0.50	0.71	LS3
1..Section	833.33	750.00	12.00	0.00	0.00	-54728.20	135139.67	1.00	0.42	0.65	LS1
16..Section	1680.00	800.00	10.00	0.00	-37843.79	-4089.04	45814.21	1.00	0.35	0.59	LS4
14..Section	3360.00	916.66	13.00	-5767.74	-32022.60	3877.02	30316.82	1.00	0.32	0.57	LS4
3..Section	895.00	733.33	14.00	-31473.86	-13045.45	-57011.91	102475.70	1.00	0.26	0.51	LS3
11..Section	2200.00	840.00	6.00	-22042.78	-688.98	10056.64	27831.28	1.00	0.12	0.35	LS4
2..Section	833.33	800.00	16.00	0.00	0.00	32752.31	72240.24	1.00	0.12	0.35	LS1
4..Section	3000.00	2600.00	16.00	0.00	-17214.97	-7224.30	21508.72	1.00	0.11	0.33	LS4
19..Section	3360.00	2500.00	10.00	0.00	0.00	12098.18	21556.67	1.00	0.07	0.27	LS1
12..Section	2200.00	1680.00	13.00	-797.43	0.00	17086.14	29716.13	1.00	0.04	0.20	LS3
21..Custor	3360.00	2770.30	21.00	-534.25	-11525.86	1486.54	11558.66	1.00	0.03	0.18	LS4
9..Section	2200.00	1680.00	13.00	-1626.04	0.00	13614.01	23707.40	1.00	0.03	0.16	LS4
6..Section	3360.00	750.00	32.00	0.00	0.00	12305.22	28488.77	1.00	0.02	0.14	LS1
22..Custor	1680.00	417.01	14.00	0.00	-17038.34	-6423.35	20371.20	1.00	0.02	0.13	LS1
23..Custor	1680.00	473.44	14.00	-4132.57	-14891.39	-2951.73	14262.89	1.00	0.01	0.11	LS1
10..Section	2200.00	1680.00	15.00	0.00	-440.07	8253.76	14336.48	1.00	0.01	0.09	LS1
18..Section	4865.22	3360.00	11.00	-2.80	0.00	3166.85	5494.14	1.00	0.01	0.09	LS1
20..Section	3360.00	866.70	20.00	-4183.28	-7378.77	-6205.66	12514.36	1.00	0.01	0.09	LS4
17..Section	2500.00	1680.00	10.00	-1332.10	-2733.15	-2517.89	4962.16	1.00	0.01	0.09	LS1
24..Custor	1680.00	432.95	14.00	-2226.32	0.00	-2569.71	8919.13	1.00	0.00	0.04	LS4
25..Custor	1680.00	486.44	14.00	-3268.88	0.00	-1906.14	7325.40	1.00	0.00	0.04	LS4
7..Section	6720.00	1050.00	32.00	0.00	-83.33	0.00	408.48	1.00	0.00	0.00	LS1
Max ove	9050.00	3360.00	12.00	-35302.00	-1830.18	1970.75	34592.24	1.00	0.80	0.90	LS4

Options:

- Check: 1..Plate Buckling (Plate Avg, Element Avg)
- Load Group: 1..Envelope
- Table Type: Expand (results on each node/element)
- Search Type: Related To Last
- Show Plates Results:
- Display Governing Loads: Short Title
- Filter by: Parameter: None, Value: 1
- Sort by: Parameter: Buckling Factor Overall, Order: Descending
- Sections on Selection: ALL, + 25 Sections
- Elements: 8818

Fill Table

6

OK Cancel

Plate Buckling Plot

1 Execute **Criteria Plot** from Plate Buckling DNV 2010 context menu

2 In Load Group, press

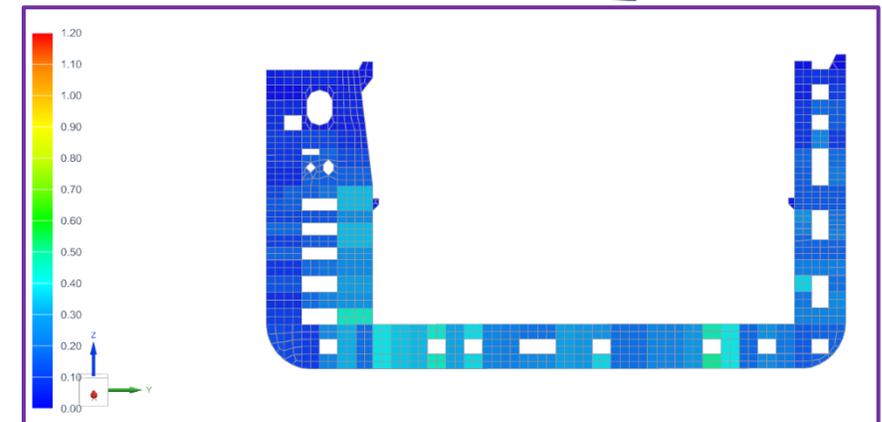
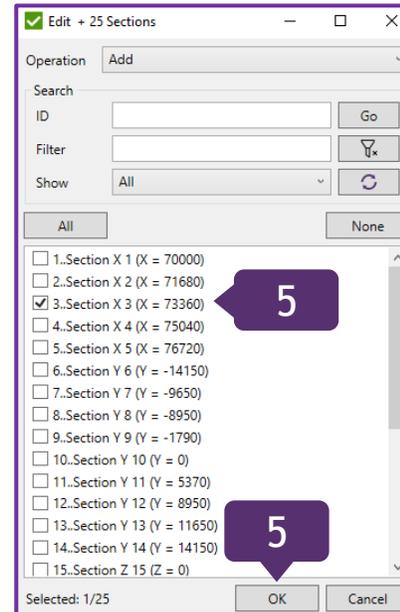
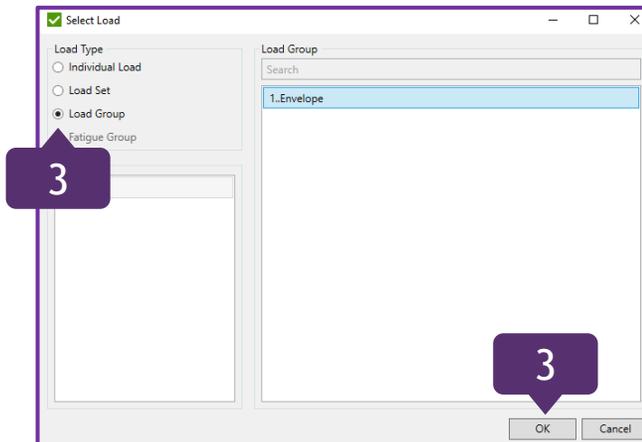
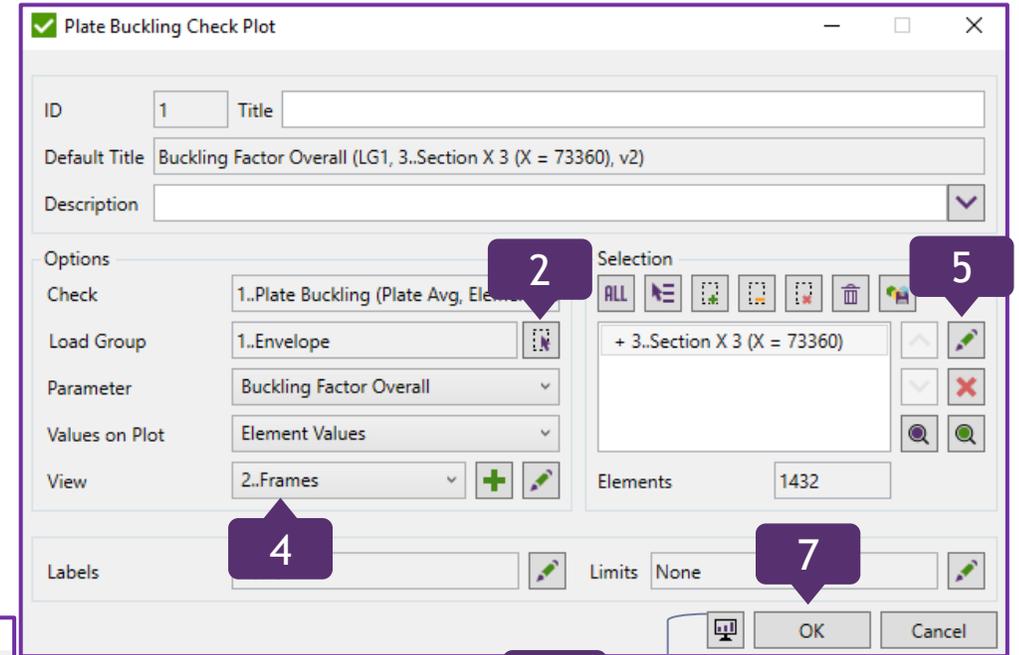
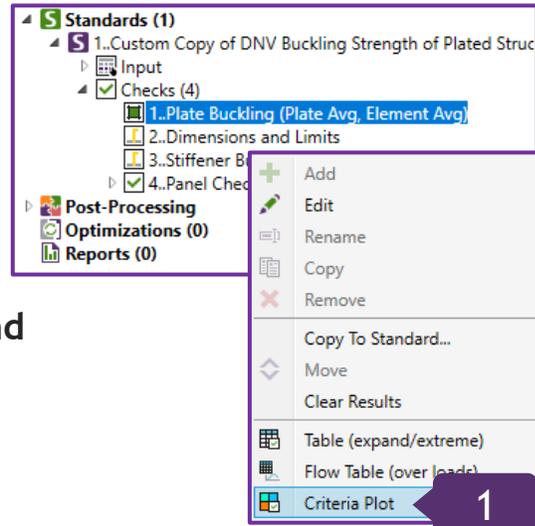
3 Select **Load Group** => **1..Envelope** and press **OK**

4 View: **2..Frames**

5 Press and select: **Section X3**;
Press **OK**

6 Press , and then **Preview**

7 Press **OK**



Stiffener Buckling Table

1

In Checks section, execute right click on 3..Stiffeners Buckling Results and select Table (expand/extreme)

2

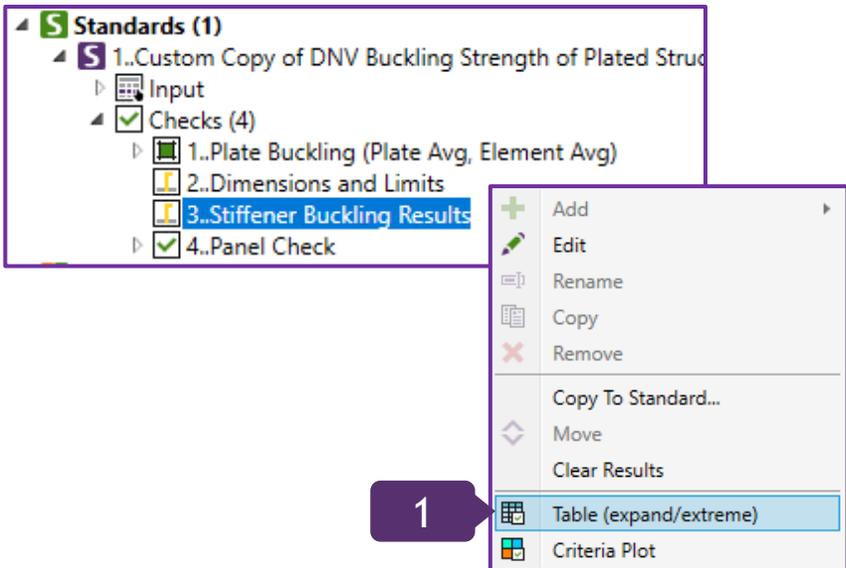
Show Stiffeners Results: ON

3

Select  Load =>Load Group: 1..Envelope

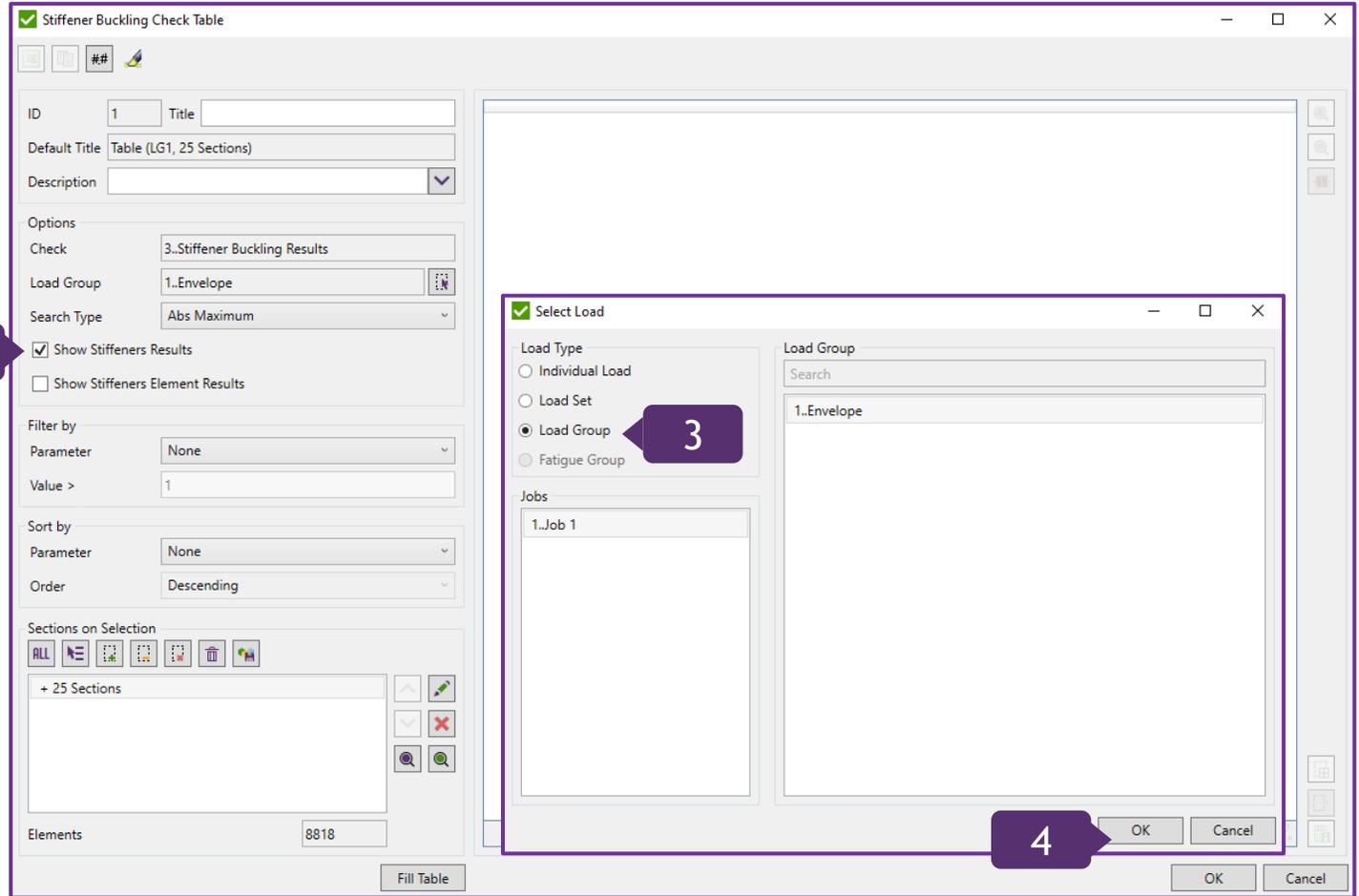
4

Press OK and Fill Table



The screenshot shows a tree view of standards under 'Standards (1)'. The 'Checks (4)' folder is expanded, showing '1..Plate Buckling (Plate Avg, Element Avg)', '2..Dimensions and Limits', '3..Stiffener Buckling Results', and '4..Panel Check'. A right-click context menu is open over '3..Stiffener Buckling Results', with the 'Table (expand/extreme)' option highlighted. A callout '1' points to this option.

2



The screenshot shows the 'Stiffener Buckling Check Table' dialog box. The 'Options' section has 'Show Stiffeners Results' checked. The 'Load Group' is set to '1..Envelope'. A 'Select Load' dialog box is open, showing 'Load Group' selected. A callout '3' points to the 'Load Group' radio button. The 'Stiffener Buckling Check Table' dialog has a 'Fill Table' button at the bottom, with a callout '4' pointing to it. The 'Select Load' dialog has 'OK' and 'Cancel' buttons, with a callout '4' pointing to the 'OK' button.

4

Stiffener Buckling Table (Continuation)

5

Press OK

Use Show stiffener results for detailed table with results for all stiffeners. Otherwise only the worst results over Sections will be shown.

Stiffener / Element	Qsd	Nsd	Vsd	M1Sd	M2Sd	Uf She	Uf Pla	Uf Stif	Uf Ovi
1..Section X 1 (X = 7)	16382.81	717718720	4057239.2	258080296	129040148	0.02	6.56	6.36	6.56
1..Stiffener 1.1.1 [70]	5322.17	81667192.0	3250621.2	214660838	107330419	0.01	0.20	0.15	0.20
2..Stiffener 1.1.2 [70]	3326.29	19345436.0	-1166566.2	134160486	670802432	0.01	0.22	0.21	0.22
3..Stiffener 1.1.3 [70]	3156.90	26611536.0	-954253.5	127328243	636641216	0.01	0.25	0.24	0.25
4..Stiffener 1.1.4 [70]	3167.73	35200768.0	-804129.3	127765222	638826112	0.01	0.27	0.25	0.27
5..Stiffener 1.1.5 [70]	3299.28	36602816.0	-772206.6	133070860	665354304	0.01	0.29	0.26	0.29
6..Stiffener 1.1.6 [70]	3113.10	31802870.0	-500035.4	125561561	627807808	0.00	0.27	0.25	0.27
7..Stiffener 1.1.7 [70]	3814.79	32040538.0	-846119.8	153863360	769316800	0.00	0.14	0.11	0.14
1..Stiffener 1.2.1 [70]	2724.20	5614788.0	131707.75	141885184	709425920	0.00	0.19	0.19	0.19
2..Stiffener 1.2.2 [70]	3822.49	-19896398	422138.31	884839296	442419648	0.00	0.13	0.11	0.13
3..Stiffener 1.2.3 [70]	4483.29	44507196.0	76525.45	259447680	129723840	0.00	0.05	0.05	0.05
4..Stiffener 1.2.4 [70]	3082.21	16816242.0	122424.44	160531916	802659584	0.00	0.24	0.22	0.24
5..Stiffener 1.2.5 [70]	6174.83	-8207381.5	38627.09	357336704	178668352	0.00	0.06	0.05	0.06
6..Stiffener 1.2.6 [70]	4450.34	18792630.0	171900.22	231788646	115894323	0.00	0.34	0.32	0.34
7..Stiffener 1.2.7 [70]	4450.34	18792630.0	171900.22	231788646	115894323	0.00	0.34	0.32	0.34
8..Stiffener 1.2.8 [70]	5516.70	-10184217	-255245.41	319250720	159625360	0.00	0.05	0.04	0.05
9..Stiffener 1.2.9 [70]	3818.22	8300980.0	-216637.67	198865651	994328256	0.00	0.26	0.26	0.26
10..Stiffener 1.2.10 [70]	8117.68	-2121688.0	60591.04	469769440	234884720	0.00	0.07	0.07	0.07
11..Stiffener 1.2.11 [70]	4912.07	7664536.0	435522.88	284260832	142130416	0.00	0.04	0.04	0.04
12..Stiffener 1.2.12 [70]	3043.46	6848354.0	106024.77	158513472	792567360	0.00	0.21	0.21	0.21
13..Stiffener 1.2.13 [70]	3103.74	67798696.0	441380.78	161653184	808265920	0.00	0.29	0.23	0.29
14..Stiffener 1.2.14 [70]	4334.76	15794938.0	192119.70	250852352	125426176	0.00	0.05	0.03	0.05
15..Stiffener 1.2.15 [70]	1292.81	53384336.0	1117575.5	496406112	248203056	0.01	0.10	0.08	0.10
16..Stiffener 1.2.16 [70]	1109.97	47438420.0	-1018417.5	269730304	134865152	0.00	0.03	0.03	0.03
1..Stiffener 1.3.1 [70]	2095.68	380566240	840663.25	559564032	279782016	0.00	0.19	0.19	0.19
1..Stiffener 1.4.1 [70]	4408.21	26363544.0	-789612.8	177797683	888988416	0.00	0.12	0.09	0.12

Stiffener Buckling Plot

1

In *Checks* section, execute right click on *3..Stiffener Buckling Results* and select *Criteria Plot*

2

In Load Group, press

3

Select *Load Group* => *1..Envelope* and press *OK*

4

View: *3..Stiffeners*

5

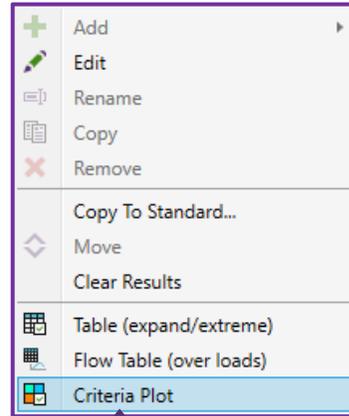
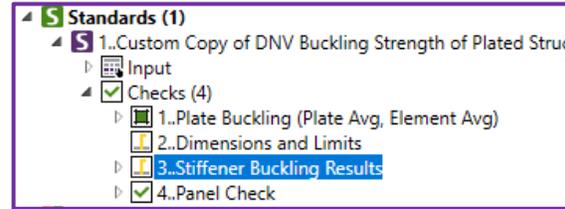
Press and select: *Section X3*

6

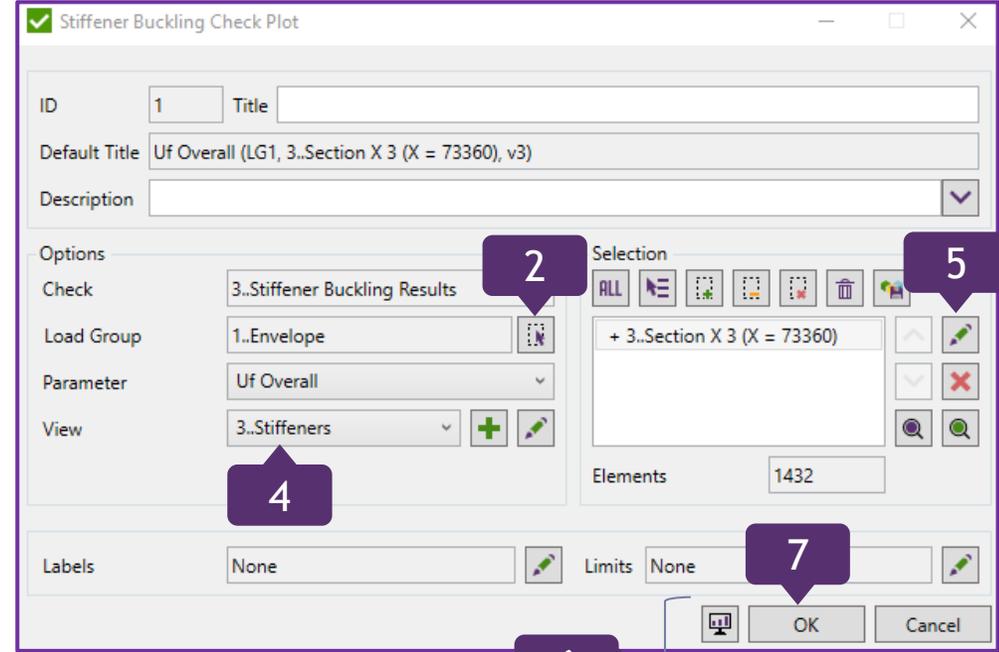
Press , and then *Preview*

7

Press *OK*



1



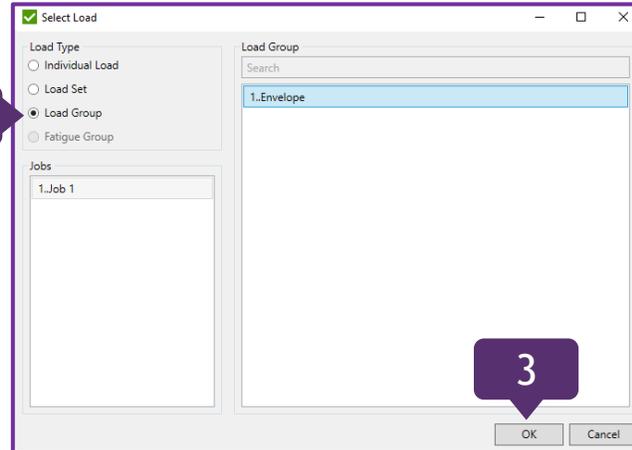
2

5

4

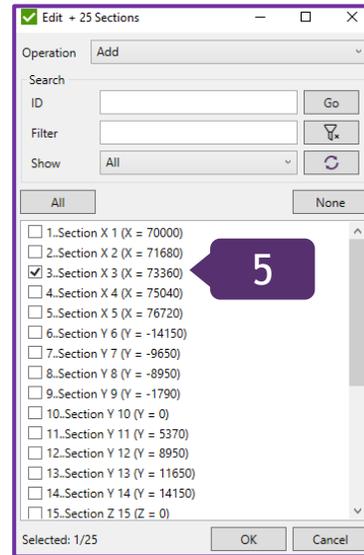
7

6

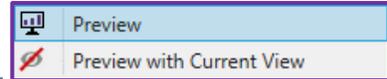
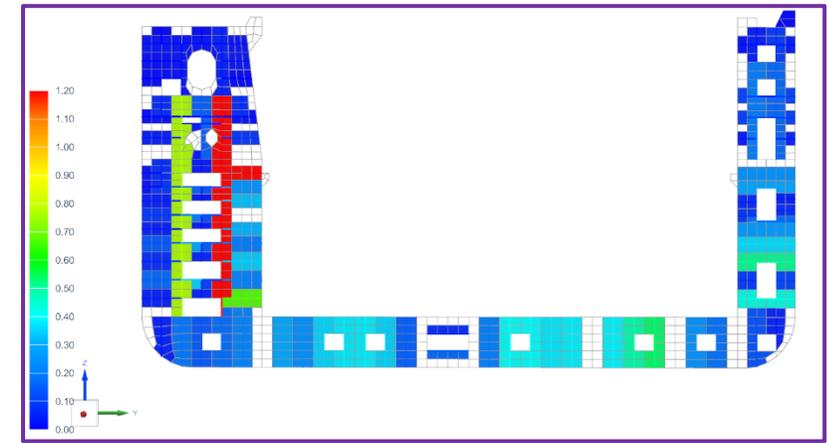


3

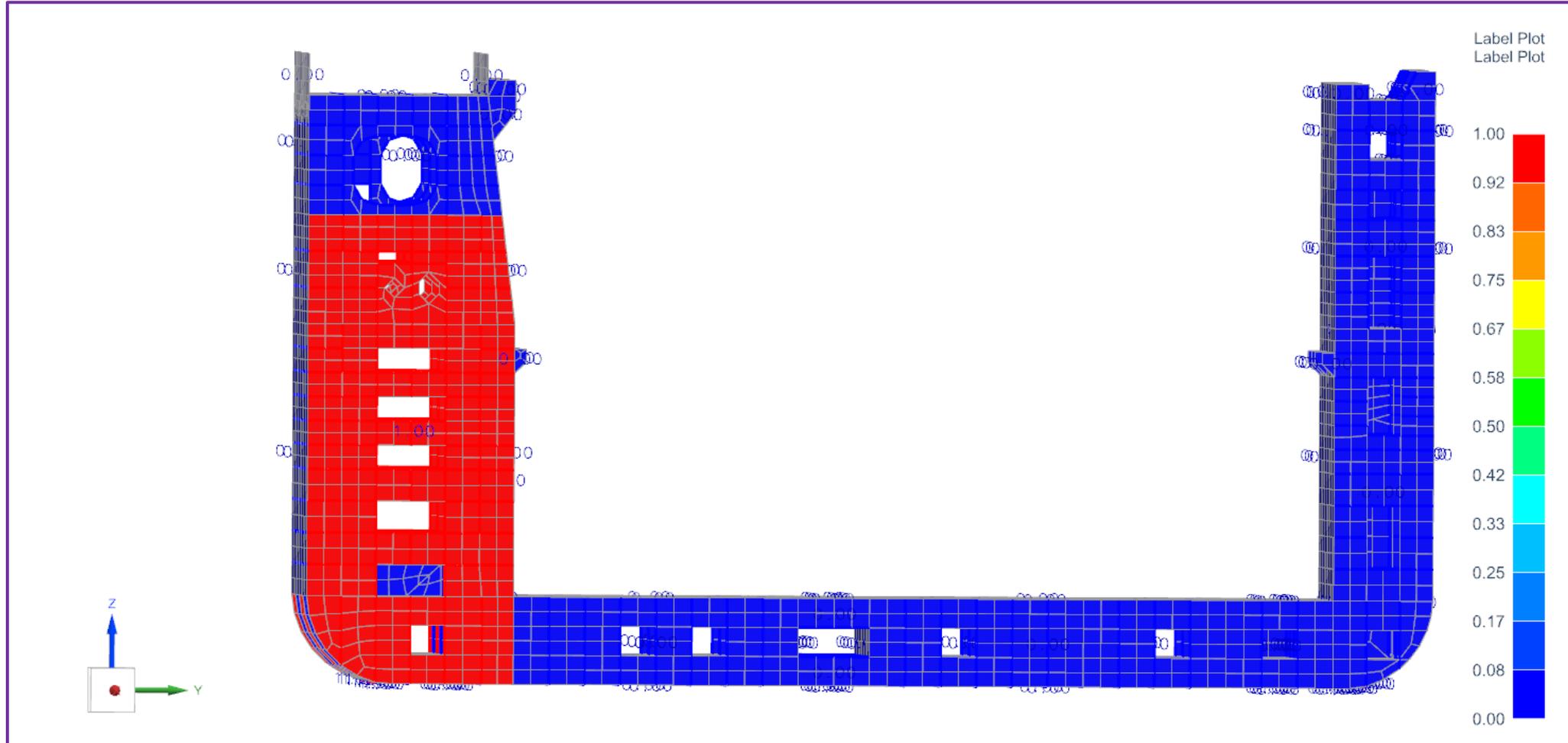
3



5



This Plot gives us possibility to elicit Panels that fail. They have the background, based on the Utilization Factor of Plate Buckling and Stiffener Buckling.



To learn how to obtain reports, please check a separate Tutorial that depicts the functionality of SDC Verifier Report Designer. It may be downloaded via this link:

<https://sdcverifier.com/tutorials/report-designer/>