



## Tutorial

# Weld Strength Eurocode3, DNV PS-C101 and C201

Updated on: 14 June 2023

Tested with: SDC Verifier 2023R1

Femap 2022.1

This step-by-step tutorial demonstrates how to perform the weld strength check according to Eurocode 3, DNV OS-C101-LRFD, DNV OS-C201-WSD standards in SDC Verifier.

The following steps are covered:

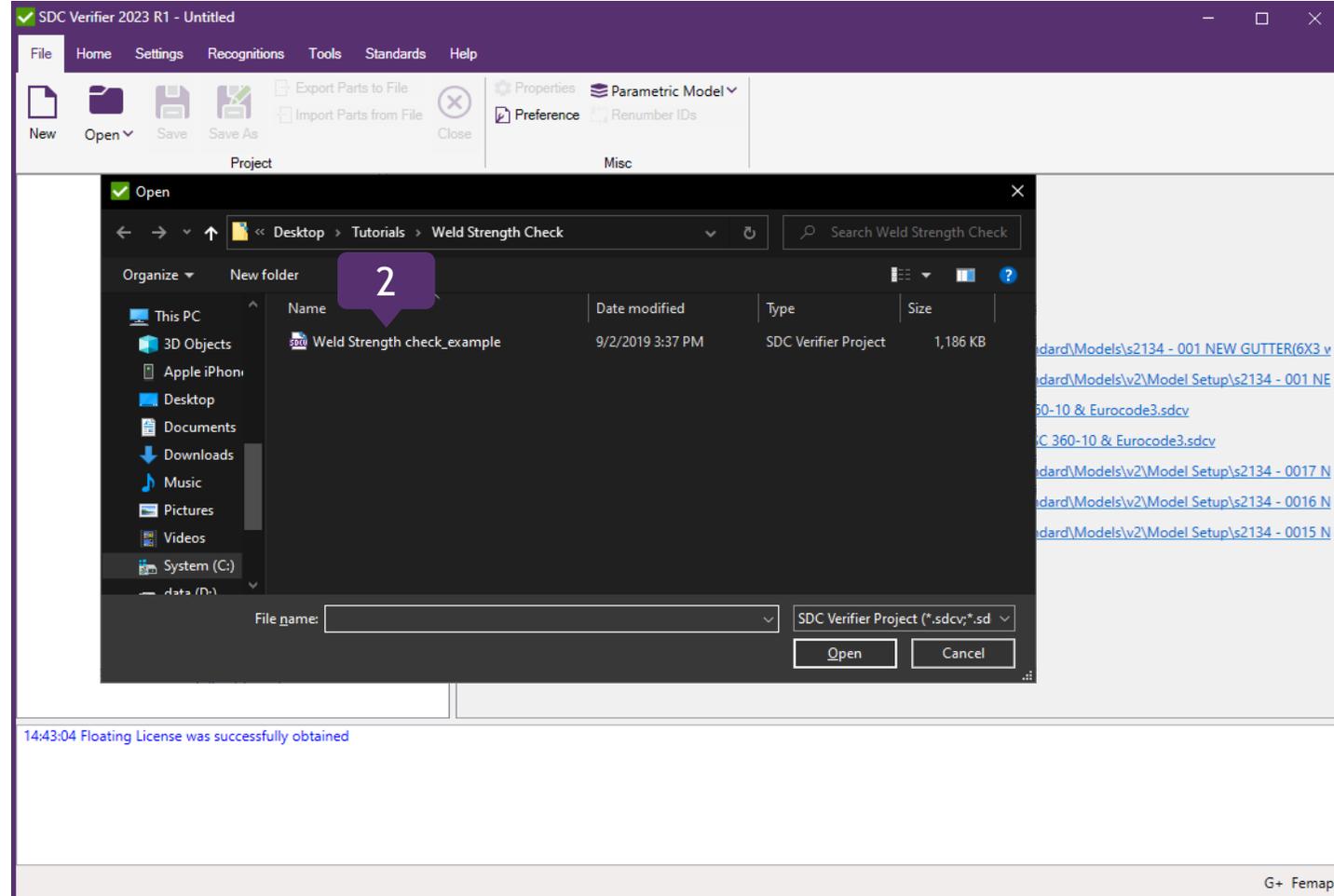
- Weld Finder Tool detailed review;
- Weld Stress calculations;
- Standards creation;
- Report preparation and results.

1

Launch *SDC Verifier* 

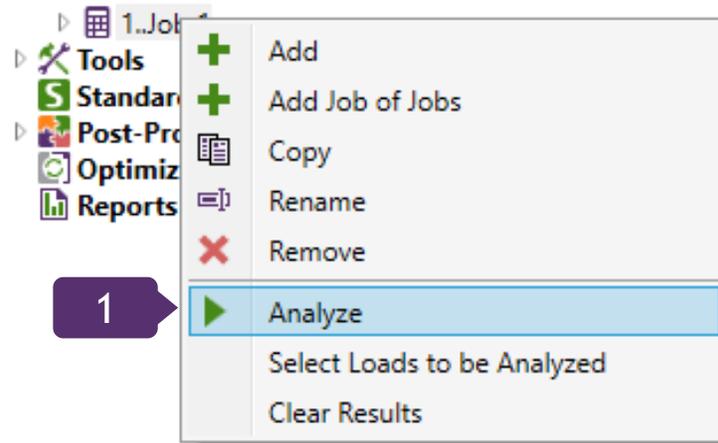
2

Open the project *Weld Strength check\_exemple*



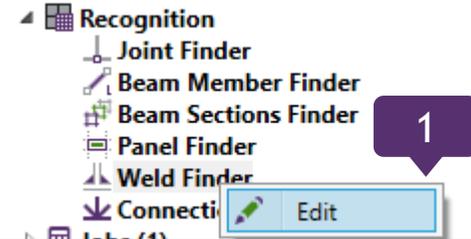
1

Execute ► **Analyze** from *Job1* context menu

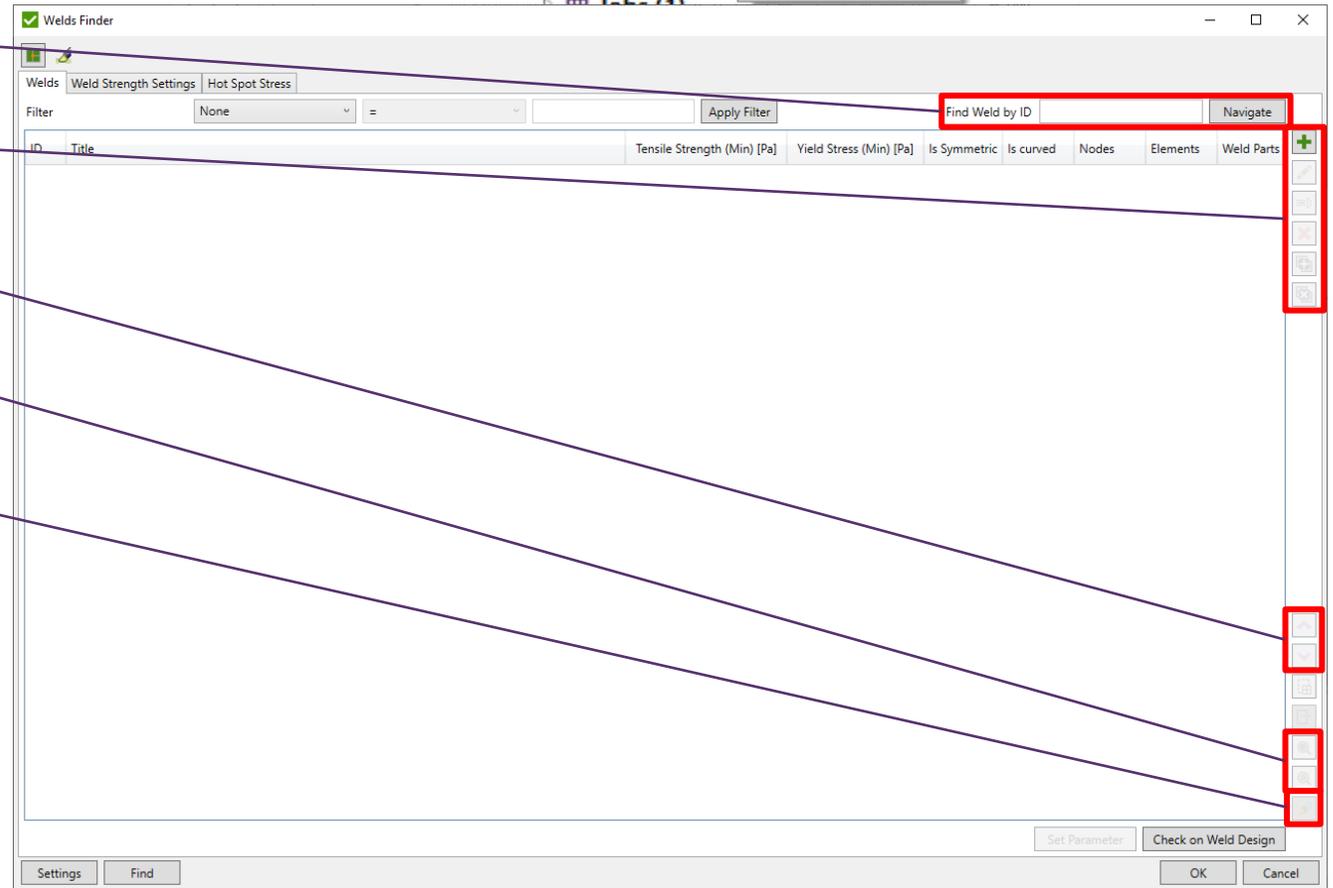


1

Execute *Recognition* => *Weld Finder* => *Edit*



- Navigate** option in order to find weld by ID.
- Add, Edit, Combine, Split** and **Remove** Weld(s).
- Move Welds**. Order is important when the same element belongs to 2 welds
- Preview** selected weld(s).
- Plot** of selected weld(s) in colors with labels of IDs (drop-drop menu).



# Add exception rule for recognition

1 Press **Settings**

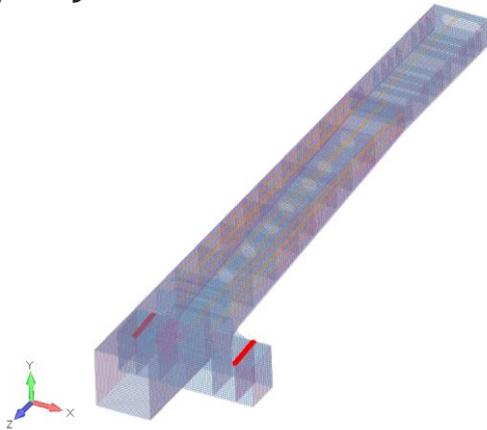
2 Press **Edit** for Not weld properties.

3 Select **property ID4**.

4 Select **property ID5**.

5 Press **Add**.

6 Press 



Connections with properties 4 and 5 are not treated as welds

3

4

5

6

2

1

Not Welded Properties

4.stl plt 20 mm thks

Property 1: 4.stl plt 20 mm thks

Property 2: 5.stl plt 25 mm thks

1.stl plt 10 mm thks

2.stl plt 8 mm thks

3.stl plt 15 mm thks

4.stl plt 20 mm thks

5.stl plt 25 mm thks

6.stl plt 35 mm thks

7.stl plt 4 mm thks

8.stl plt 12 mm thks

Add

Add by Ids

Property 1 ID:

Property 2 ID:

Add

Welds

Weld Strength Settings

Hot Spot Stress

Filter: None

ID Title

Selection: All Entries

Not welded properties: 0

Default Weld Title: Weld

Weld Parts Recognition Settings

Set All Weld Parts Welded if Different Property IDs

Prop 1

Prop 2

Prop 3

Angle < 20

Angle < 70

6 welds

1 weld

Angle

Normals

Prop 1

Angle

Settings

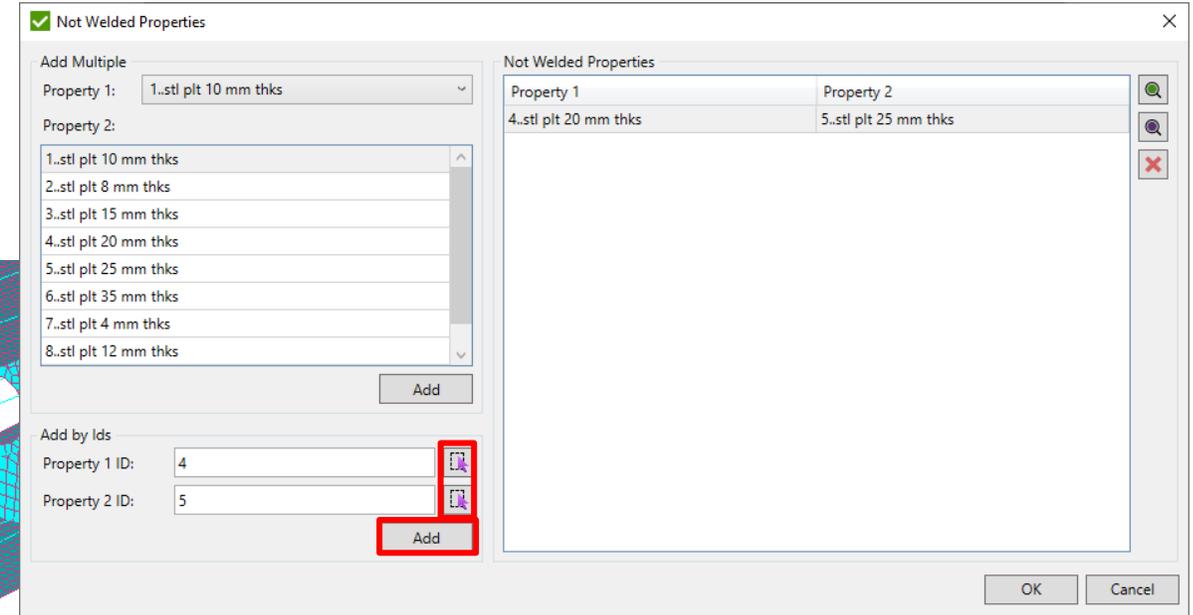
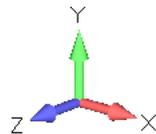
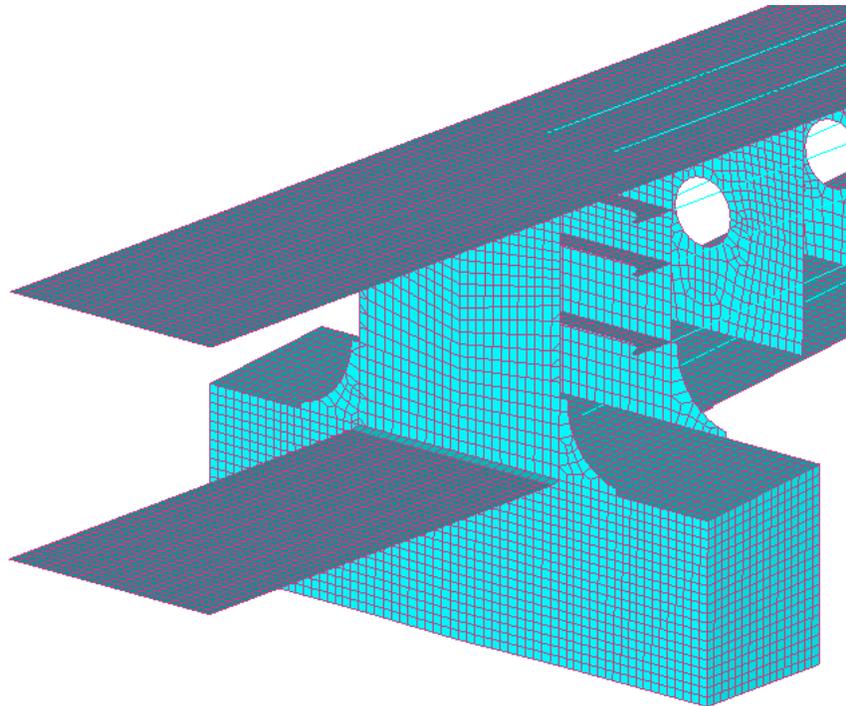
Find

Set Parameter

Check on Weld Design

OK

Cancel



It is possible to select properties manually in Femap by elements to add a not welded combination

# Recognize welds

1 Press *Find*.

2 Press *Close*.

3 Press *Weld Strength Settings*.

Check weld design

Unable to recognize weld parameters automatically. Welds that match one of the following criteria are displayed:

#	Type	Description	Issue
1	Warning	All weld parts in a weld are welded	Continuous parts in real model will be treated as welded
2	Warning	Different weld part lengths in a weld	Different area of the weld that will lead to stress variation
3	Error	Length of any weld part of a weld is zero	Possible mesh discontinuity. Weld area is 0

ID	Title	Nodes	Elements	Length	Criterion	Welded	Non-Welded
75	Weld 75 [-30.11; 12.75; 5.47]	25	72	1.010002	1	3	0
187	Weld 187 [-29.77; 12.27; 5.47]	9	24	0.336667	1	3	0
188	Weld 188 [-30.11; 12.27; 5.47]	9	24	0.336664	1	3	0
189	Weld 189 [-30.44; 12.27; 5.47]	9	24	0.336667	1	3	0

Set welded parts by elements    Set non-welded parts by elements    Close

Welds Finder

Welds    Weld Strength Settings    Hot Spot Stress

Filter: None    =    Apply Filter    Find Weld by ID    Navigate

ID	Title	Tensile Strength (Min) [Pa]	Yield Stress (Min) [Pa]	Is Symmetric	Is curved	Nodes	Elements	Weld Parts
1	Weld 1 [-29.6; 12.38; 11.53]	0	0	Yes	No	6	15	3
2	Weld 2 [-29.6; 12.38; 11.53]	0	0	Yes	No	6	15	3
3	Weld 3 [-29.6; 12.06; 11.53]	0	0	Yes	No	6	15	3
4	Weld 4 [-30.61; 12.6; 11.53]	0	0	Yes	No	6	15	3
5	Weld 5 [-30.61; 12.38; 11.53]	0	0	Yes	No	6	15	3
6	Weld 6 [-30.61; 12.06; 11.53]	0	0	Yes	No	6	15	3
7	Weld 7 [-29.6; 11.29; 12.1]	0	0	Yes	No	21	60	3
8	Weld 8 [-29.6; 11.84; 12.1]	0	0	Yes	No	7	30	4
9	Weld 9 [-29.6; 12.38; 12.09]	0	0	Yes	No	21	60	3
10	Weld 10 [-30.61; 11.29; 12.1]	0	0	Yes	No	21	60	3
11	Weld 11 [-30.61; 11.83; 12.09]	0	0	Yes	No	10	39	4
12	Weld 12 [-30.61; 12.38; 12.09]	0	0	Yes	No	21	60	3
13	Weld 13 [-29.59; 12.27; 5.47]	0	0	Yes	No	2	2	2
14	Weld 14 [-30.62; 12.27; 5.47]	0	0	Yes	No	2	2	2
15	Weld 15 [-29.6; 11.2; 11.43]	0	0	Yes	No	15	42	3
16	Weld 16 [-29.6; 12.22; 11.43]	0	0	Yes	No	7	18	3
17	Weld 17 [-29.6; 12.49; 11.43]	0	0	Yes	No	7	18	3
18	Weld 18 [-29.6; 12.67; 11.43]	0	0	Yes	No	5	12	3
19	Weld 19 [-30.11; 11.67; 12.1]	0	0	No	No	25	97	4
20	Weld 20 [-30.61; 11.2; 11.43]	0	0	Yes	No	15	42	3
21	Weld 21 [-30.61; 12.22; 11.43]	0	0	Yes	No	7	18	3
22	Weld 22 [-30.61; 12.49; 11.43]	0	0	Yes	No	7	18	3
23	Weld 23 [-30.61; 12.67; 11.43]	0	0	Yes	No	5	12	3
24	Weld 24 [-30.11; 12.75; 4.07]	0	0	Yes	No	68	201	3
25	Weld 25 [-29.6; 12.38; 7.79]	0	0	Yes	No	2	3	3
26	Weld 26 [-29.6; 12.38; 7.81]	0	0	Yes	No	2	3	3
27	Weld 27 [-30.61; 12.38; 7.79]	0	0	Yes	No	2	3	3
28	Weld 28 [-30.61; 12.38; 7.81]	0	0	Yes	No	2	3	3
29	Weld 29 [-30.61; 12.38; 2.12]	0	0	Yes	No	2	2	2

Settings    Find    Set Parameter    Check on Weld Design    OK    Cancel

Selection gives a possibility to select a part of the model (group, component) for making changes.

This filter can be used to search the weld(s) due to different parameters (length, thickness, area, weld only, non weld only etc.).

Navigate option in order to find a weld by ID.

Edit, Combine, Split, Export and Remove Weld(s).

Preview selected weld(s).

Plot of selected weld(s) in colors and with labels of IDs (drop-down menu).

The screenshot shows the 'Welds Finder' application window. At the top, there are tabs for 'Welds', 'Weld Strength Settings', and 'Hot Spot Stress'. Below the tabs, the 'Information' section includes a 'Selection' dropdown set to 'All Entities', a 'Display Weld Parts' section with radio buttons for 'All', 'Welded', and 'Non-Welded', and a 'Filter Rule' section with a 'Show all' dropdown and an 'Apply Filter' button. A 'Find Weld by ID' field and a 'Navigate' button are also present. The main area is a table with columns: Weld ID, Title, Length [m], Weld Type, Welded, Csys, t [m], Weld Side, r [m], h [m], s [m], Alpha, and Throat Thickness (a) [m]. The table contains 12 rows of data. Below the table, there are two sections for applying settings to selected weld parts: 'Apply to selected weld parts' and 'Apply to selected weld parts (only for welded parts)'. A dropdown menu is open on the right side, showing various visualization options like 'Welded/non-welded parts', 'Weld parts', 'Welds in colors', etc. The bottom of the window has 'Settings', 'Find', 'OK', and 'Cancel' buttons.

# Weld Finder - Set weld parameters

Set Non-welded only - change selected welded parts by selecting elements on the model.

Set Welded only - change selected non-welded parts by selecting elements on the model.

Restore default data if some of them were assigned incorrectly.

Possibility to apply weld type and dimensions of weld to all selected weld(s) parts.

Possibility to modify or change length, thickness, coordinate system and origin to all selected weld(s) parts.

Welds Finder
Welds | Weld Strength Settings | Hot Spot Stress

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Information

Selection:

Filter Rule:

Display Weld Parts:  All  Welded  Non-Welded

Find Weld by ID:

Current Filter: All Entities; Display Welded Weld Parts; Show all

Weld ID	Title	Length [m]	Weld Type	Welded	Csys	t [m]	Weld Side	r [m]	h [m]	s [m]	Alpha	Throat Thickness (a) [m]
1	Weld Part 1.1 [-29.61; 12.6; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
2	Weld Part 2.1 [-29.61; 12.38; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
3	Weld Part 3.1 [-29.61; 12.06; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
4	Weld Part 4.1 [-30.6; 12.6; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
5	Weld Part 5.1 [-30.6; 12.38; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
6	Weld Part 6.1 [-30.6; 12.06; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
7	Weld Part 7.3 [-29.6; 11.29; 12.09]	0.757	None	Yes	Rotation [180; 0; 90]	0.012						
8	Weld Part 8.1 [-29.6; 11.84; 12.1]	0.337	None	Yes	Rotation [0; 0; -90]	0.012						
8	Weld Part 8.2 [-29.6; 11.84; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
9	Weld Part 9.3 [-29.61; 12.38; 12.09]	0.742	None	Yes	Rotation [179.56; -89.95; 90]	0.015						
10	Weld Part 10.3 [-30.61; 11.29; 12.09]	0.757	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.1 [-30.61; 11.83; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.2 [-30.61; 11.83; 12.11]	0.337	None	Yes	Rotation [0; 0; -90]	0.012						

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Apply to selected weld parts

Set Welded / Non-Welded:

Length [m]:

Weld part thickness (t) [m]:

Csys:

Origin:

Weld Side:

Apply to selected weld parts (only for welded parts)

Weld Type:

Apply by sizes  Apply by throat thickness (a)

Weld leg horizontal (r) [m]:   Throat thickness (a) [m]:

Weld leg vertical (h) [m]:   Set a = t / 2

Penetration depth (s) [m]:   Override type:

Side By Weld Part Csys:

Side By Direction:

10

<https://sdcverifier.com>

# Set welded parts by elements

1

Select all welds part by pressing **Ctrl+A** keys combination.

2

Press **Set welded parts by elements** to find weld parts by elements and include them in weld strength calculations (also this command could be performed for few or single weld part).

1

Welds Finder

Welds Weld Strength Settings Hot Spot Stress

Information

Selection: All Entities  Display Weld Parts:  All  Welded  Non-Welded

Filter Rule: Show all   Find Weld by ID:

Current Filter: All Entities; Display Welded Weld Parts; Show all

Weld ID	Title	Length [m]	Weld Type	Welded	Csyz	t [m]	Weld Side	r [m]	h [m]	s [m]	Alpha	Throat Thickness (a) [m]
1	Weld Part 1.1 [-29.61; 12.6; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
2	Weld Part 2.1 [-29.61; 12.38; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
3	Weld Part 3.1 [-29.61; 12.06; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
4	Weld Part 4.1 [-30.6; 12.6; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
5	Weld Part 5.1 [-30.6; 12.38; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
6	Weld Part 6.1 [-30.6; 12.06; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
7	Weld Part 7.3 [-29.6; 11.29; 12.09]	0.757	None	Yes	Rotation [180; 0; 90]	0.012						
8	Weld Part 8.1 [-29.6; 11.84; 12.1]	0.337	None	Yes	Rotation [0; 0; -90]	0.012						
8	Weld Part 8.2 [-29.6; 11.84; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
9	Weld Part 9.3 [-29.61; 12.38; 12.09]	0.742	None	Yes	Rotation [179.56; -89.95; 90]	0.015						
10	Weld Part 10.3 [-30.61; 11.29; 12.09]	0.757	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.1 [-30.61; 11.83; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.2 [-30.61; 11.83; 12.11]	0.337	None	Yes	Rotation [0; 0; 90]	0.012						

Restore Default **Set Welded Parts by Elements** Set Non-Welded Parts by Elements

Apply to selected weld parts

Set Welded / Non-Welded: Yes

Length [m]: 0

Weld part thickness (t) [m]: 0

Csyz: [0;0;0]

Origin: [0;0;0]

Weld Side: +Y

Apply to selected weld parts (only for welded parts)

Weld Type: None

Apply by sizes  Apply by throat thickness (a)

Weld leg horizontal (r) [m]: 0

Weld leg vertical (h) [m]: 0

Penetration depth (s) [m]: 0

Side By Weld Part Csyz: +Y

Side By Direction: [0, 0, 0]

Throat thickness (a) [m]:

Set a = t / 2

Override type: All

2

# Set weld part type welded (manually)

1

Select **Non-Welded** element(s) which should be changed to **Welded** element(s).

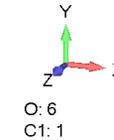
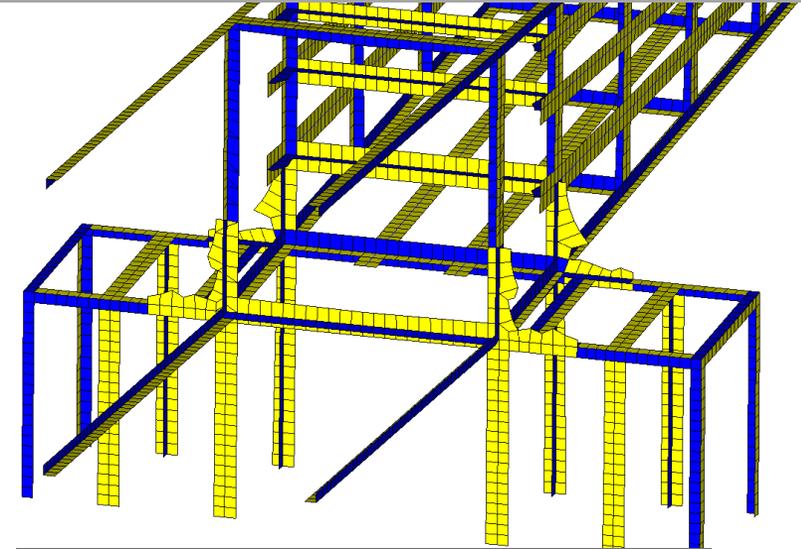
It is sufficient to select only one element from a weld part to pick full part automatically.

2

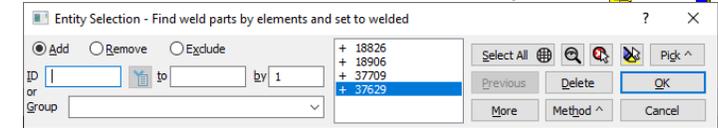
Some text in Trebuchet MS, 14 px in **Bold** or *italic* or ***Bold italic***. Two lines max

3

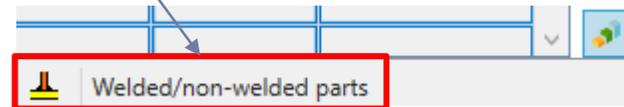
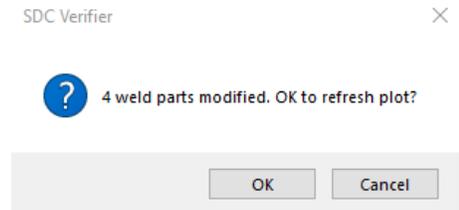
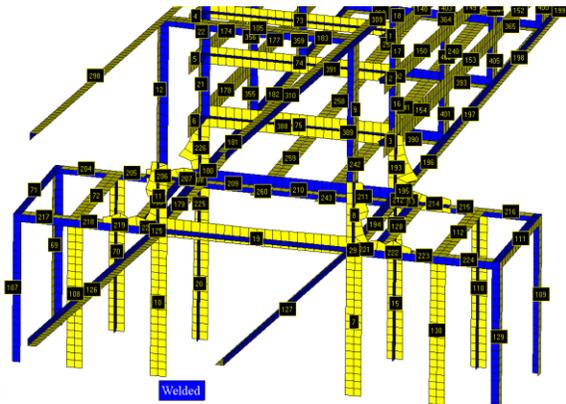
Some text in Trebuchet MS, 14 px in **Bold** or *italic* or ***Bold italic***. Two lines max



O: 6  
C1: 1



In order to get refreshed plot of the weld(s), select all weld parts by using **Ctrl+A** keys combination and choose command **Welded/non-welded parts**



# Set weld parameters

1

Select all weld parts by pressing **Ctrl+A** keys combination.

2

Select the type of weld **Double fillet**.

3

Choose the method: **Apply by throat thickness**.

4

Select **Set  $a = t / 2$**  type (half of thickness welded plate).

5

Press **Apply**.

6

Press **OK**.

For beams elements  $t$  is the minimum thickness of shape. For bars element  $t$  is the minimum of height/width. For plates element  $t$  is a plate thickness.

Welds Finder

Welds Weld Strength Settings Hot Spot Stress

Information

Selection: All Entities

Display Weld Parts:  All  Welded  Non-Welded

Filter Rule: Show all +Y

Apply Filter Find Weld by ID: Navigate

Current Filter: All Entities; Display Welded Weld Parts; Show all

Weld ID	Title	Length [m]	Weld Type	Welded	Csys	t [m]	Weld Side	r [m]	h [m]	s [m]	Alpha	Throat Thickness (a) [m]
1	Weld Part 1.1 [-29.61; 12.6; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
2	Weld Part 2.1 [-29.61; 12.38; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
3	Weld Part 3.1 [-29.61; 12.06; 11.53]	0.205	None	Yes	Rotation [-180; -90; 0]	0.008						
4	Weld Part 4.1 [-30.6; 12.6; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
5	Weld Part 5.1 [-30.6; 12.38; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
6	Weld Part 6.1 [-30.6; 12.06; 11.53]	0.205	None	Yes	Rotation [0; 90; 0]	0.008						
7	Weld Part 7.3 [-29.6; 11.29; 12.09]	0.757	None	Yes	Rotation [180; 0; 90]	0.012						
8	Weld Part 8.1 [-29.6; 11.84; 12.1]	0.337	None	Yes	Rotation [0; 0; -90]	0.012						
9	Weld Part 8.2 [-29.6; 11.84; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
10	Weld Part 10.3 [-30.61; 11.29; 12.09]	0.757	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.1 [-30.61; 11.83; 12.09]	0.337	None	Yes	Rotation [-180; 0; 90]	0.012						
11	Weld Part 11.2 [-30.61; 11.83; 12.1]	0.337	None	Yes	Rotation [0; 0; -90]	0.012						

SDC Verifier

Weld type will be changed in 462 welded parts. OK to continue?

OK Cancel

Apply to selected weld parts

Set Welded / Non-Welded: Yes Apply

Length [m]: 0 Apply

Weld part thickness (t) [m]: 0 Apply

Csys: [0;0;0] Apply

Origin: [0;0;0] Apply

Weld Side: +Y Apply

Apply to selected weld parts (only for welded parts)

Weld Type: Double fillet

Apply by sizes

Apply by throat thickness (a)

Weld leg horizontal (r) [m]: 0

Weld leg vertical (h) [m]: 0

Penetration depth (s) [m]: 0

Override type: All

Side By Weld Part Csys +Y

Side By Direction [0, 0, 0]

Alpha=45°

t

h

s=0

r

Apply

Settings Find OK Cancel

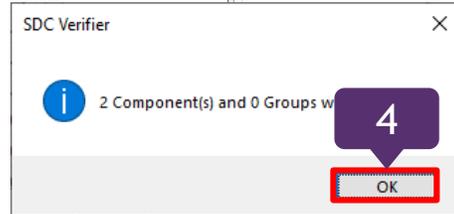
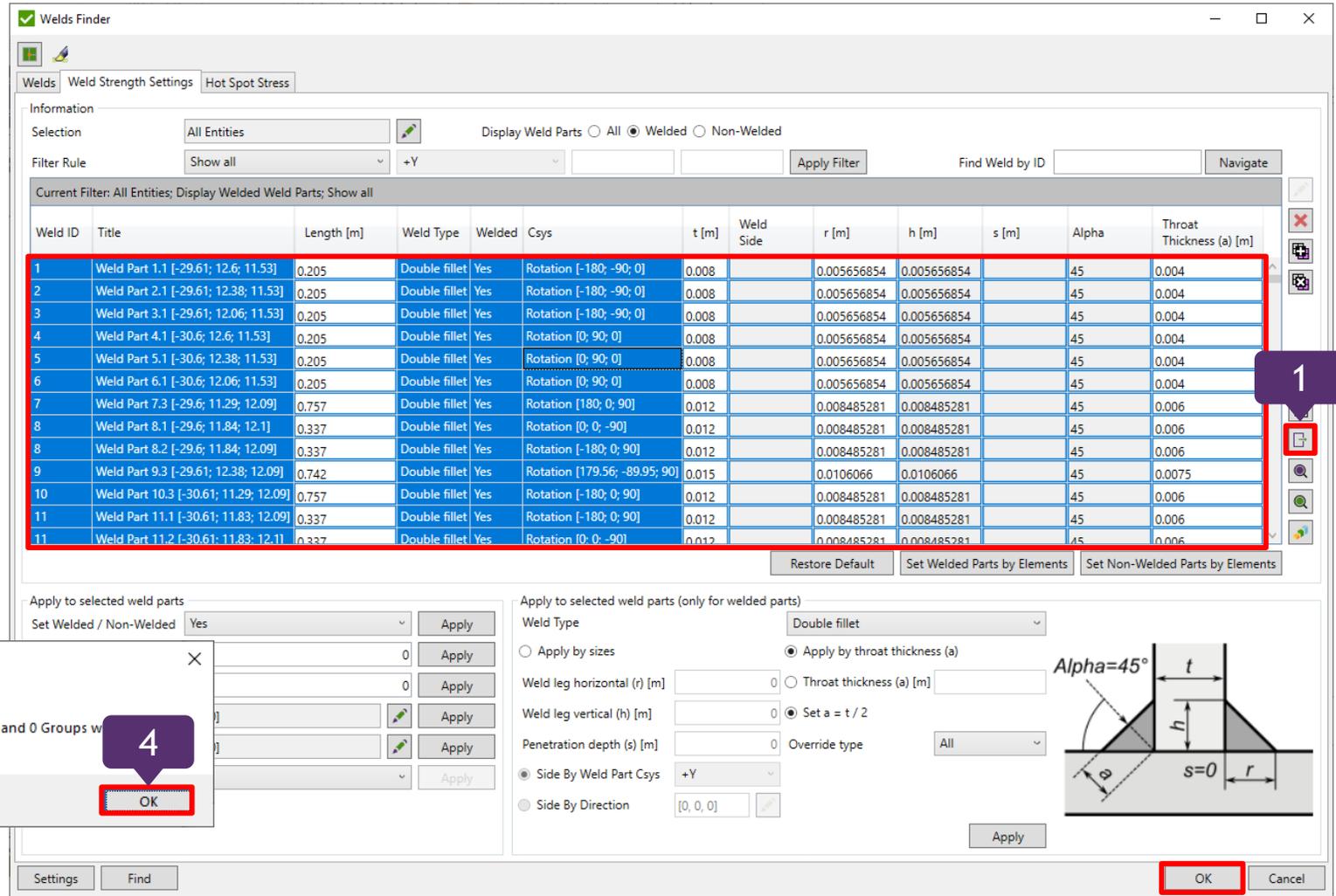
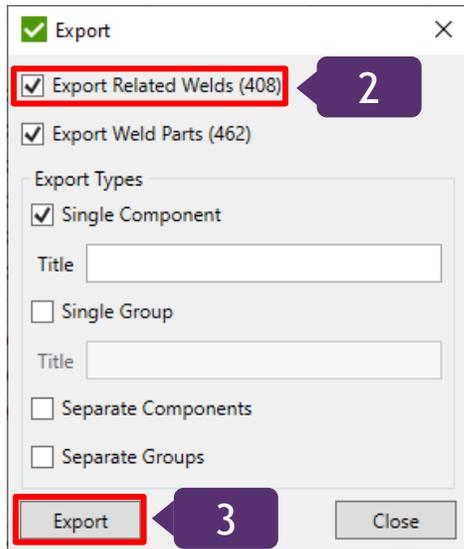
# Export Welds

1 Press *Export weld*.

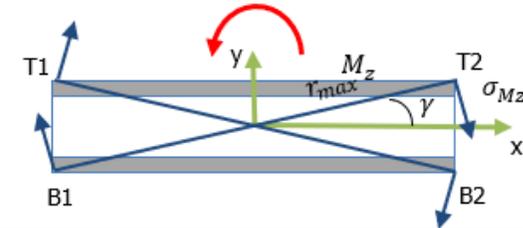
2 Select *Export welds*.

3 Press *Export*.

4 Press *OK* twice.



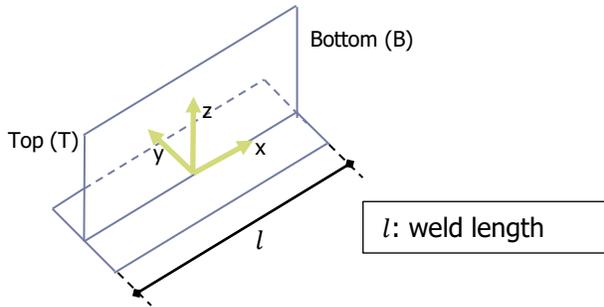
Moments depend on the axis in a weld plane and are also included in the weld strength calculations



The stresses  $\tau_{||}$ ,  $\sigma_{\beta}$  and  $\tau_{\beta}$  are evaluated at the points T1, T2, B1 and B2 as follows:

Stress calculations

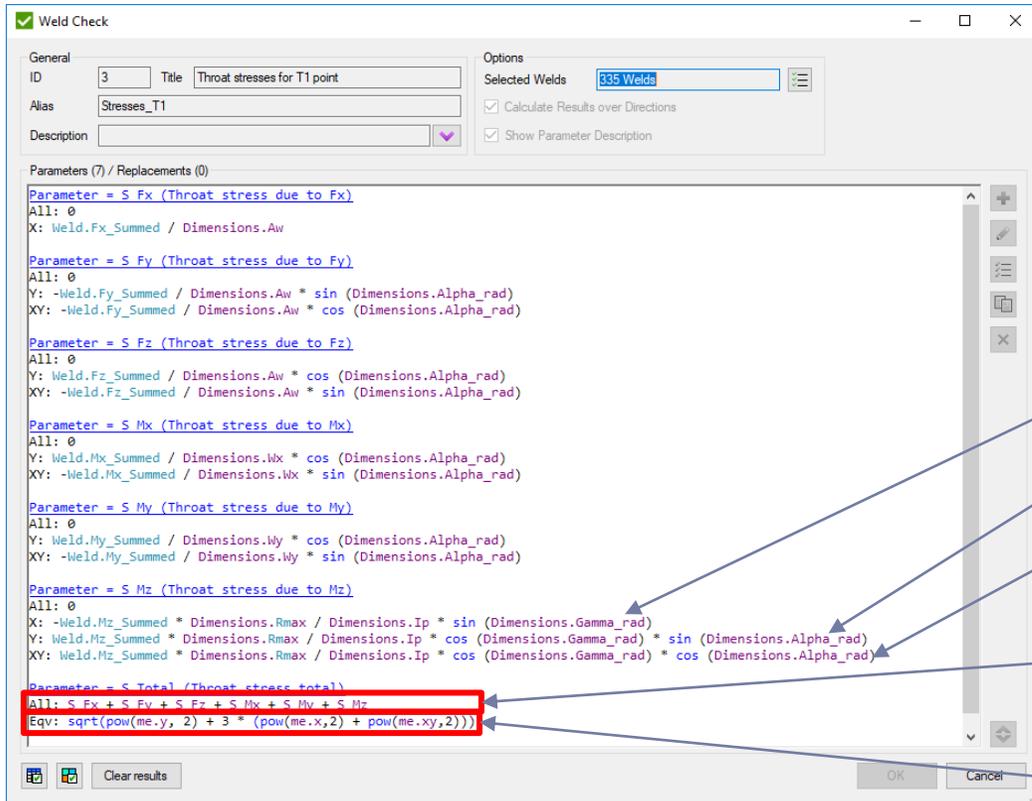
$\tau_{||}$  = shear design stress (in plane of the throat) parallel to the axis of the weld (equal to X direction in the check);  
 $\sigma_{\perp}$  = normal design stress perpendicular to the throat (equal to Y direction of the check);  
 $\tau_{\perp}$  = shear design stress (in plane of the throat) perpendicular to the axis of the weld (equal to XY direction of the check)



Angles matrix of rotations due to weld throat plane.

$\tau_{  ,T1}$	1	0	0	0	0	$-\sin \gamma$
$\sigma_{\perp,T1}$	0	$-\sin \alpha$	$\cos \alpha$	$\cos \alpha$	$\cos \alpha$	$\cos \gamma * \sin \alpha$
$\tau_{\perp,T1}$	0	$-\cos \alpha$	$-\sin \alpha$	$-\sin \alpha$	$-\sin \alpha$	$\cos \gamma * \cos \alpha$
$\tau_{  ,T2}$	1	0	0	0	0	$-\sin \gamma$
$\sigma_{\perp,T2}$	0	$-\sin \alpha$	$\cos \alpha$	$\cos \alpha$	$-\cos \alpha$	$-\cos \gamma * \sin \alpha$
$\tau_{\perp,T2}$	0	$-\cos \alpha$	$-\sin \alpha$	$-\sin \alpha$	$\sin \alpha$	$-\cos \gamma * \cos \alpha$
$\tau_{  ,B1}$	1	0	0	0	0	$\sin \gamma$
$\sigma_{\perp,B1}$	0	$\sin \alpha$	$\cos \alpha$	$-\cos \alpha$	$\cos \alpha$	$-\cos \gamma * \sin \alpha$
$\tau_{\perp,B1}$	0	$\cos \alpha$	$-\sin \alpha$	$\sin \alpha$	$-\sin \alpha$	$-\cos \gamma * \cos \alpha$
$\tau_{  ,B2}$	1	0	0	0	0	$\sin \gamma$
$\sigma_{\perp,B2}$	0	$\sin \alpha$	$\cos \alpha$	$-\cos \alpha$	$-\cos \alpha$	$\cos \gamma * \sin \alpha$
$\tau_{\perp,B2}$	0	$\cos \alpha$	$-\sin \alpha$	$\sin \alpha$	$\sin \alpha$	$\cos \gamma * \cos \alpha$

$\frac{F_x}{A_w}$   
 $\frac{F_y}{A_w}$   
 $\frac{F_z}{A_w}$   
 $\frac{M_x}{I_x} d_y$   
 $\frac{M_y}{I_y} d_x$   
 $\frac{M_z * r_{max}}{I_p}$


 $\tau_{||,Mz}$ 
 $\sigma_{\beta,Mz}$ 
 $\tau_{\beta,Mz}$ 

$$\tau_{||} = \tau_{||,Fx} + \tau_{||,Fy} + \tau_{||,Fz} + \tau_{||,Mx} + \tau_{||,My} + \tau_{||,Mz}$$

$$\sigma_{\beta} = \sigma_{\beta,Fx} + \sigma_{\beta,Fy} + \sigma_{\beta,Fz} + \sigma_{\beta,Mx} + \sigma_{\beta,My} + \sigma_{\beta,Mz}$$

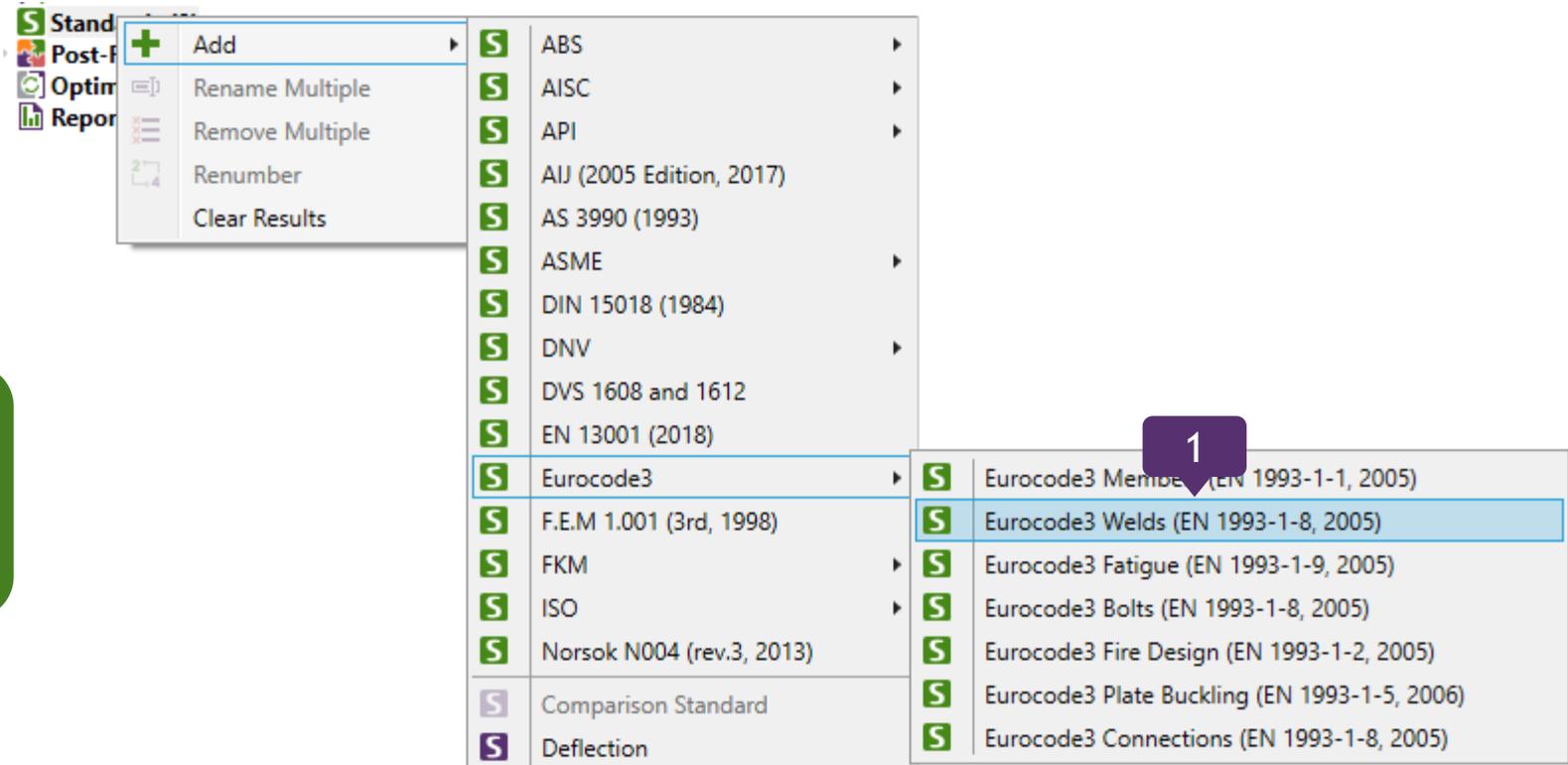
$$\tau_{\beta} = \tau_{\beta,Fx} + \tau_{\beta,Fy} + \tau_{\beta,Fz} + \tau_{\beta,Mx} + \tau_{\beta,My} + \tau_{\beta,Mz}$$

Von Mises stress at certain point.

$$\sigma_{VM} = \sqrt{\sigma_I^2 + 3 * (\tau_I^2 + \tau_{||}^2)}$$

1

Execute **Add => Eurocode3 Weld (EN 1993-1-8. 2005)** in the Standards context menu.



Eurocode3 Weld (EN 1993-1-8. 2005) Design of joints is implemented to verify the structure stability of each structural member (weld).

Weld Selection gives a possibility to include or exclude weld(s), preview chosen weld(s) or go to weld finder.

- 1 Press the button to select the Correction factor.
- 2 Select the material for which the Correction factor will be applied.
- 3 Input value of the Correction factor according to the table 4.1, and press Apply to selected.
- 4 Press OK.

Table 4.1: Correlation factor  $\beta_w$  for fillet welds

Standard and steel grade			Correlation factor $\beta_w$
EN 10025	EN 10210	EN 10219	
S 235 S 235 W	S 235 H	S 235 H	0,8
S 275 S 275 N/NL S 275 M/ML	S 275 H S 275 NH/NLH	S 275 H S 275 NH/NLH S 275 MH/MLH	0,85
S 355 S 355 N/NL S 355 M/ML S 355 W	S 355 H S 355 NH/NLH	S 355 H S 355 NH/NLH S 355 MH/MLH	0,9
S 420 N/NL S 420 M/ML		S 420 MH/MLH	1,0
S 460 N/NL S 460 M/ML S 460 Q/QL/QL1	S 460 NH/NLH	S 460 NH/NLH S 460 MH/MLH	1,0

1

Press the button  to apply **Material Yield and Tensile** parameters.

2

Select the material for which the **Properties** will be applied.

3

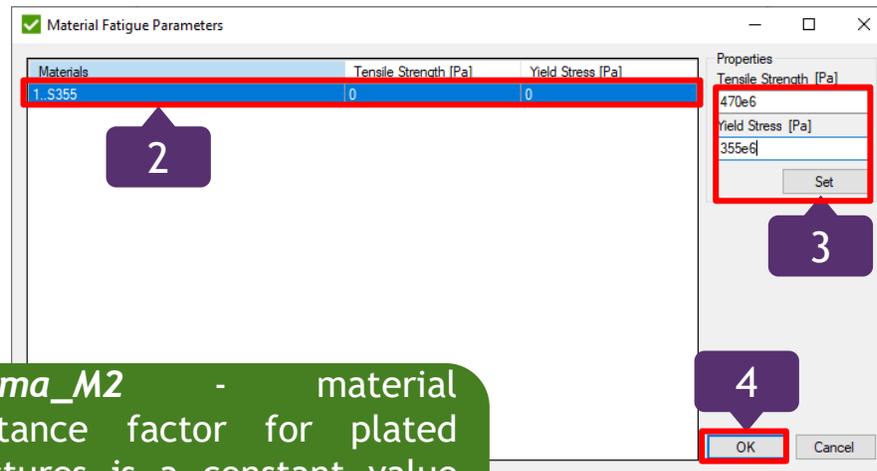
Input value of the **Material Yield and Tensile** parameters, and press *Set*.

4

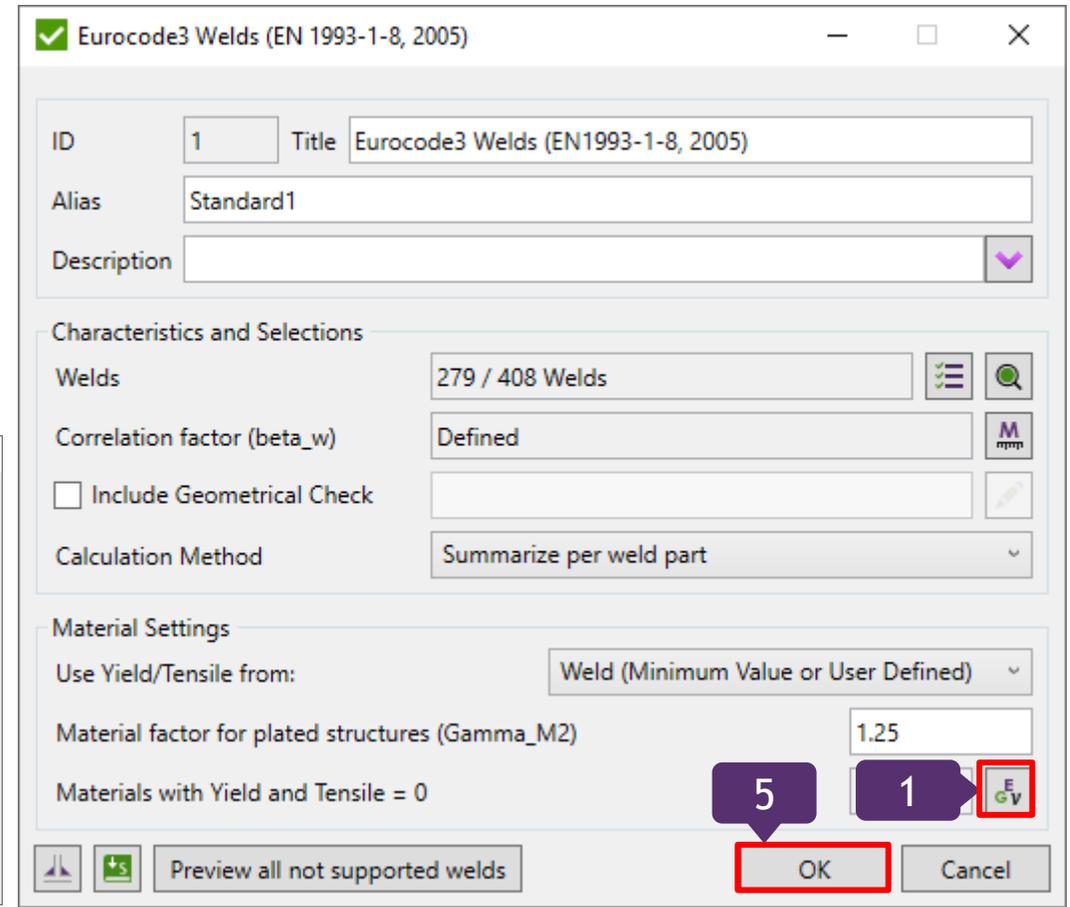
Press *OK*.

5

Press *OK*.



**Gamma\_M2** - material resistance factor for plated structures is a constant value (=1.25) and used in calculations to check a base material strength.



# Create extreme table

1

Execute **Extreme Table** in the **Weld Check Total** context menu.

2

Press the  button and select **Load Group 1**

3

Press **OK**.

4

Selection: **All Entities**.

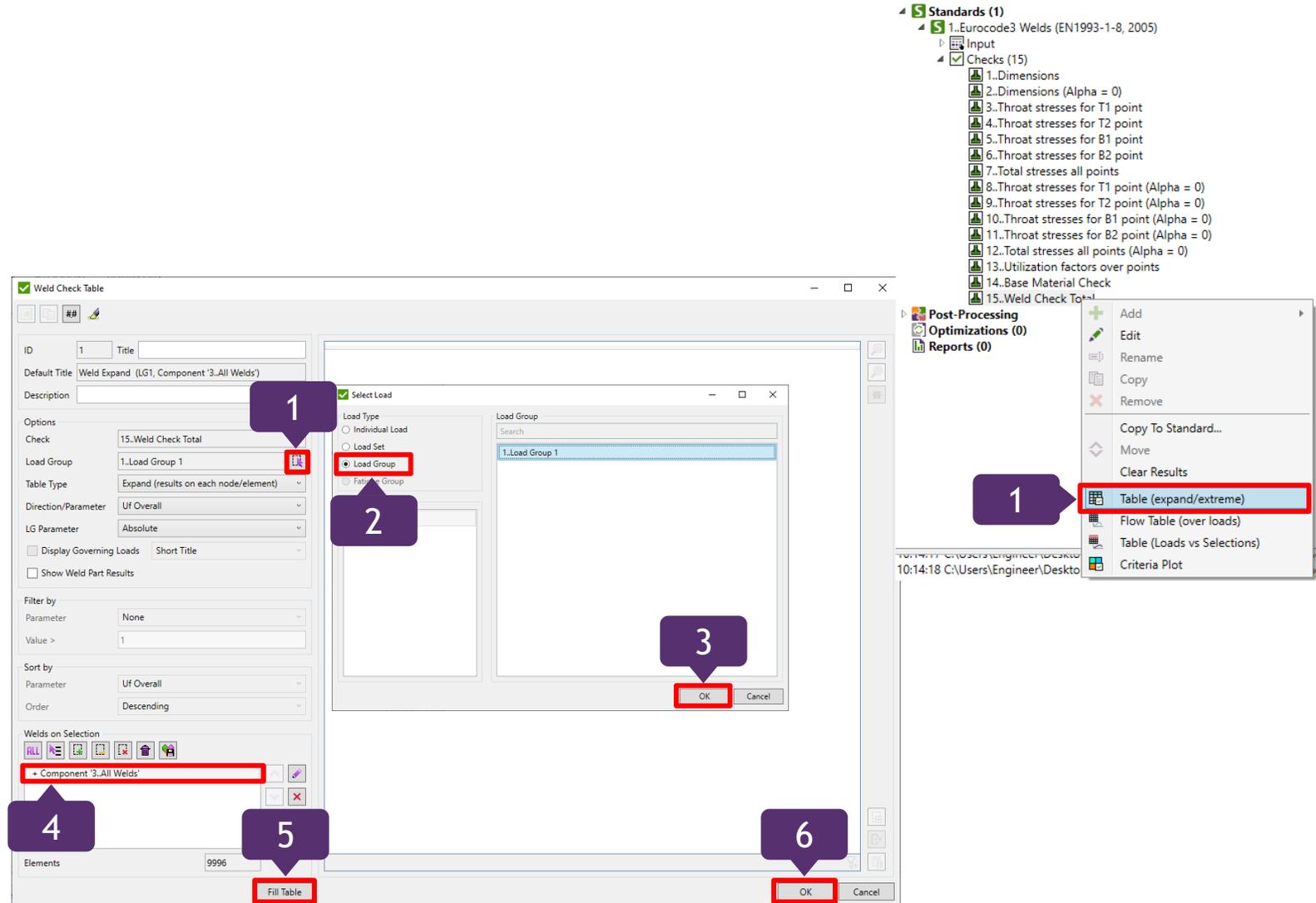
5

Press **Fill Table**.

6

Press **OK**.

Extreme table for '1..Load Group 1' can be added to DNV OS-C101 and DNV OS-C201 standards respectively.



The screenshot shows the 'Weld Check Table' dialog box in SDC Verifier. The dialog has the following fields and buttons:

- ID: 1, Title: [empty]
- Default Title: Weld Expand (LG1, Component '3.All Welds')
- Description: [empty]
- Options: Check: 15..Weld Check Total, Load Group: 1..Load Group 1, Table Type: Expand (results on each node/element), Direction/Parameter: Uf Overall, LG Parameter: Absolute, Display Governing Loads: Short Title, Show Weld Part Results: [unchecked]
- Filter by: Parameter: None, Value: 1
- Sort by: Parameter: Uf Overall, Order: Descending
- Welds on Selection: Component '3.All Welds' (highlighted with a red box and callout 4)
- Buttons: Fill Table (callout 5), OK (callout 6), Cancel

The 'Select Load' dialog box is also visible, showing 'Load Group' selected (callout 2) and 'OK' button (callout 3).

The context menu is open over the 'Table (expand/extreme)' option (callout 1), with other options like 'Table (Loads vs Selections)' and 'Criteria Plot' also visible.

# Create criteria plot

1 Execute Criteria Plot in the Weld Strength Check context menu

2 Load: Load Group 1;  
Parameter: UF Overall.

3 Press Save as component.

4 Name All Welds.

5 Press the  to preview Plot in Femap

6 Press OK.

Criteria plot for '1..Load Group 1' can be added to DNV OS-C101 and DNV OS-C201 standards respectively.

1

2

3

4

5

6

1

2

3

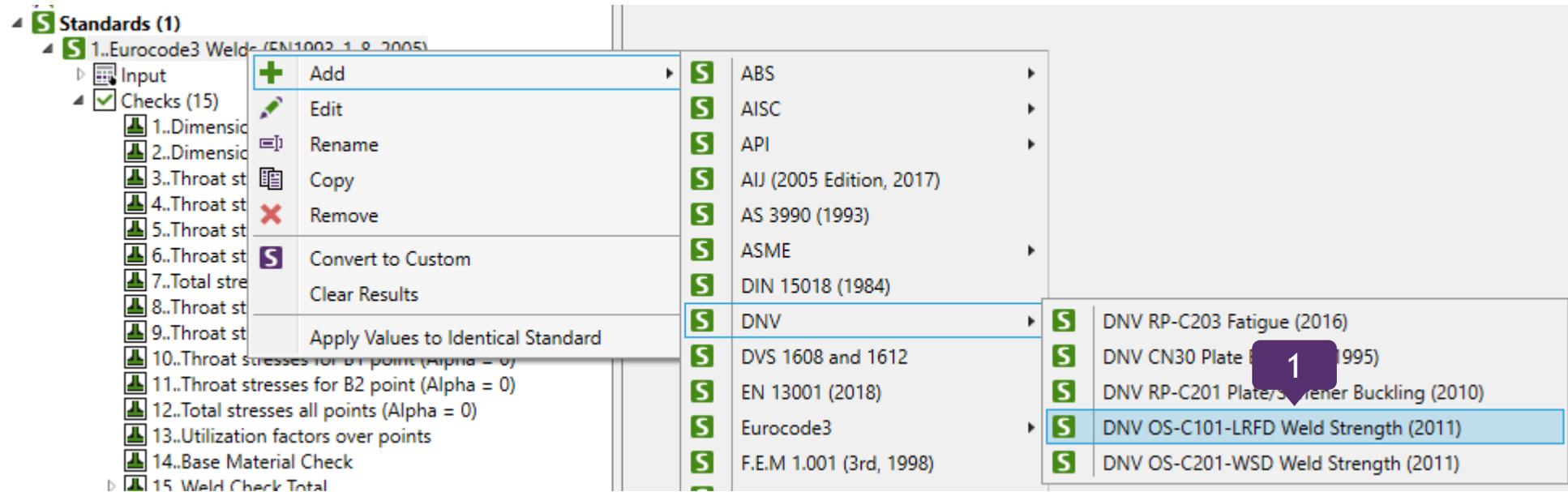
4

5

6

1

Execute *Criteria Plot* in the *Weld Strength Check* context menu



The offshore standard *DNV OS-C101* (released in April, 2011) verifies structural stability for each structural member (weld).

Weld Selection gives a possibility to include or exclude weld(s), preview chosen weld(s) or go to weld finder.

1

Press the button  to select **Correction factor**.

2

Select the material for which the **Correction factor** will be applied.

3

Input value of the **Correction factor** according to the table, and press *Apply to selected*.

4

Press *OK*.

5

Press *OK*.

6

Make same action as in slide 20-21 for **DNV OS-C101-LRFD Weld Strength (2011)**

The screenshot shows two windows from the SDC Verifier software. The 'Materials Characteristics' window (left) has a table with the following data:

Material	Value
1.S355	0.86

The 'DNV OS-C101-LRFD Weld Strength (2011)' window (right) shows a 'Welds' field with '279 / 408 Welds' and an 'OK' button. Below the dialog is a table:

Steel grade	Lowest ultimate tensile strength $f_u$	Correlation factor $\beta_w$
NV NS	400	0.83
NV 27	400	0.83
NV 32	440	0.86
NV 36	490	0.89
NV 40	510	0.9
NV 420	530	1.0
NV 460	570	1.0

Numbered callouts 1-6 point to specific UI elements: 1. 'M' icon in 'Materials Characteristics' dialog; 2. '1.S355' material row; 3. '0.86' value input field; 4. 'Apply to selected' button; 5. 'OK' button in 'Materials Characteristics' dialog; 6. 'OK' button in 'DNV OS-C101-LRFD Weld Strength (2011)' dialog.

DNV OS-C101-LRFD Weld Strength (2011)

ID: 2 Title: DNV OS-C101-LRFD Weld Strength (2011)

Alias: Standard2

Description: [dropdown]

Characteristics and Selections

Welds: 279 / 408 Welds

Correlation factor (beta\_w): Defined

Include Geometrical Check

Calculation Method: Summarize per weld part

Material Settings

Use Yield/Tensile from: Weld (Minimum Value or User Defined)

Limit state: ULS

Material factor for welded connections (Gamma\_Mw): 1.3

Material factor for plated structures (Gamma\_M): 1.15

Materials with Yield and Tensile = 0: 0

Buttons: OK, Cancel, Preview all not supported welds

Gamma\_Mw - material factor that is used for DNV OS C 101 calculation can be found in Table C1, section 9 of the standard.

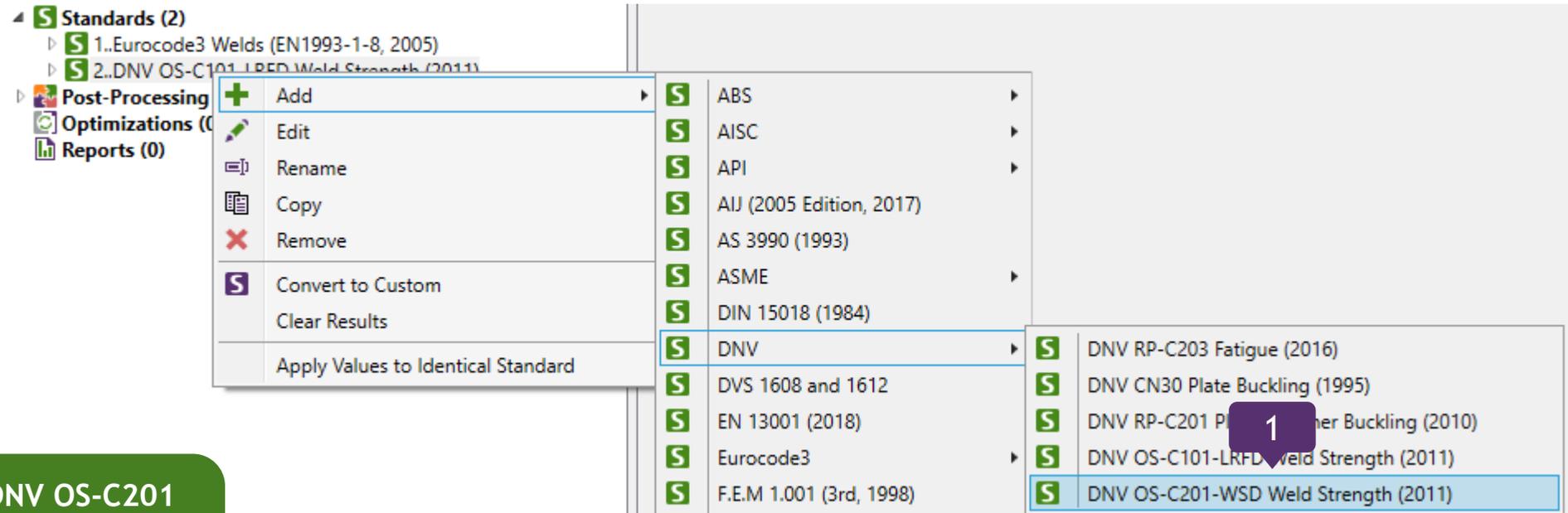
101 The material factors  $\gamma_{Mw}$  for welded connections are given in Table C1.

Limit states	Material factor
ULS	1.3
ALS	1.0

Gamma\_M - material resistance factor for plated structures is a constant value (=1.15) and used in calculations to check base material strength.

1

Execute Add => DNV OS-C201 WSD Weld Strength (2011) in the Standards context menu.



The offshore standard DNV OS-C201 (released in April, 2011) verifies structural stability for each structural member (weld)

Weld Selection gives a possibility to include or exclude weld(s), preview chosen weld(s) or go to weld finder.

- 1
- 2
- 3
- 4
- 5
- 6

Press the button to select **Correction factor**.

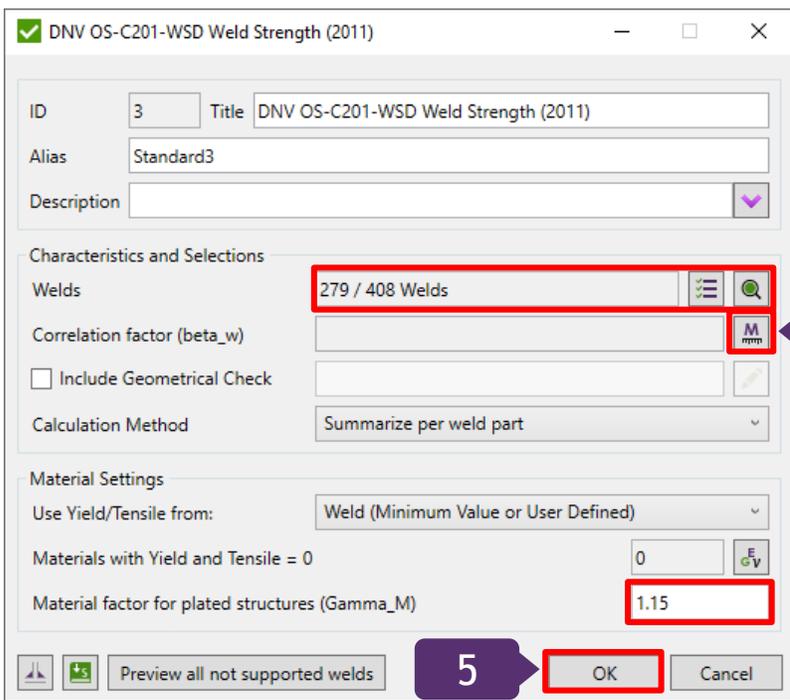
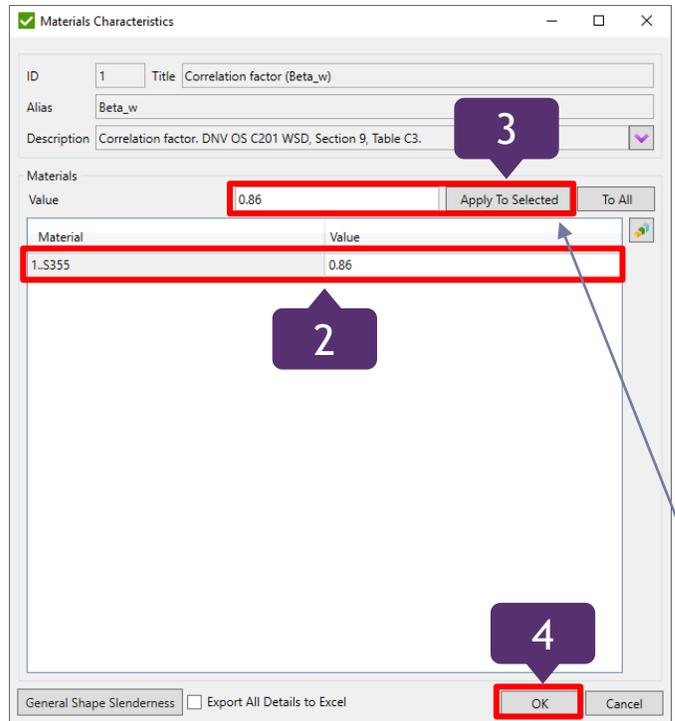
Select the material for which the **Correction factor** will be applied.

Input value of the **Correction factor** according to the table, and press *Apply to selected*.

Press **OK**.

Press **OK**.

Make same action as in slide 20-21 for **DNV OS-C201-WSD Weld Strength (2011)**

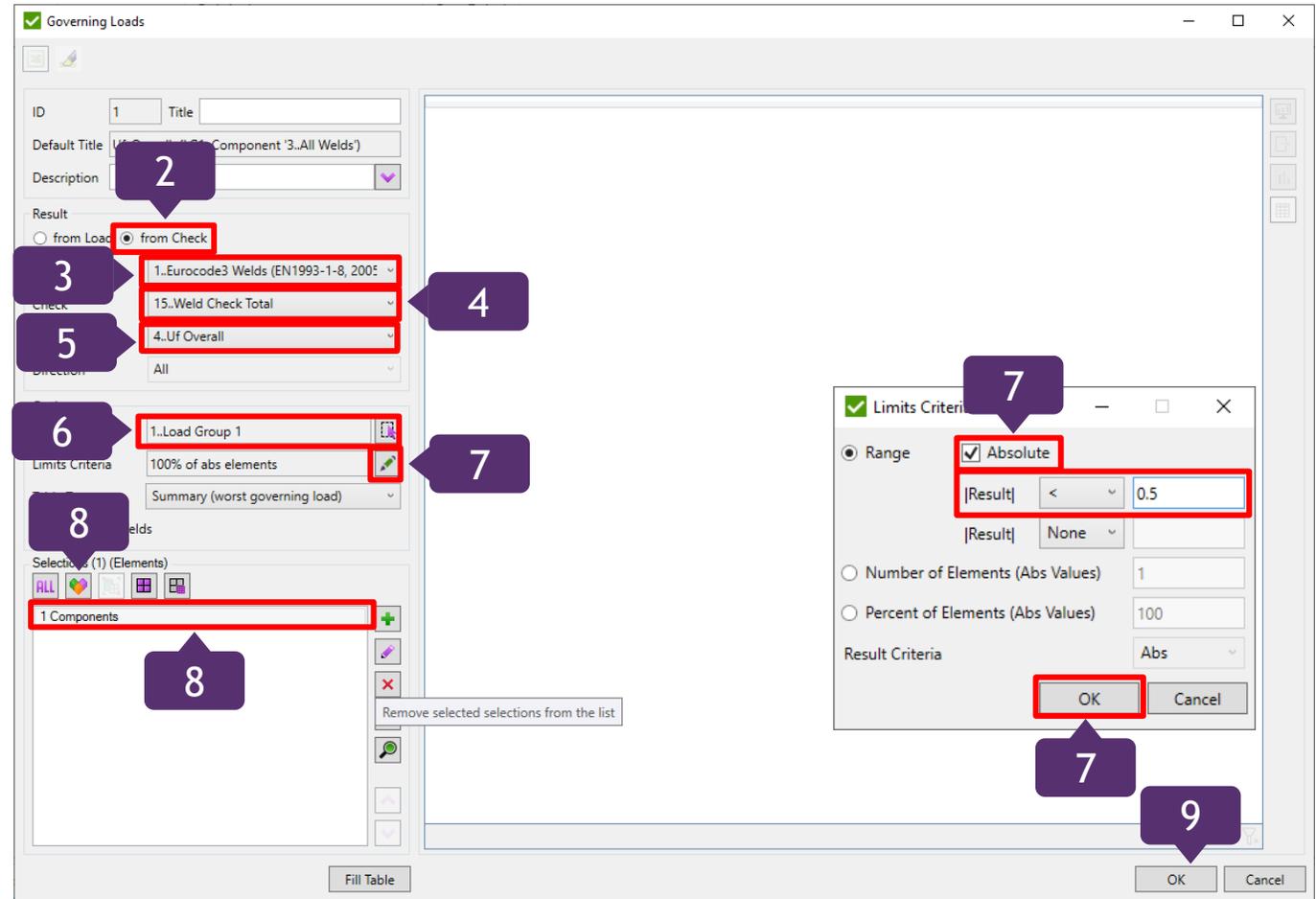
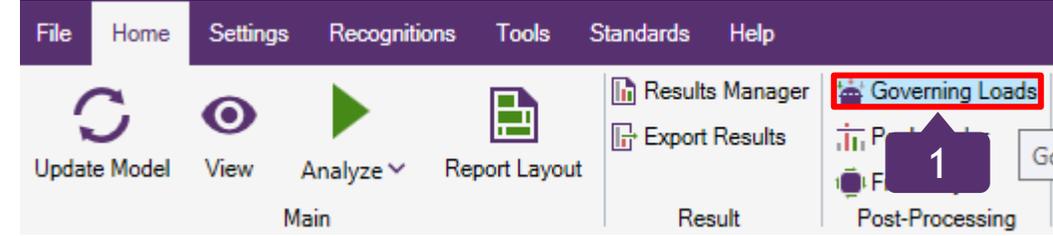


**Gamma<sub>M</sub>** - material resistance factor for plated structures is a constant value (=1.15) and used in calculations to check base material strength.

Steel grade	Lowest ultimate tensile strength $f_u$	Correlation factor $\beta_w$
NV NS	400	0.83
NV 27	400	0.83
NV 32	440	0.86
NV 36	490	0.89
NV 40	510	0.9
NV 420	530	1.0
NV 460	570	1.0

# Add Governing Load

- 1 Post Processing => Governing Loads => Add
- 2 Result: from Check;
- 3 Standard: Eurocode 3 Weld.
- 4 Check: Weld Check Total.
- 5 Parameter: Uf Overall.
- 6 Load Group: Load Group 1.
- 7 Press **Absolute** in Limits Criteria => **Absolute**; **Result < 0.5** => OK
- 8 Selection: **Components** => **All Loads**
- 9 Press **OK**.



1

Make the action as in 27 slide for DNV OS-C101-LRFD Weld Strength (2011)

2

Make the action as in 27 slide for DNV OS-C201-WSD Weld Strength (2011)

## Standards (3)

1..Eurocode3 Welds (EN1993-1-8, 2005)

2..DNV OS-C101-LRFD Weld Strength (2011)

3..DNV OS-C201-WSD Weld Strength (2011)

1

2

## 1 Execute Reports => Add => Designer - Results

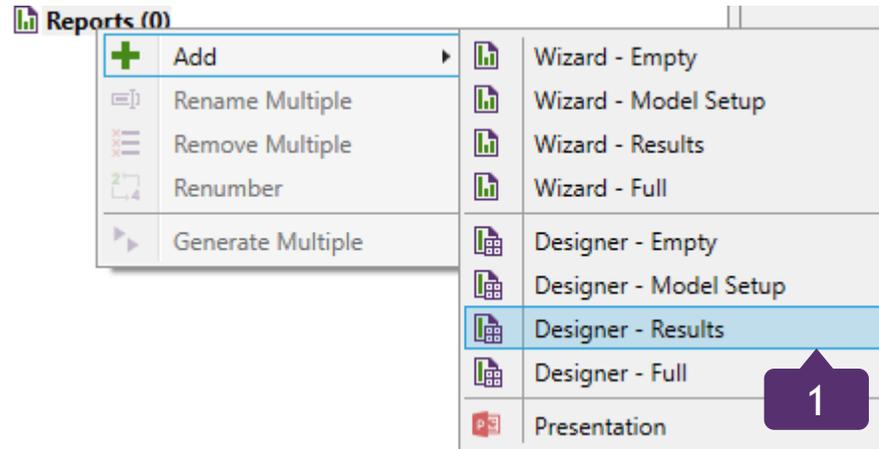
There are 4 templates of the reports:

**Empty** - only first page and preface items are included;

**Model Setup** - description of the model data (materials, properties, components, boundary conditions) is included;

**Results** - for each load extreme displacement tables, stress and displacement plots are included. Predefined tables: sum of reaction forces, stresses/displacements summary tables. In addition all standards are included with a set of tables/plots created in the project;

**Full** - Model Setup + Results + all tables/plots created in jobs.



1

Post Processing => Governing Loads => Import

2

Select Governing Loads(LG1) => OK

3

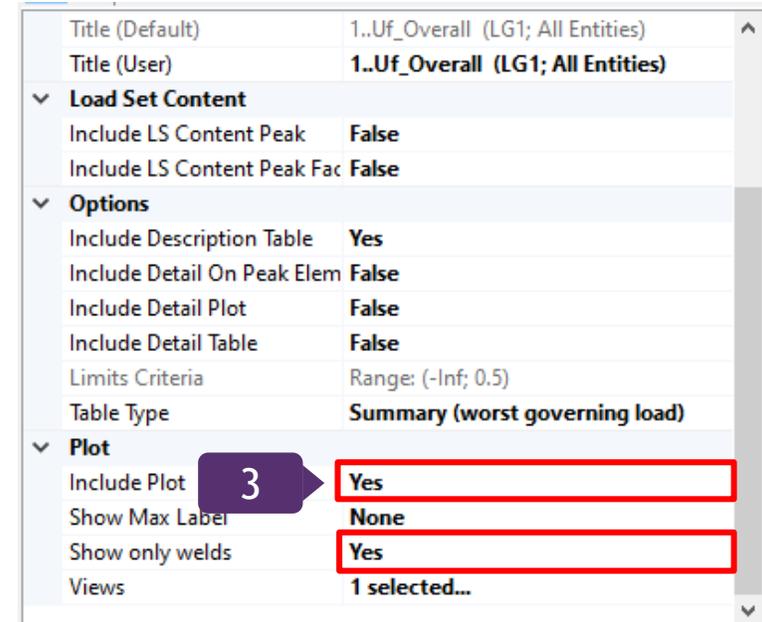
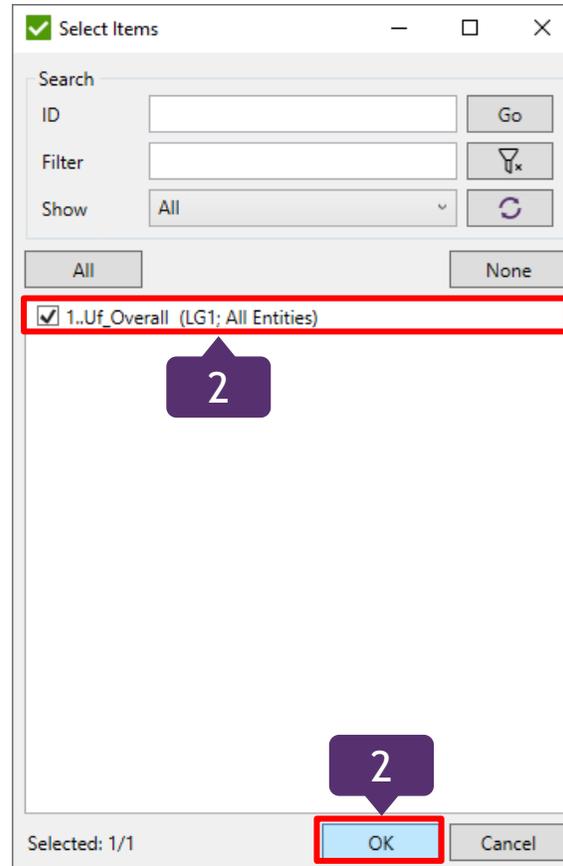
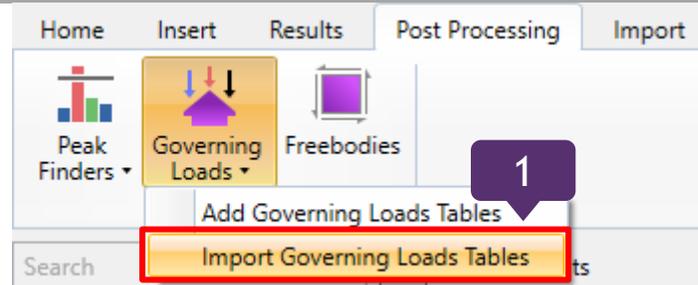
Include Plot: **Yes**.  
Show only welds: **Yes**.

4

Make the same action for DNV OS-C101-LRFD Weld Strength (2011)

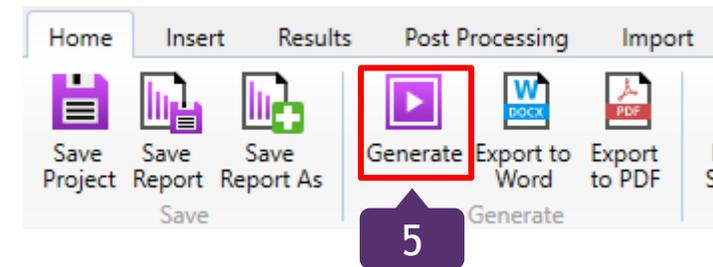
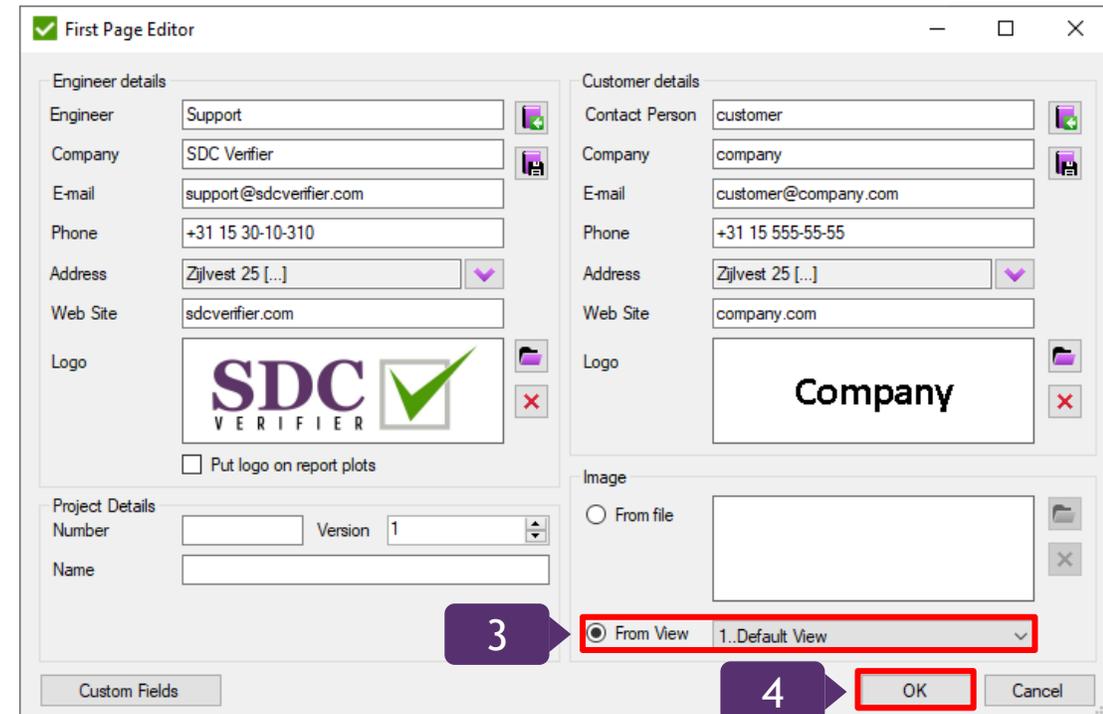
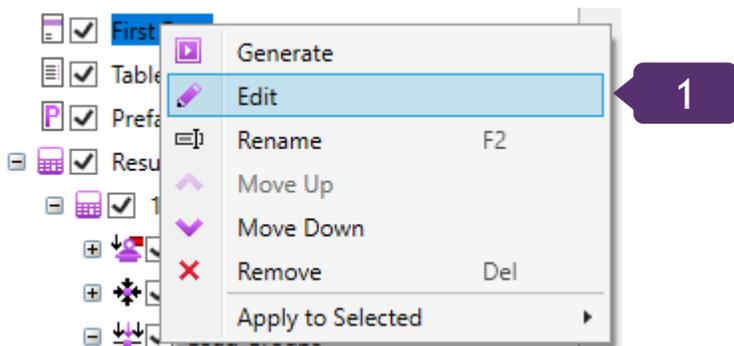
5

Make the same action for DNV OS-C201-WSD Weld Strength (2011)



# Report - First Page

- 1 Right click on *First Page* => **Edit**.
- 2 Fill in information about project.
- 3 Select Image *From View* and pick.
- 4 Press **OK**.
- 5 Press button  to generate report.



## Eurocode3

## DNV OS-C101

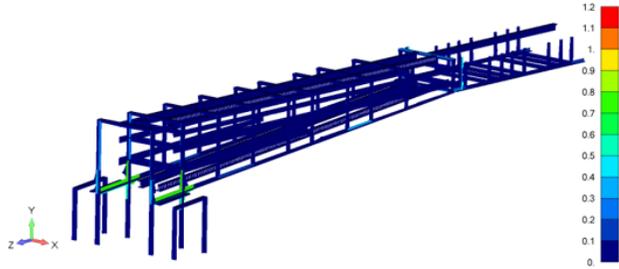
## DNV OS-C201

### Load Group '1...Load Group 1'

#### 1...Eurocode3 Welds (EN1993-1-8, 2005)

Weld Extreme (LG1, All Entities)			
Standard	Load Group	Check Selection	[S1] $f_{weld}$ Weld Check Total
1...Eurocode3 Welds (EN1993-1-8, 2005)	LG1...Load Group 1		All Entities
<b>Extreme</b> All			
Minimum			0.00
Maximum			0.79
Absolute			0.79

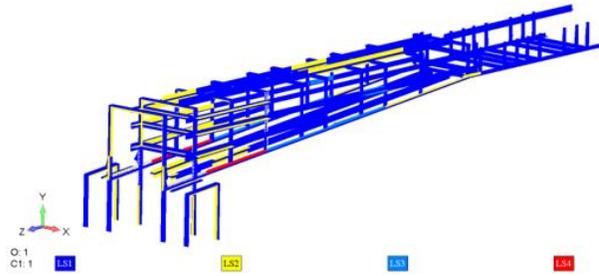
#### 1...Abs Uf Overall (LG1, Component '3..All Welds', v1)



Check Parameter	[S1] $f_{weld}$ Weld Check Total	Load Group Selection	LG1...Load Group 1
View	Absolute Uf Overall		Component '3..All Welds'
	1...Default View		

#### 1...Uf Overall (LG1; Component '3..All Welds')

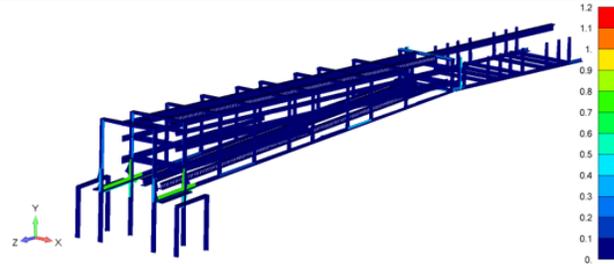
Standard	Check Criteria	Direction Parameter	All
1...Eurocode3 Welds (EN1993-1-8, 2005)	$f_{weld}$ Weld Check Total		
Range: (-inf; 0.5)			
Selection	Elements Count	Peak Entity Id	Peak Value
Component '3..All Welds'	9996 / 9996	5849	0.44
			LS1...Load Set 1



#### 2...DNV OS-C101-LRFD Weld Strength (2011)

Weld Extreme (LG1, Component '3..All Welds')			
Standard	Load Group	Check Selection	[S2] $f_{weld}$ Weld Check Total
2...DNV OS-C101-LRFD Weld Strength (2011)	LG1...Load Group 1		Component '3..All Welds'
<b>Extreme</b> All			
Minimum			0.00
Maximum			0.79
Absolute			0.79

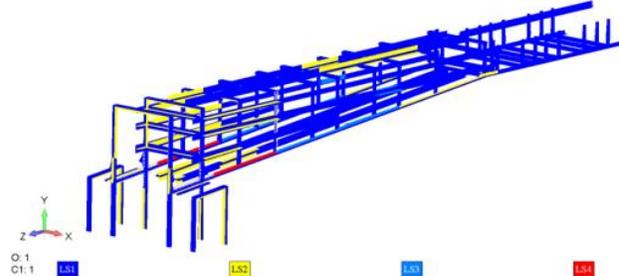
#### 1...Abs Uf Overall (LG1, 279 Welds, v1)



Check Parameter	[S2] $f_{weld}$ Weld Check Total	Load Group Selection	LG1...Load Group 1
View	Absolute Uf Overall		279 Welds
	1...Default View		

#### 2...Uf Overall (LG1; Component '3..All Welds')

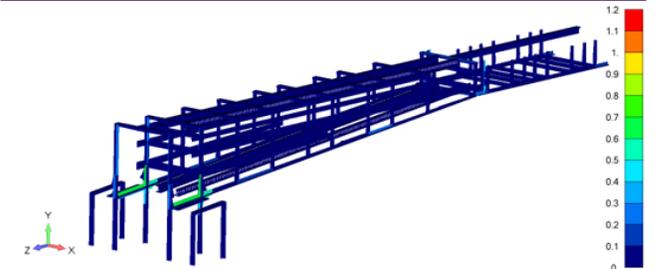
Standard	Check Criteria	Direction Parameter	All
2...DNV OS-C101-LRFD Weld Strength (2011)	$f_{weld}$ Weld Check Total		
Range: (-inf; 0.5)			
Selection	Elements Count	Peak Entity Id	Peak Value
Component '3..All Welds'	9996 / 9996	5849	0.44
			LS1...Load Set 1



#### 3...DNV OS-C201-WSD Weld Strength (2011)

Weld Extreme (LG1, Component '3..All Welds')			
Standard	Load Group	Check Selection	[S3] $f_{weld}$ Weld Check Total
3...DNV OS-C201-WSD Weld Strength (2011)	LG1...Load Group 1		Component '3..All Welds'
<b>Extreme</b> All			
Minimum			0.00
Maximum			0.64
Absolute			0.64

#### 1...Abs Uf Overall (LG1, Component '3..All Welds', v1)



Check Parameter	[S3] $f_{weld}$ Weld Check Total	Load Group Selection	LG1...Load Group 1
View	Absolute Uf Overall		Component '3..All Welds'
	1...Default View		

#### 3...Uf Overall (LG1; Component '3..All Welds')

Standard	Check Criteria	Direction Parameter	All
3...DNV OS-C201-WSD Weld Strength (2011)	$f_{weld}$ Weld Check Total		
Range: (-inf; 0.5)			
Selection	Elements Count	Peak Entity Id	Peak Value
Component '3..All Welds'	9996 / 9996	236	0.49
			LS2...Load Set 2

