



Tutorial

Hot Spot Stresses in BS 7608 Fatigue (2014) Standard

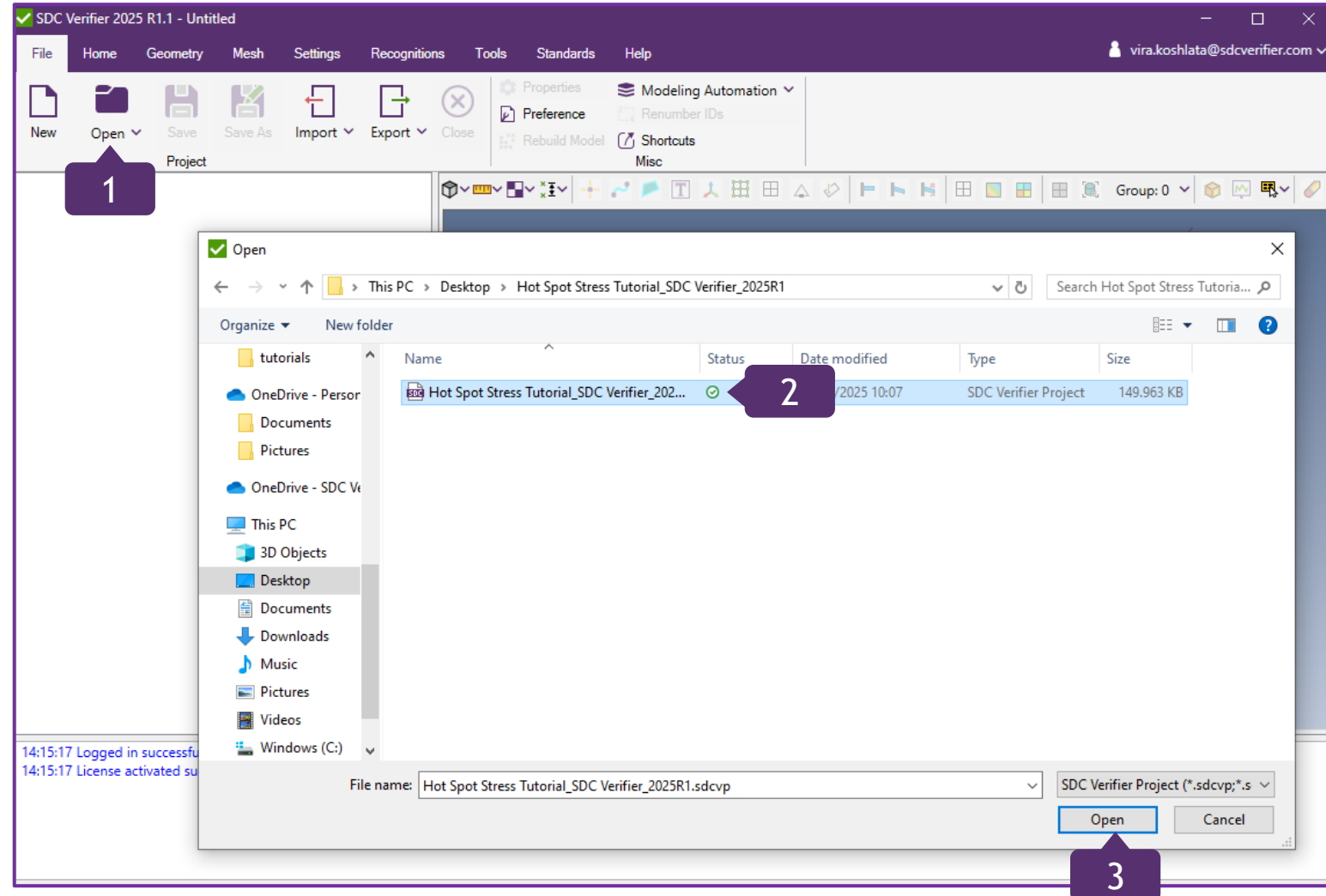
Updated on: June 11th, 2025

Tested with: SDC Verifier 2025 R1.1

- This step-by-step tutorial demonstrates how to implement Hot Spot Stress Method and the Fatigue Check according to BS 7608 Fatigue (2014) in SDC Verifier;
- Weld Finder Tool overview;
- Hot Spot Stress Settings detailed overview;
- Hot Spot Types overview;
- Configuring Fatigue parameters in line with the Component specifications;
- Applying the correct SN curve settings;
- Fatigue tables and Contour plots;
- Report preparation and results

Open the Starter Model

- 1 Launch SDC Verifier
- 2 Open project
*Hot Spot Stress Tutorial_SDC
Verifier_2025R1.sdcvp*
- 3 Press *Open*

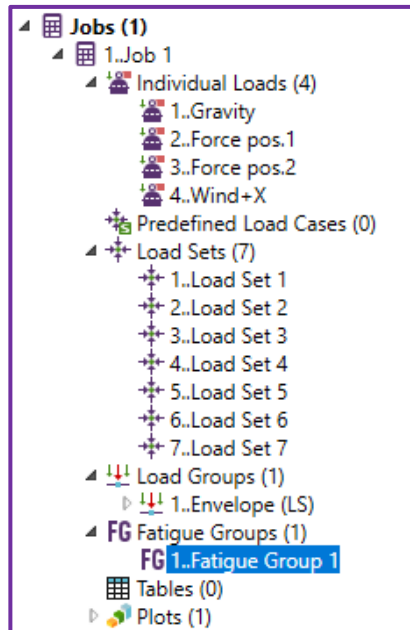


1 Go to *Home* section on the Ribbon

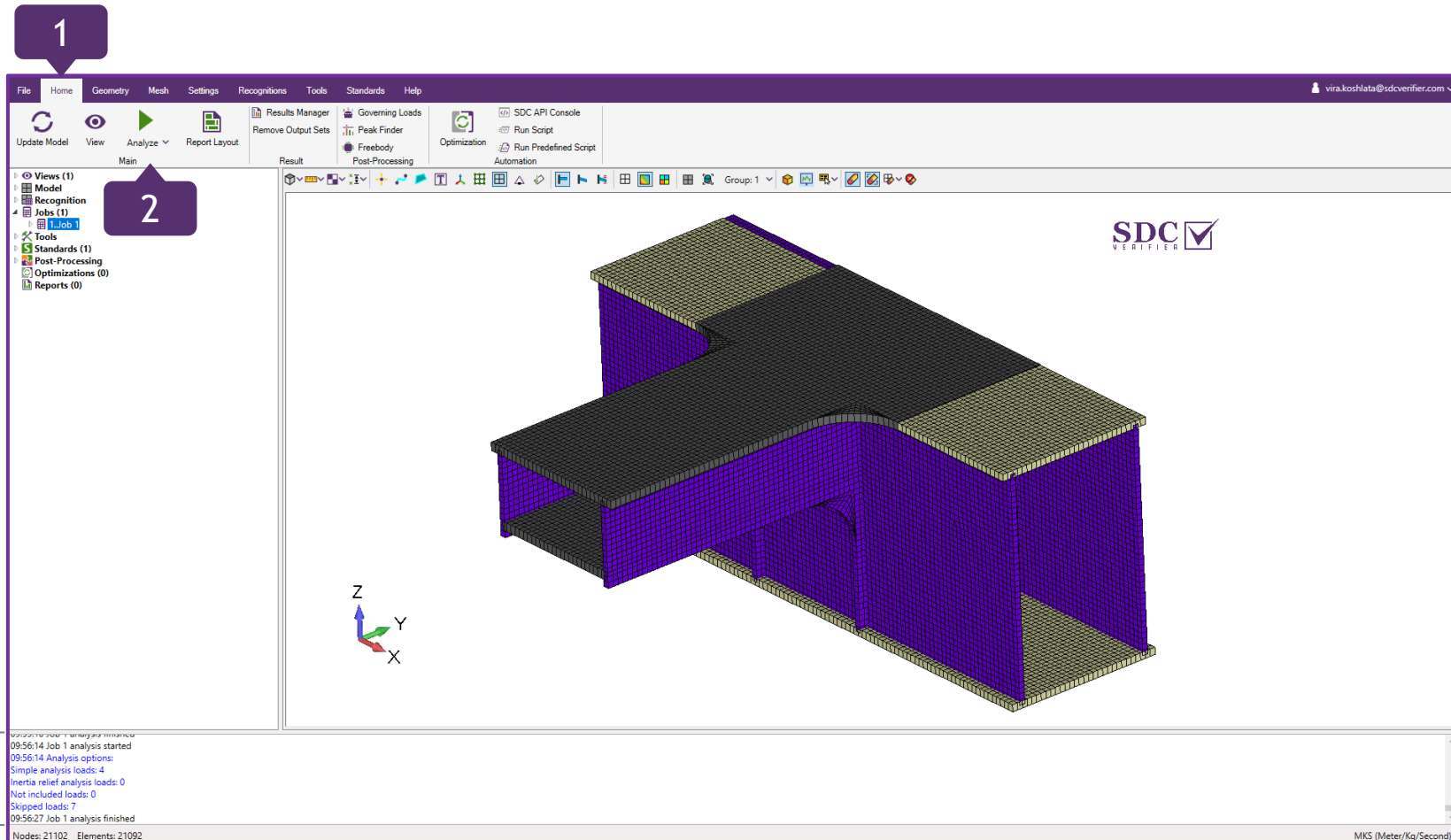
2 Press  on the toolbar to analyze Job

Job is the calculation set that contains loads and their combinations to be calculated with the defined calculation options.

Job 1 predefined items: Individual Loads, Load Sets, Load Groups and Fatigue Group.



Job 1 analysis started and finished



Weld Finder. Find Welds

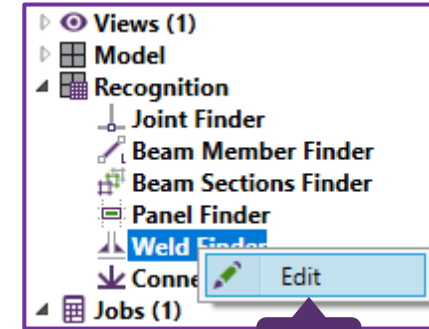
1

In the Model tree => Recognition, select *Weld Finder* and press *Edit*

2

Press *Find*

In SDC Verifier, Weld Finder Tool recognizes welds automatically and converts stresses from local element direction into weld direction, which helps to set classification in different weld stress directions.



1

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 [0.4; 0.18; 0.22]	460000000	355000000	Yes	No	26	75	3
2	Weld 2 [0.4; -0.02; 0.22]	460000000	355000000	Yes	No	26	100	4
3	Weld 3 [0.5; -0.02; 0.27]	460000000	355000000	Yes	No	15	56	4
4	Weld 4 [0.5; -0.02; 0.11]	460000000	355000000	Yes	No	28	108	4
5	Weld 5 [0.5; 0.18; 0.27]	460000000	355000000	Yes	No	15	42	3
6	Weld 6 [0.5; 0.18; 0.11]	460000000	355000000	Yes	No	28	81	3
7	Weld 7 [0.5; 0.08; 0.22]	460000000	355000000	Yes	No	27	78	3
8	Weld 8 [0.5; -0.23; 0.22]	460000000	355000000	Yes	No	53	156	3
9	Weld 9 [0.7; -0.02; 0.32]	460000000	355000000	Yes	No	26	75	3
10	Weld 10 [0.55; -0.02; 0.32]	460000000	355000000	Yes	No	13	36	3
11	Weld 11 [0.4; -0.02; 0.32]	460000000	355000000	Yes	No	26	75	3
12	Weld 12 [0.25; -0.02; 0.32]	460000000	355000000	Yes	No	13	36	3
13	Weld 13 [0.1; -0.02; 0.32]	460000000	355000000	Yes	No	26	75	3
14	Weld 14 [0.5; 0.08; 0.32]	460000000	355000000	Yes	No	27	78	3
15	Weld 15 [0.5; -0.23; 0.32]	460000000	355000000	Yes	No	53	156	3
16	Weld 16 [0.3; 0.08; 0.32]	460000000	355000000	Yes	No	27	78	3
17	Weld 17 [0.3; -0.23; 0.32]	460000000	355000000	Yes	No	53	156	3
18	Weld 18 [0.1; 0.18; 0.32]	460000000	355000000	Yes	No	26	75	3
19	Weld 19 [0.25; 0.18; 0.32]	460000000	355000000	Yes	No	13	36	3
20	Weld 20 [0.4; 0.18; 0.32]	460000000	355000000	Yes	No	26	75	3
21	Weld 21 [0.55; 0.18; 0.32]	460000000	355000000	Yes	No	13	36	3
22	Weld 22 [0.7; 0.18; 0.32]	460000000	355000000	Yes	No	26	75	3
23	Weld 23 [0.3; 0.08; 0.22]	460000000	355000000	Yes	No	27	78	3
24	Weld 24 [0.3; -0.23; 0.22]	460000000	355000000	Yes	No	53	156	3
25	Weld 25 [0.6; -0.03; 0.32]	460000000	355000000	Yes	No	3	5	2
26	Weld 26 [0.6; 0.08; 0.32]	460000000	355000000	Yes	No	27	52	2
27	Weld 27 [0.6; 0.18; 0.32]	460000000	355000000	Yes	No	3	4	2
28	Weld 28 [0.6; 0.18; 0.32]	460000000	355000000	Yes	No	15	56	4
29	Weld 29 [0.6; 0.18; 0.32]	460000000	355000000	Yes	No	28	108	4

Settings Find Set Parameter Check on Weld Design OK Cancel

2

Add, Edit, Combine and Remove Welds

Move Welds. Order is important when one element belongs to 2 Welds

Preview selected Welds

Plot of selected Welds in colors and with labels of IDs

Set Sizes in Weld Strength Settings

- 1 In Weld Type, select *Double fillet*
- 2 Apply by throat thickness (a): *ON*;
Set $a = t/2$: *ON*
- 3 Select all Weld parts (Ctrl + A) and press *Apply*
- 4 Press *OK*

The result

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:

Apply Filter

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 [0.4; 0.17; 0.22]	0.2	None	Yes	Rotation [90; 0; 0]	0.012						
2	Weld Part 2.1 [0.4; -0.02; 0.22]	0.2	None	Yes	Rotation [0; 0; 0]	0.008						
2	Weld Part 2.2 [0.4; -0.02; 0.21]	0.2	None	Yes	Rotation [-180; 0; 0]	0.008						
3	Weld Part 3.3 [0.5; -0.03; 0.27]	0.104	None	Yes	Rotation [90; 0; 90]	0.008						
3	Weld Part 3.4 [0.5; -0.02; 0.27]	0.104	None	Yes	Rotation [-90; 0; -90]	0.008						
4	Weld Part 4.3 [0.5; -0.02; 0.11]	0.216	None	Yes	Rotation [180; 90; 0]	0.008						
4	Weld Part 4.4 [0.5; -0.02; 0.11]	0.216	None	Yes	Rotation [0; -90; 0]	0.008						
5	Weld Part 5.3 [0.5; 0.17; 0.27]	0.104	None	Yes	Rotation [90; 0; 90]	0.008						
6	Weld Part 6.1 [0.5; 0.17; 0.11]	0.216	None	Yes	Rotation [90; 0; 90]	0.008						
7	Weld Part 7.3 [0.5; 0.08; 0.22]	0.199	None	Yes	Rotation [-90; -90; 0]	0.012						
8	Weld Part 8.3 [0.5; -0.23; 0.22]	0.416	None	Yes	Rotation [-90; -90; 0]	0.012						
9	Weld Part 9.3 [0.7; -0.02; 0.32]	0.204	None	Yes	Rotation [180; 0; 0]	0.008						
10	Weld Part 10.3 [0.55; -0.02; 0.31]	0.096	None	Yes	Rotation [180; 0; 0]	0.008						

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 (a) [m]: 0

Weld Type: Double fillet

Apply by sizes: ☒ Apply by throat thickness (a)

Weld leg horizontal [m]: 0

Weld leg vertical [m]: 0

Penetration depth (s) [m]: 0

Side By Weld Part Csys: +Y

Side By Direction: [0, 0, 0]

Override type: All

Alpha=45°

t

h

s=0

r

Apply

OK Cancel

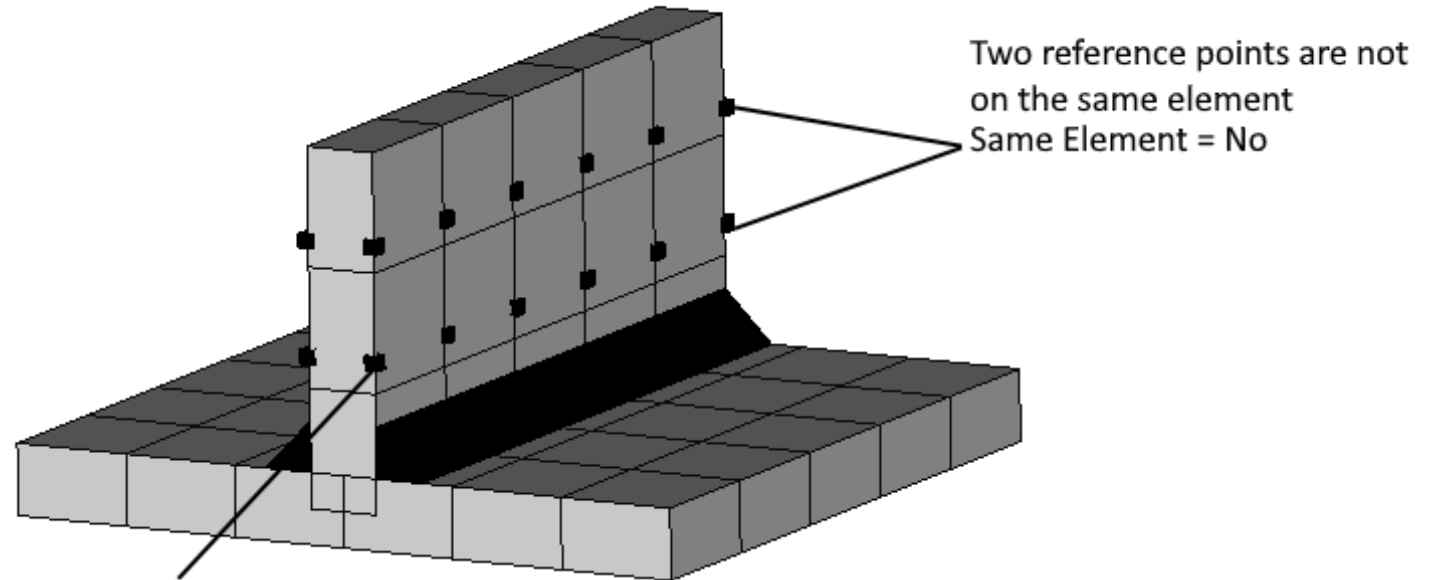
SDC Verifier

Weld type will be changed in 49 welded parts. OK to continue?

OK Cancel

Hot spot locations should be set to interpolate stresses from the reference points in order to calculate Hot Spot Stresses that can be used in fatigue calculations.

Note: In order to obtain correct stress interpolation, reference points should not be located at the same element and first interpolation point should not be located on the element of the weld part:



First reference point is not on
the weld element
Is Mesh Valid = Yes

Displays weld parts that are calculated by coefficient * t or the value in model units

Welds Finder

Welds Weld Strength Settings Hot Spot Stress

Information

Selection All Entities

Filter Rule Show all

Display Weld Parts All Welded Non-Welded

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

Weld ID	Title	Length [m]	Welded	t [m]	h [m]	Distance Related to Thickness	Drp1	Crp1	Drp2	Crp2	Drp3	Crp3	Is Mesh Valid	Same Element
1	Weld Part 1.1 [0.4; 0.17; 0.22]	0.2	Yes	0.012										
2	Weld Part 2.1 [0.4; -0.02; 0.22]	0.2	Yes	0.008										
3	Weld Part 3.3 [0.5; -0.03; 0.27]	0.104	Yes	0.008										
4	Weld Part 4.3 [0.5; -0.02; 0.11]	0.216	Yes	0.008										
5	Weld Part 5.3 [0.5; 0.17; 0.27]	0.104	Yes	0.008										
6	Weld Part 6.1 [0.5; 0.17; 0.11]	0.216	Yes	0.008										
7	Weld Part 7.3 [0.5; 0.08; 0.22]	0.199	Yes	0.012										
8	Weld Part 8.3 [0.5; -0.23; 0.22]	0.416	Yes	0.012										
9	Weld Part 9.3 [0.7; -0.02; 0.32]	0.204	Yes	0.008										
10	Weld Part 10.3 [0.55; -0.02; 0.31]	0.096	Yes	0.008										
11	Weld Part 11.1 [0.4; -0.02; 0.31]	0.2	Yes	0.008										
12	Weld Part 12.3 [0.25; -0.02; 0.31]	0.096	Yes	0.008										

Apply to selected weld parts

Calculate Hot Spot Stress $\sigma_{hs} = Crp1 \cdot \sigma_{Drp1} + Crp2 \cdot \sigma_{Drp2} + Crp3 \cdot \sigma_{Drp3}$

Reference Points Formula 1) Formula (2.7) (type a)

Distance Related to Thickness (t)

Reference Point Distance 1 (Drp1) 0.5 t

Reference Point Distance 2 (Drp2) 1.5 t

Reference Point Distance 3 (Drp3)

Coefficient Reference Point 1 (Crp1) 1.5

Coefficient Reference Point 2 (Crp2) -0.5

Coefficient Reference Point 3 (Crp3)

Check Mesh

Apply

Settings Find OK Cancel

Displays weld parts with the first point location (Yes - located farther than the weld part elements; No - located on the weld part elements)

Displays weld parts with the reference points locations (Yes - points are located on the same element; No - points are located on different elements)

Hot Spot Stresses are calculated for each welded node and respective point of interest (top or bottom) of the element by the following interpolation formula:

Where:

C_{rp1} , C_{rp2} , C_{rp3} are interpolation coefficients;

σ_{Drp1} , σ_{Drp2} , σ_{Drp3} - nominal stresses at the reference points at distances Drp1, Drp2 and Drp3

Press to get information about predefined Parameters

Information about predefined Parameters

The decision to choose one of these formulas depends on the size of the mesh.

✓ Hot Spot Types (IIW Fatigue Recommendations IIW-1823-07/XIII-2151r4-07/XV-1254r4-07 Dec. 2008)

The structural hot spot stress σ_{hs} is determined using the reference points and extrapolation equations as given below (see also Figure (2.2)-12).

- 1) Fine mesh with element length not more than **0.4 t** at the hot spot: Evaluation of nodal stresses at two reference points **0.4 t** and **1.0 t**, and linear extrapolation (eq. 2.7).

$$\sigma_{hs} = 1.67 \cdot \sigma_{0.4 \cdot t} - 0.67 \cdot \sigma_{1.0 \cdot t} \quad (2.7)$$
- 2) Fine mesh as defined in 1) above: Evaluation of nodal stresses at three reference points **0.4 t**, **0.9 t** and **1.4 t**, and quadratic extrapolation (eq. 2.8). This method is recommended for cases of pronounced non-linear structural stress increase towards the hot spot, at sharp changes of direction of the applied force or for thickwalled structures.

$$\sigma_{hs} = 2.52 \cdot \sigma_{0.4 \cdot t} - 2.24 \cdot \sigma_{0.9 \cdot t} + 0.72 \cdot \sigma_{1.4 \cdot t} \quad (2.8)$$
- 3) Coarse mesh with higher-order elements having lengths equal to plate thickness at the hot spot: Evaluation of stresses at mid-side points or surface centres respectively, i.e. at two reference points **0.5 t** and **1.5 t**, and linear extrapolation (eq. 2.9).

$$\sigma_{hs} = 1.50 \cdot \sigma_{0.5 \cdot t} - 0.50 \cdot \sigma_{1.5 \cdot t} \quad (2.9)$$
- 4) Fine mesh with element length of not more than **4 mm** at the hot spot: Evaluation of nodal stresses at three reference points **4 mm**, **8 mm** and **12 mm** and quadratic extrapolation (eq. 2.10).

$$\sigma_{hs} = 3 \cdot \sigma_{4 \text{ mm}} - 3 \cdot \sigma_{8 \text{ mm}} + \sigma_{12 \text{ mm}} \quad (2.10)$$
- 5) Coarse mesh with higher-order elements having length of **10 mm** at the hot spot: Evaluation of stresses at the mid-side points of the first two elements and linear extrapolation (eq. 2.11).

$$\sigma_{hs} = 1.5 \cdot \sigma_{5 \text{ mm}} - 0.5 \cdot \sigma_{15 \text{ mm}} \quad (2.11)$$

Figure (2.2)-12: Reference points at different types of meshing

Close

Set Reference Points Formula to Weld Parts

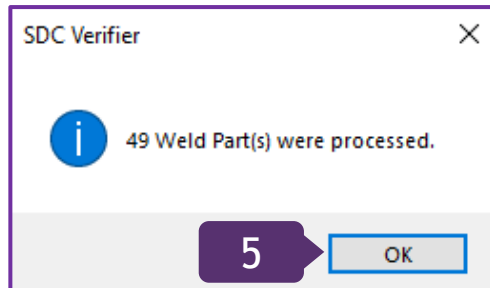
1 Select all Weld Parts (Ctrl + A)

2 Select Reference Points Formula:
3) Formula (2.9) (type a)

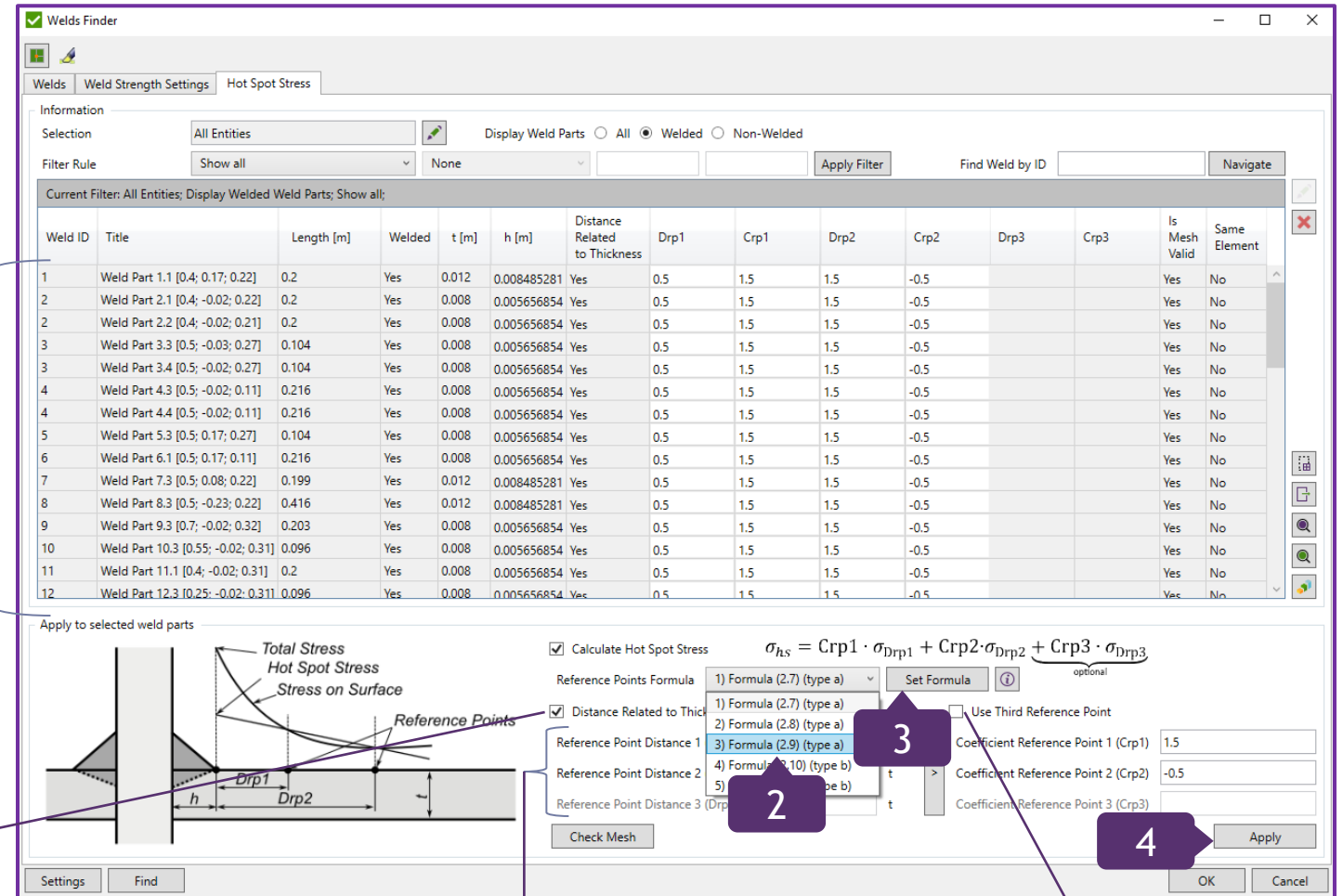
3 Press Set Formula

4 Press Apply

5 Press OK



An option takes distances as coefficient * t if turned on or by custom distance in model units otherwise.



Distances from the weld toe that are based on weld part vertical leg size (h). Input value depends on the *Distance Related to Thickness* (t) option. If option is turned ON, the distance is calculated as an input value * weld part thickness (t). Otherwise, custom distance in model units should be filled in.

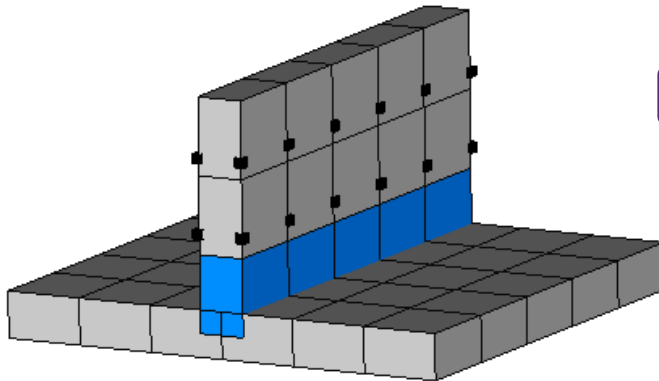
Enables/disables usage of third reference point to have a quadratic interpolation by 3 points.

Plot Weld Parts + Reference Points

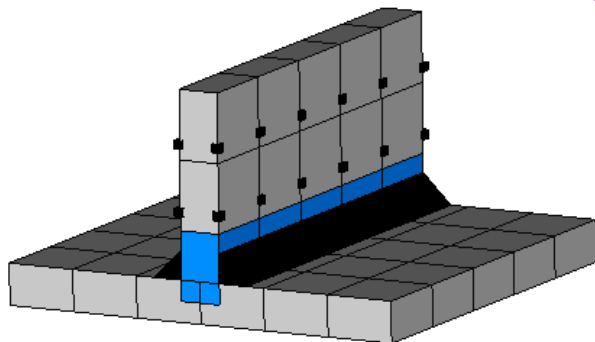
1 Select all Weld Parts (Ctrl + A)

2 Press  and select **Weld Parts + Reference Points**

Weld Parts + Reference Points



Weld Parts + Reference Points + Throat



Welds Finder

Welds Weld Strength Settings Hot Spot Stress

Information

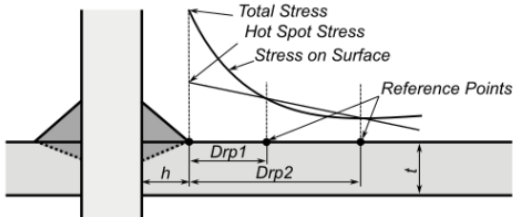
Selection All Entities  Display Weld Parts ☐ All ☒ Welded ☐ Non-Welded

Filter Rule Show all None Apply Filter Find Weld by ID Navigate

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

Weld ID	Title	Length [m]	Welded	t [m]	h [m]	Distance Related to Thickness	Drp1	Crp1	Drp2	Crp2	Drp3	Crp3	Is Mesh Valid	Same Element
1	Weld Part 1.1 [0.4; 0.17; 0.22]	0.2	Yes	0.012	0.008485281	Yes	0.5	1.5	1.5	-0.5			Yes	No
2	Weld Part 2.1 [0.4; -0.02; 0.22]	0.2	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
2	Weld Part 2.2 [0.4; -0.02; 0.21]	0.2	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
3	Weld Part 3.3 [0.5; -0.03; 0.27]	0.104	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
3	Weld Part 3.4 [0.5; -0.02; 0.27]	0.104	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
4	Weld Part 4.3 [0.5; -0.02; 0.11]	0.216	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
4	Weld Part 4.4 [0.5; -0.02; 0.11]	0.216	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
5	Weld Part 5.3 [0.5; 0.17; 0.27]	0.104	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
6	Weld Part 6.1 [0.5; 0.17; 0.11]	0.216	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
7	Weld Part 7.3 [0.5; 0.08; 0.22]	0.199	Yes	0.012	0.008485281	Yes	0.5	1.5	1.5	-0.5			Yes	No
8	Weld Part 8.3 [0.5; -0.23; 0.22]	0.416	Yes	0.012	0.008485281	Yes	0.5	1.5	1.5	-0.5			Yes	No
9	Weld Part 9.3 [0.7; -0.02; 0.32]	0.203	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
10	Weld Part 10.3 [0.55; -0.02; 0.31]	0.096	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
11	Weld Part 11.1 [0.4; -0.02; 0.31]	0.2	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No
12	Weld Part 12.3 [0.25; -0.02; 0.31]	0.096	Yes	0.008	0.005656854	Yes	0.5	1.5	1.5	-0.5			Yes	No

Apply to selected weld parts

 $\sigma_{hs} = Crp1$

☒ Calculate Hot Spot Stress

Reference Points Formula 3) Formula (2.9) (type a)

☒ Distance Related to Thickness (t)

Reference Point Distance 1 (Drp1) 0.5

Reference Point Distance 2 (Drp2) 1.5

Reference Point Distance 3 (Drp3)

Check Mesh

Settings Find

Welded/non-welded parts

Weld parts

Welds in colors

Welds in colors + Labels of IDs

Reference Point Distance Related to Thickness

Mesh Validity State

Reference Points in Same Elements

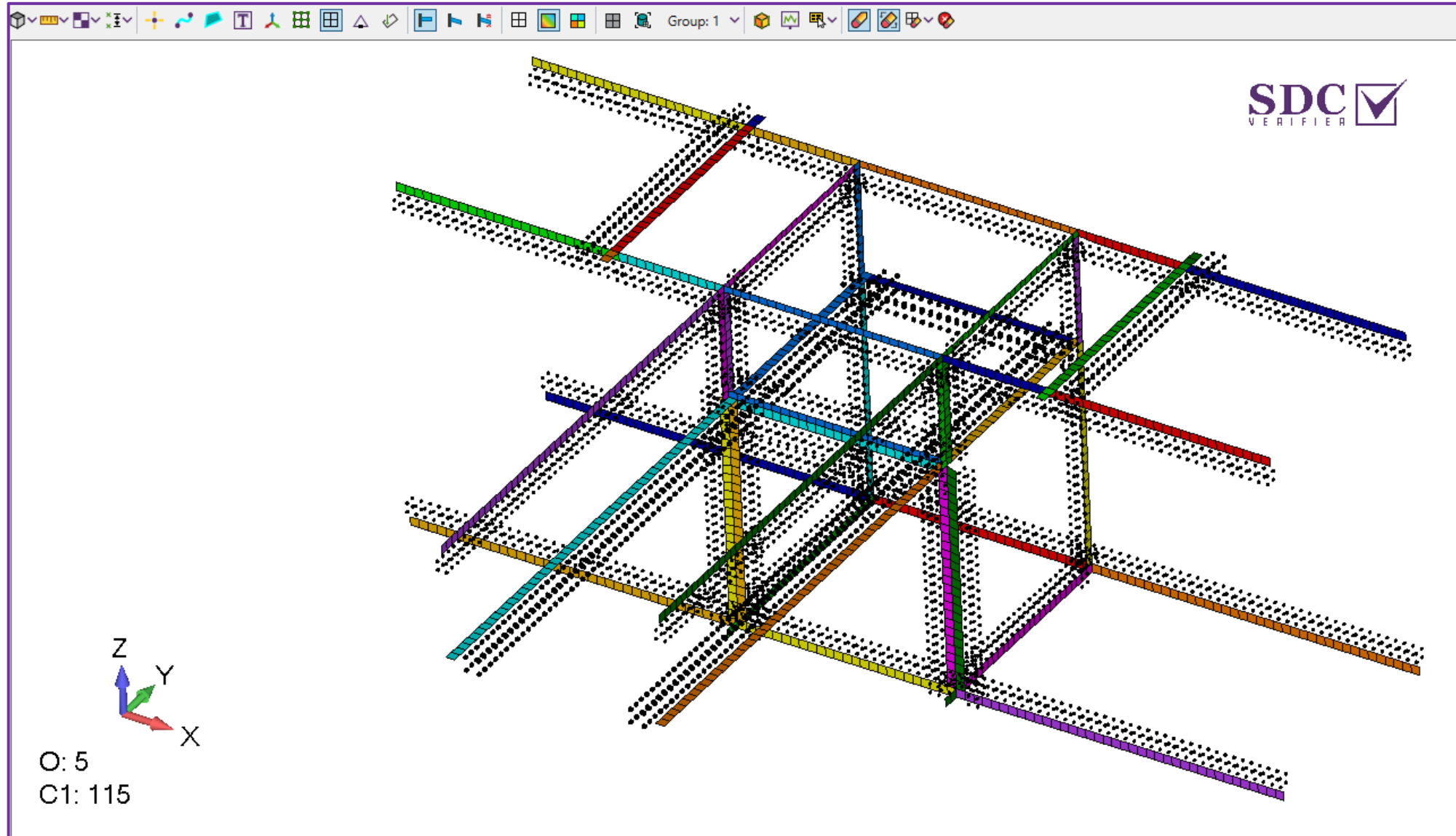
Weld Parts + Reference Points

Weld Parts + Reference Points + Throat

It displays selected weld parts in colors and draw locations of reference points in the model.

Another option to plot: **Weld Parts + Reference Points + Throat**. It displays selected weld parts in colors and draw locations of reference points and weld part throat in the model.

Plot Weld Parts + Reference Points (Continuation)

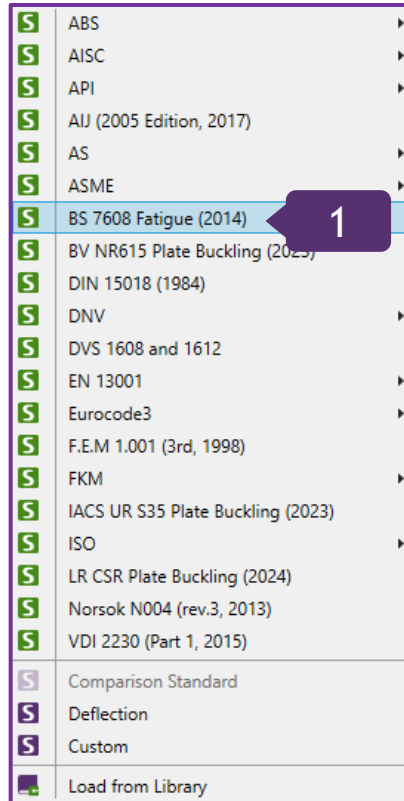
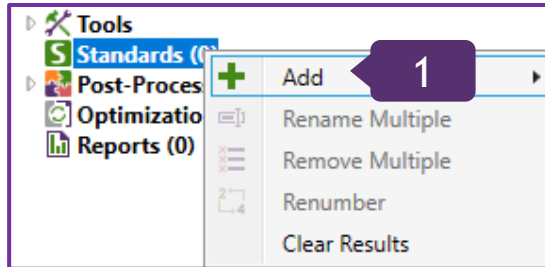


Add BS 7608 Fatigue (2014) Standard

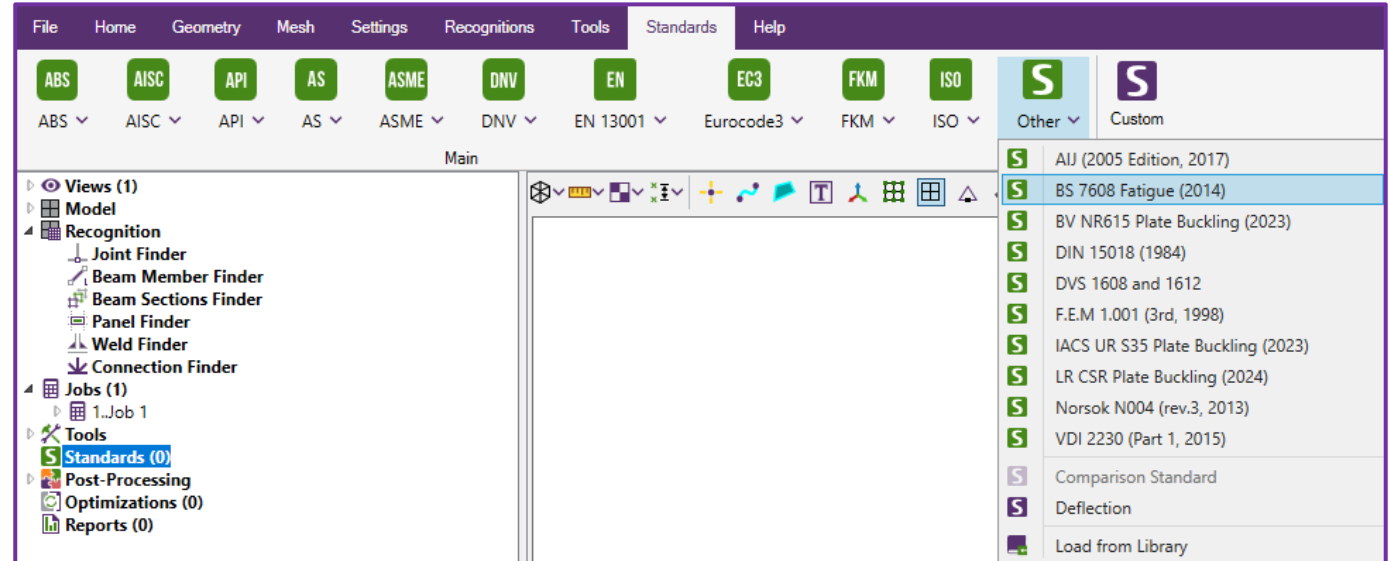
1

Execute right click on Standards and select
Add => BS 7608 Fatigue (2014)

BS 7608:2014 + A1:2015 - Guide to fatigue design and assessment of steel products.



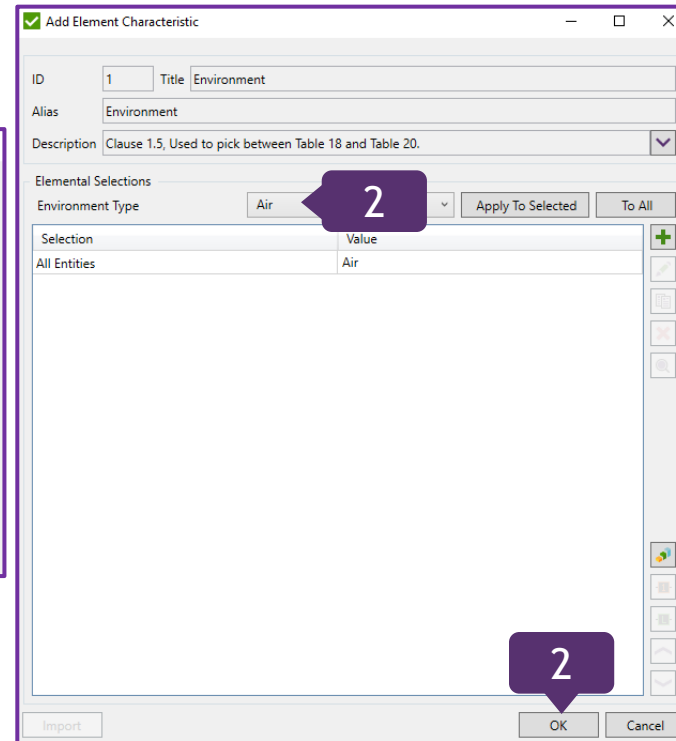
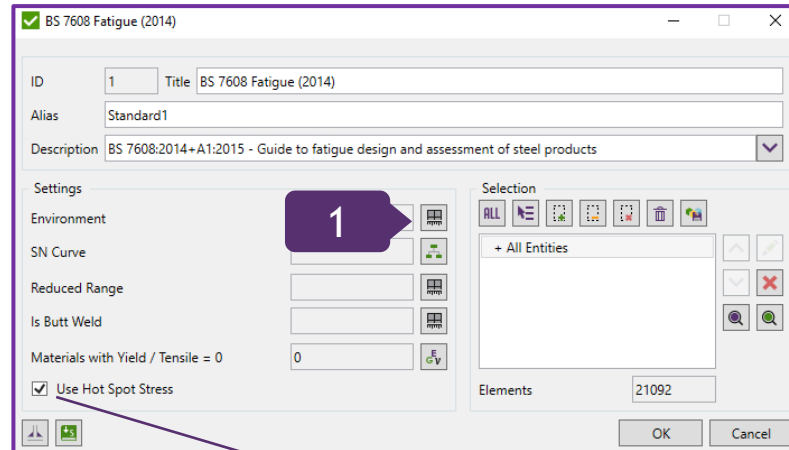
An alternative way of adding Standards



Define Environment (Clause 1.5 Air)

1 Press  to define *Environment*

2 Environment Type: Air;
Press *OK*



Use Hot Spot Stress activated - use Hot Spot Stress results for locations defined in Weld Finder Tool or Weld Stress results in the Fatigue Checks.

Table 18 Details of basic S-N curves

Class	C_o	$\log_{10} C_o$	m	Standard deviation of $\log_{10} N$, SD	C_2	S_{ov} (N=10 ⁷ cycles) N/mm ²	S_{ov} (N=5×10 ⁷ cycles) N/mm ²
B	2.343×10^{15}	15.3697	4.0	0.1821	1.01×10^{15}	100	67
C	1.082×10^{14}	14.0344	3.5	0.2041	4.23×10^{13}	78	49
D	3.988×10^{12}	12.6008	3.0	0.2095	1.52×10^{12}	53	31
E	3.289×10^{12}	12.5171	3.0	0.2509	1.04×10^{12}	47	27
F	1.726×10^{12}	12.2371	3.0	0.2183	6.32×10^{11}	40	23
F2	1.231×10^{12}	12.0902	3.0	0.2279	4.31×10^{11}	35	21
G	5.656×10^{11}	11.7526	3.0	0.1793	2.48×10^{11}	29	17
G2	3.907×10^{11}	11.5918	3.0	0.1952	1.59×10^{11}	25	15
W1	2.500×10^{11}	11.3979	3.0	0.2140	9.33×10^{10}	21	12
X	9.298×10^{11}	11.9684	3.0	0.2134	3.48×10^{11}	33	19
S ₁	5.902×10^{16}	16.7710	5.0	0.2350	2.00×10^{16}	46 (at 10 ⁸ cycles) ^{B)}	46 (at 10 ⁸ cycles) ^{B)}
S ₂	3.949×10^{16}	16.5965	5.0	0.3900	6.55×10^{15}	37 (at 10 ⁸ cycles) ^{B)}	37 (at 10 ⁸ cycles) ^{B)}
TJ	8.750×10^{12}	12.9420	3.0	0.2330	2.99×10^{12}	67 ^{A)}	39 ^{A)}

For example the TJ curve is $\log N = 12.942 - 0.233d - 3\log S_1$.

^{A)} Idealized hot-spot stress.

^{B)} Curve extrapolated to N=10⁸ cycles without slope change.

NOTE The figures in **bold** are to be taken as exact and definitive; figures that are not bold are calculated exactly from the exact definitive figures and then rounded to the displayed number of significant figures.

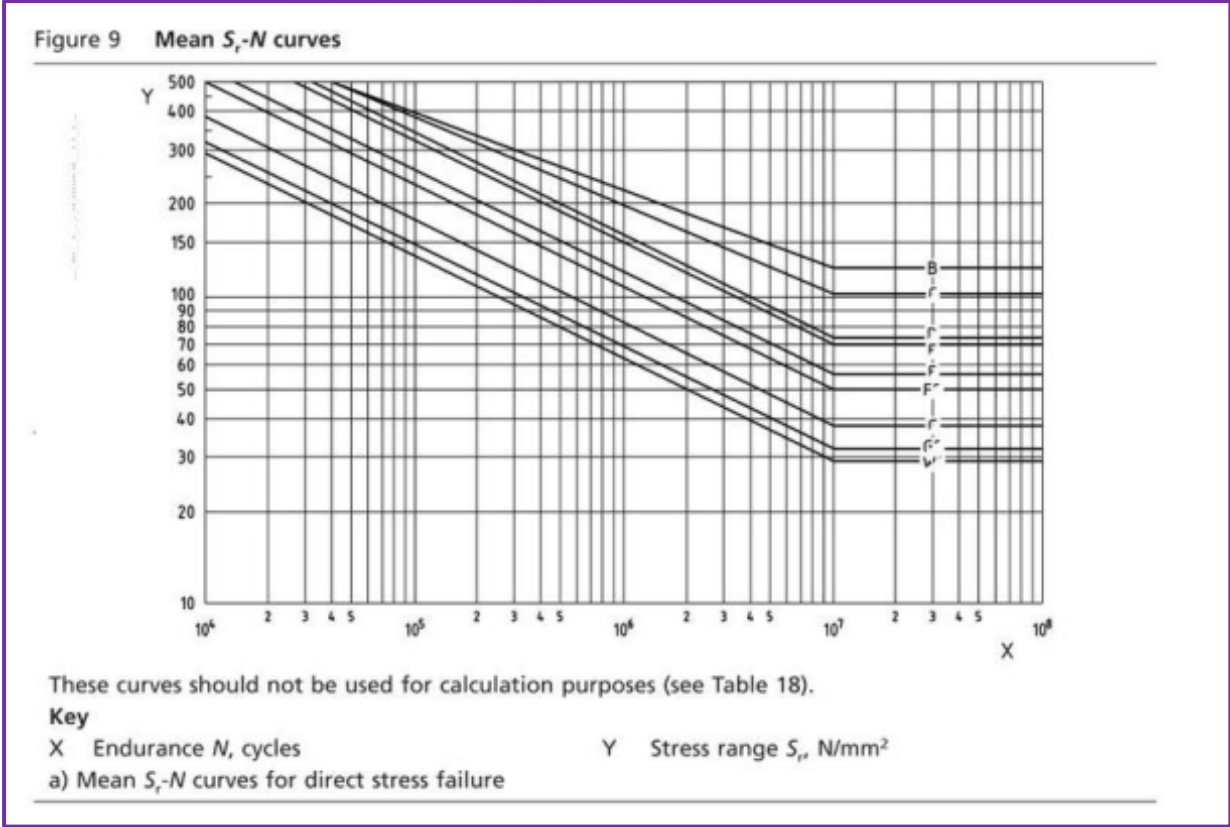
BRITISH STANDARD

Note: if *Hot Spot Stress* option is disabled the Nominal Stress Method will be used.

Another option of Environment Type: Seawater With Cathodic Protection

BS 7608:2014+A1:2015

The S-N curves are specified by the standard and take into account the type of the material, the connection or connection (welds), the stress direction and the surrounding environment. As an example, see the S-N curves for BS 7608:2014+A1:2015.



S-N category depends on the type of constructional detail (non-welded, welded) and stress direction (parallel to the weld, perpendicular to the weld and shear). In the finite element model, the required information is missing and in result, the task of setting a classification can be time-consuming.

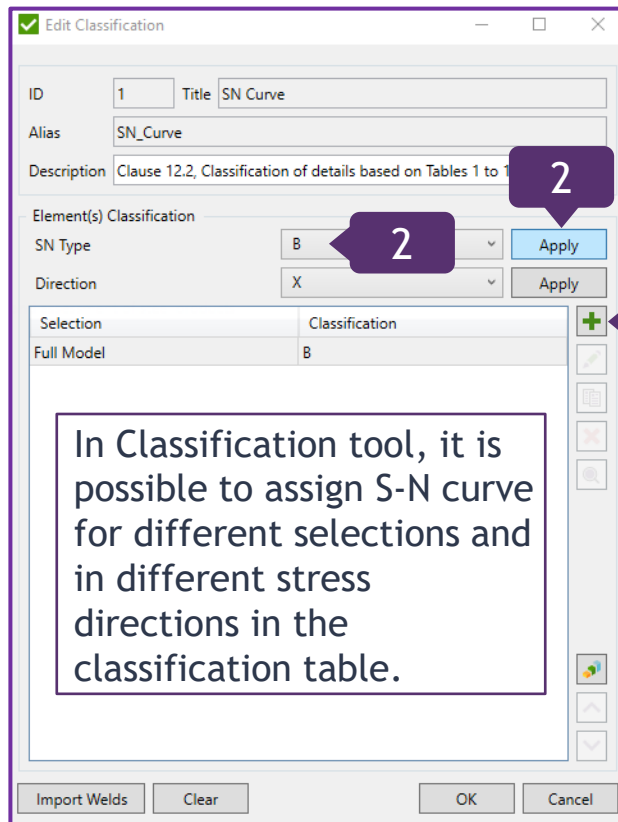
Define SN Curve (Clause 12.2)

SN Curve is directional classification. X - direction is parallel to the weld, Y - perpendicular. First set non-welded curve for full model. Second step is to define SN curve for welds (parallel and perpendicular). For welds intersection (last step) the lowest class between X, Y should be set. Clause 12.2, Classification of details based on Tables 1 to 10;

1 Press  to define SN Curve

2 For Full Model - SN Type: B;
Press Apply

3 Press  to Edit Condition



The 'Edit Classification' dialog box shows the following fields and actions:

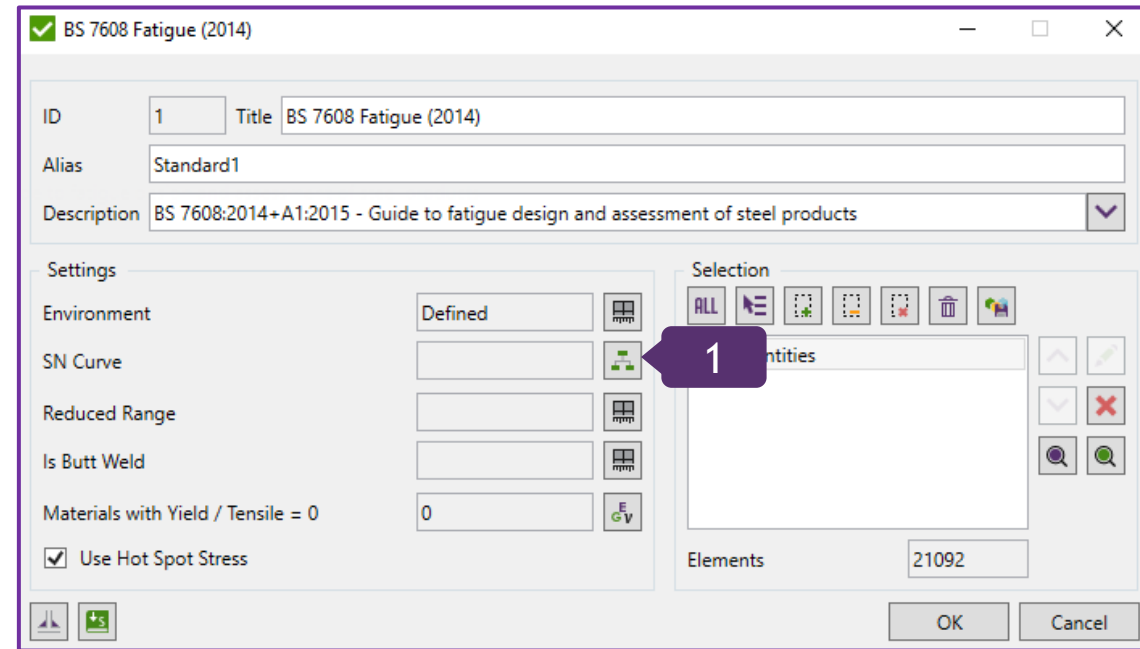
- ID: 1, Title: SN Curve
- Alias: SN_Curve
- Description: Clause 12.2, Classification of details based on Tables 1 to 10
- Element(s) Classification: SN Type: B (selected), Direction: X (selected). Both have 'Apply' buttons.
- Selection table:

Selection	Classification
Full Model	B
- A green '+' icon is used to add new conditions.

Annotations: A purple circle with '2' points to the SN Type dropdown. A purple circle with '2' points to the 'Apply' button. A purple circle with '3' points to the '+' icon.

In Classification tool, it is possible to assign S-N curve for different selections and in different stress directions in the classification table.

Buttons at the bottom: Import Welds, Clear, OK, Cancel.



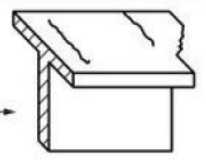
The 'BS 7608 Fatigue (2014)' dialog box shows the following fields and actions:

- ID: 1, Title: BS 7608 Fatigue (2014)
- Alias: Standard1
- Description: BS 7608:2014+A1:2015 - Guide to fatigue design and assessment of steel products
- Settings:
 - Environment: Defined
 - SN Curve: (empty field with a green '+' icon)
 - Reduced Range: (empty field with a green '+' icon)
 - Is Butt Weld: (empty field with a green '+' icon)
 - Materials with Yield / Tensile = 0: 0 (with a green 'EV' icon)
 - ☒ Use Hot Spot Stress
- Selection: A list of entities with a green '+' icon and a '21092' count.

Annotation: A purple circle with '1' points to the green '+' icon in the SN Curve field.

Buttons at the bottom: OK, Cancel.

Table 1 Classification of details: plain material free from welding

Type no.	Product form	Location of potential crack initiation	Detail	Manufacturing requirements	Special requirements	Design stress area	Class ^{A)}	Notes	Sketch
1.1	Rolled steel plates and sections	Away from all welds or connections	Member of constant or smoothly varying cross section with no holes or re-entrant corners	All surfaces fully machined and polished. No flame cutting			A	See B.2.2	
1.2				Edges as rolled or machined smooth. No flame cutting. The surface condition should be in accordance with BS EN 10163 as a minimum.			B ^{B)}		

Define SN Curve (Clause 12.2) (Continuation 1)

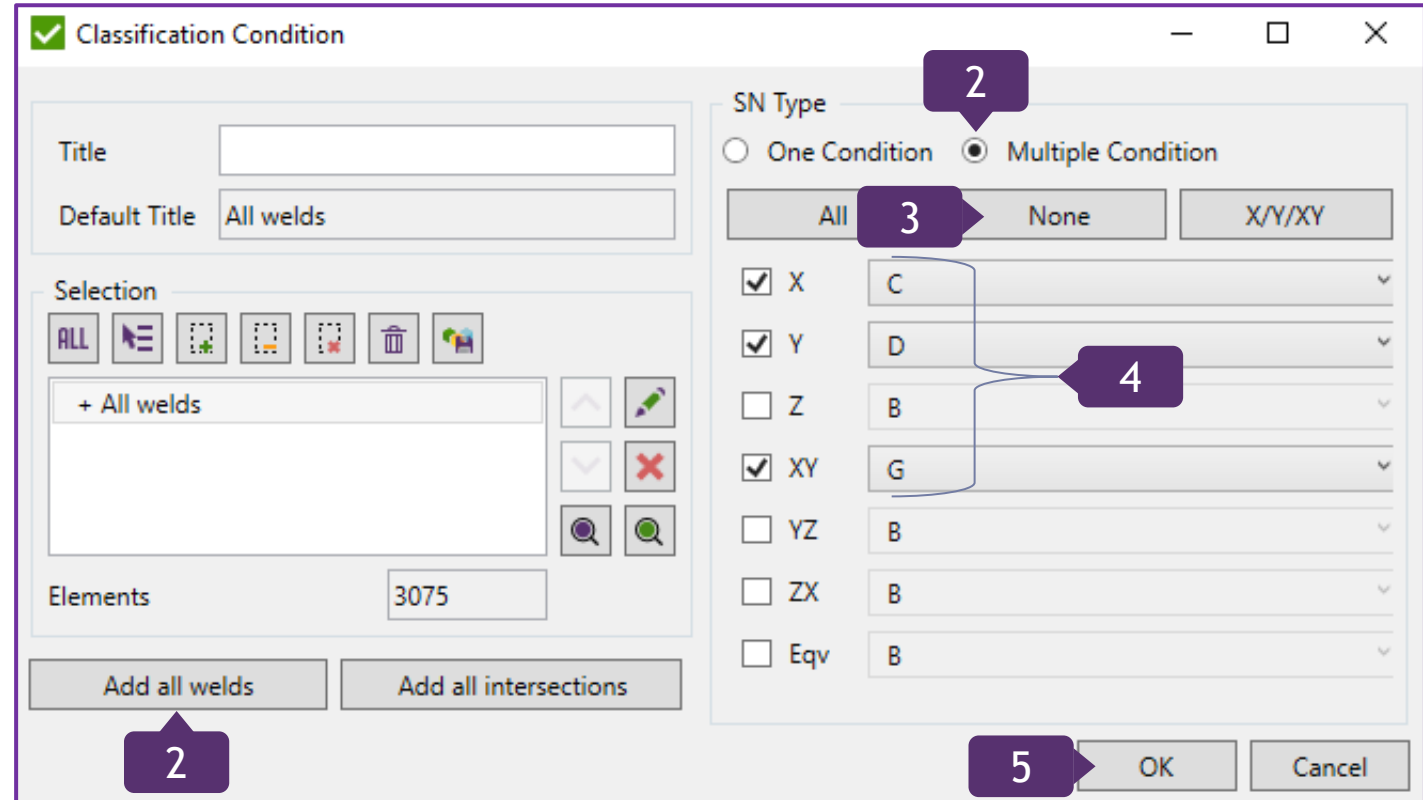
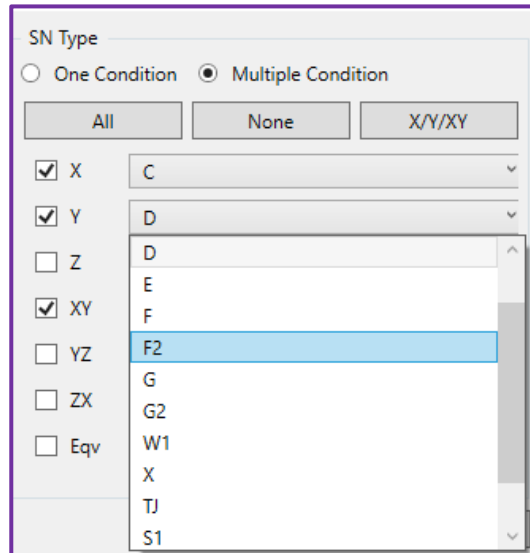
1 Press *Add all Welds*

2 Select *Multiple Condition*

3 Press *None*

X: C
Y: D
XY: G

5 Press *OK*



Note: As Hot Spot Stresses usage was activated (see Slide 14), for Y Direction D Class is used. In case Hot Spot Stresses are off, for Y Direction F2 can be selected.

Define SN Curve (Clause 12.2) (Continuation 2)

1 Press  to Edit Condition

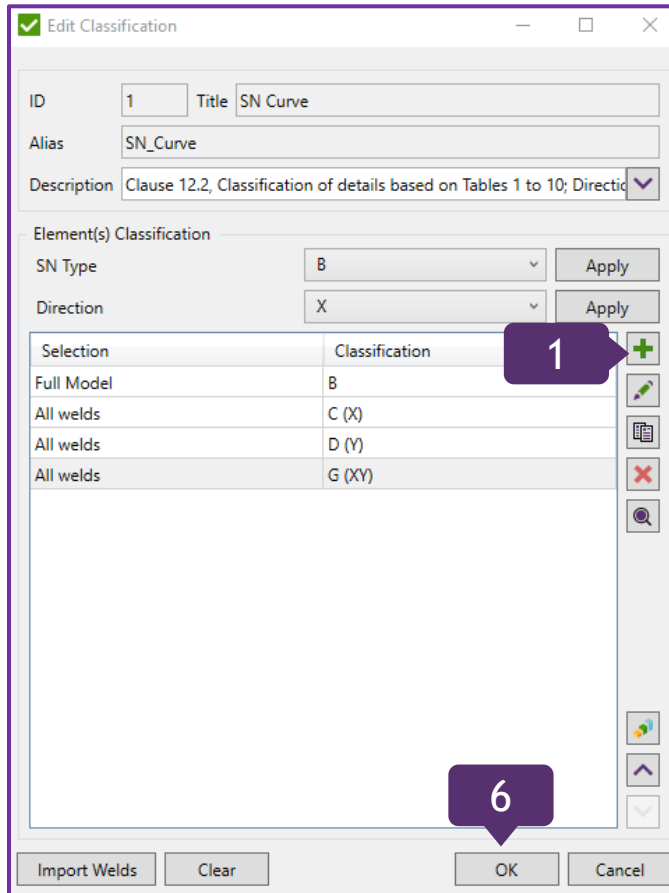
2 Press *Add all intersections*

3 Press *None*

4 Value: *F2*;
Direction: *X*

5 Press *OK*

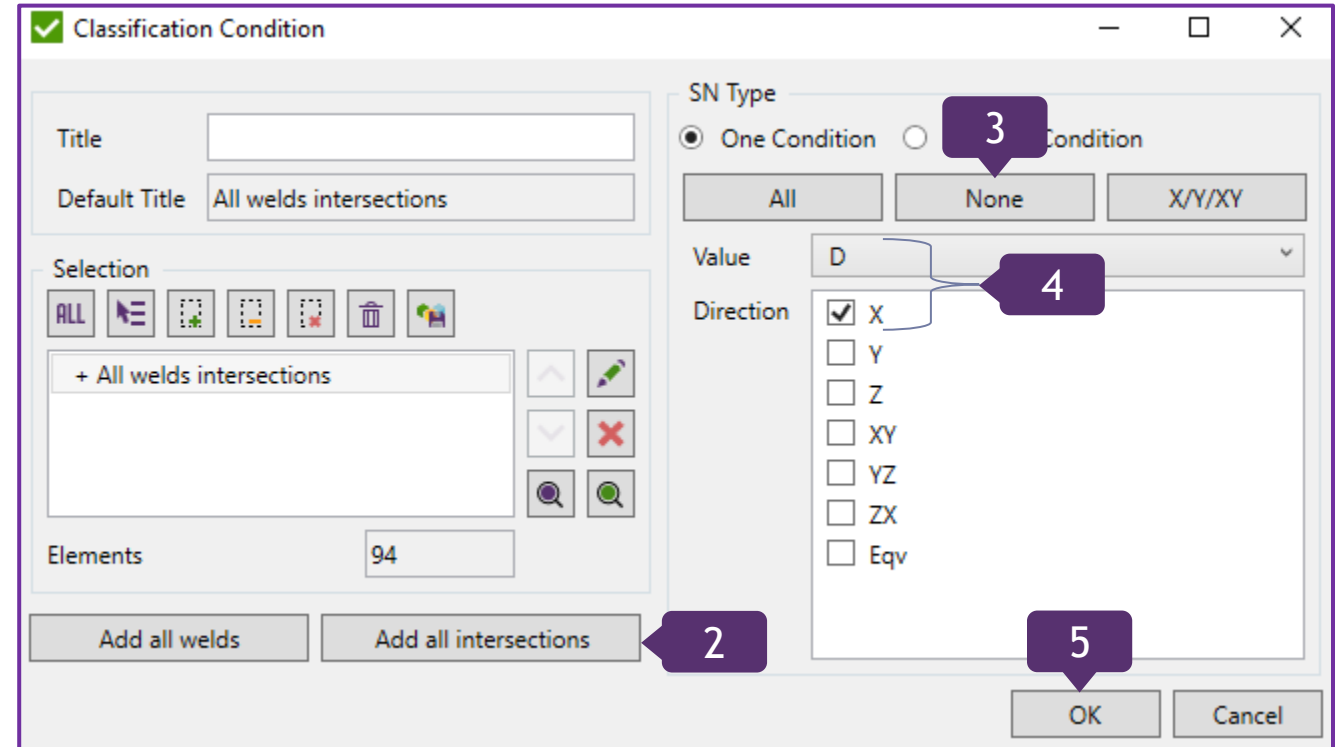
6 Press *OK*



The 'Edit Classification' dialog box is shown. It has fields for ID (1), Title (SN Curve), Alias (SN_Curve), and Description (Clause 12.2, Classification of details based on Tables 1 to 10; Direction). Below these are dropdowns for SN Type (B) and Direction (X), each with an 'Apply' button. A table lists elements and their classifications:

Selection	Classification
Full Model	B
All welds	C (X)
All welds	D (Y)
All welds	G (XY)

At the bottom are buttons for 'Import Welds', 'Clear', 'OK', and 'Cancel'. A purple callout '1' points to the '+' icon in the table's right margin. A purple callout '6' points to the 'OK' button.



The 'Classification Condition' dialog box is shown. It has a 'Title' field and a 'Default Title' field (All welds intersections). Below is a 'Selection' section with icons and a list containing '+ All welds intersections'. An 'Elements' field shows '94'. At the bottom are 'Add all welds' and 'Add all intersections' buttons. On the right, the 'SN Type' section has radio buttons for 'One Condition' (selected) and 'Two Condition'. Below are 'All', 'None', and 'X/Y/XY' buttons. A 'Value' dropdown is set to 'D'. A 'Direction' section has checkboxes for X (checked), Y, Z, XY, YZ, ZX, and Eqv. At the bottom are 'OK' and 'Cancel' buttons. Purple callouts are numbered: '2' points to 'Add all intersections', '3' points to 'Two Condition', '4' points to 'D' in the Value dropdown, and '5' points to the 'OK' button.

Note: As Hot Spot Stresses usage was activated (see Slide 14), for X Direction D Class is used. In case Hot Spot Stresses are off, for X Direction F2 can be selected.

Classification of Details: All Welds C (X)



✓ Edit Classification

ID1TitleSN Curve

AliasSN_Curve

DescriptionClause 12.2, Classification of details based on Tables 1 to 10; Direction

Element(s) Classification

SN TypeBApply

DirectionXApply

SelectionClassification

Full ModelB

All weldsC (X)

All weldsD (Y)

All weldsG (XY)

All welds intersectionsD (X)

Import Welds

Clear

OK

Cancel

Table 3 Classification of details: butt welds and continuous welded attachments essentially parallel^(A) to the direction of applied stress

Type no.	Product form	Location of potential crack initiation	Detail	Manufacturing requirements	Special treatments or requirements	Design stress area	Class		Thickness and bending correction (see 16.3.2)	Notes	Sketch
							Nominal stress	Hot-spot stress			
3.1	Rolled steel plates, sections and built-up members	Weld surface or embedded flaw	Butt weld with full penetration and no permanent backing strip.	Weld reinforcement dressed flush.	Proved free of all flaws which are likely to degrade the joint below its stated classification (see 14.3.4)	Minimum transverse cross section of member at location of potential crack initiation	B ^(B)	Not applicable	Not applicable	Finish machining should be in the direction of S_r . In view of the difficulty of ensuring freedom from significant flaws (see 14.3.4), this class is only recommended for use in exceptional circumstances (see B.2.2.1 and B.3.1)	
3.2		Fillet weld root or ripples on weld surface away from the weld end.	Butt weld with full penetration or butt or fillet welded web or attachment (in the direction of S_r), including lap joints.	All welds continuous with no stop/starts. Butt welds with full penetration. If used, backing should be incorporated (e.g. joggle joint), continuous and either not attached or attached by continuous fillet welds.	Weld toe improvement techniques not relevant.		C	Not applicable	Not applicable	Accidental stop/starts are not uncommon even in automatic processes. Repair to the standard of a C classification should be the subject of specialist advice and inspection and as a result, the use of this type is not recommended.	

BS 7608:2014+A1:2015

SDC
VERIFIER

Type no.	Product form	Location of potential crack initiation	Detail	Manufacturing requirements	Special treatments or requirements	Design stress area	Class		Thickness and bending correction (see 16.3.2)	Notes	Sketch	
							Nominal stress	Hot-spot stress				
7.1	Rolled steel plates, sections and built-up members	At weld toe in member X	Weld joining two members end to end with third member transverse through joint. Member Y can be regarded as one with a non-load-carrying weld (see joint type 4.2 or 4.3).	Full penetration butt weld with longitudinal axes in line.	Any undercut should be ground smooth particularly on the corners of member X at weld toe.	Cross section of member X at weld toe. Allowance should be made for any misalignment of the joint exceeding that already allowed for in the classification (see 8.7.2 and 8.5.2.1).	F	D	σ Applicable assuming $b = 0.25$; related to plate X σ	Weld metal failure does not govern with full penetration welds.		
7.2				Partial penetration butt or fillet weld with longitudinal axes in line.	make weld continuous around the joint; otherwise grind ends flush with edge of member X. All regions of plate Y stressed in the through thickness direction to be free from lamellar defects and tears. Weld toe improvement techniques	In some circumstances (see 8.7.2), it might be necessary to include a stress concentration factor in the nominal stress design calculation.	F2	D		In this type of joint failure is likely to occur in the weld throat unless the weld is made sufficiently large. (See joint type 7.8).		
7.3				Weld joining the end of one member to the surface of another.	Full penetration butt weld made from one or both sides.	note need to assess partial penetration welded joints with respect to	Cross section of member X at weld toe	F		D	See joint type 7.1.	
7.4				Member Y can be regarded as one with a non-load-carrying weld (see joint type 4.2 or 4.3).	Partial penetration butt or fillet welds made from both sides	potential failure through the weld throat (see type 7.8)		F2		D	See joint type 7.2.	

SDC
VERIFIER

Type no.	Product form	Location of potential crack initiation	Detail	Manufacturing requirements	Special treatments or requirements	Design stress area	Class		Thickness and bending correction (see 16.3.2)	Notes	Sketch
							Nominal stress	Hot-spot stress			
7.5	Rolled steel plates, sections and built-up members	At weld toe in member X	Transverse load carrying fillet weld in lap joint on both sides of plate symmetrically.	Care needed to avoid undercutting plate edge if weld ends at or close to edge. Any such undercutting should be ground out.	Weld toe improvement techniques applicable but not need to assess joints with respect to potential failure through the weld throat (see type 7.8 or 7.10)	Cross section of member X at weld toe.	F2	D	E) Applicable assuming $b = 0.75$; related to plate X [C]	The nominal stress classification may be deemed to include stress concentrations arising from normal eccentricities in the thickness direction. Where a narrow attachment, X, is transferring the entire load out of a wide member, X, as in the case of a welded lap type connection between, for example, a cross brace and a gusset, the nominal stress in the gusset at the end of the cross brace varies substantially across the section. For assessing the nominal stress in the gusset X the effective width (W) should be taken as shown for type 7.6.	Minimum weld length 150 mm
7.6		At weld toe in member X	Transverse load carrying fillet weld in lap joint on one surface only			These classifications do not include allowance for bending due to misalignment of the applied forces (see B.5.2.1)	G	D		For failure in the cross brace at Z, the cross brace, Y, is the "member" and the gusset is the "attachment" (See type 7.7)	Minimum weld length 150 mm
7.7		At weld end in member Y	Longitudinal load carrying fillet welds, with the weld end on a plate edge. Weld length $\geq$ cover plate width	Welds on both edges of member Y. Any undercutting of plate edge should be ground out.	Weld toe improvement techniques not suitable.	Cross section of member Y	G	D	Not applicable	This type applies regardless of the shape of the end of the attachment. Weld returns across a corner should be avoided and the use of cover plates wider than the flange, to which they are attached, is not recommended. For fatigue cracking in member X see types 7.5 or 7.6.	

Plot SN Curve Labels in X Direction

1 Press  to plot with Values

2 Select *Labels* => X

3 Press *OK*

Edit Classification

ID: 1 Title: SN Curve

Alias: SN_Curve

Description: Clause 12.2, Classification of details based on Tables 1 to 10; Direction: v

Element(s) Classification

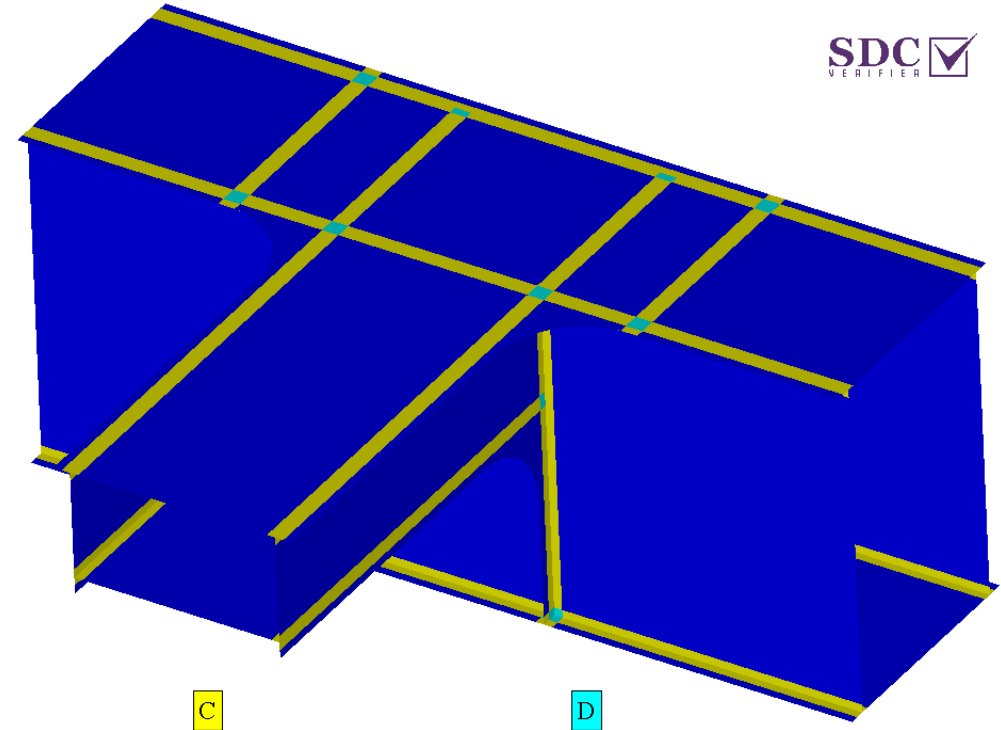
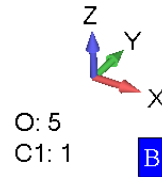
SN Type: B Apply

Direction: X Apply

Selection	Classification
Full Model	B
All welds	C (X)
All welds	D (Y)
All welds	G (XY)
All welds intersections	D (X)

1 

3 OK Cancel



Values	
Labels	2
Selection	

X	2
Y	
Z	
XY	
YZ	
ZX	
Equivalent	

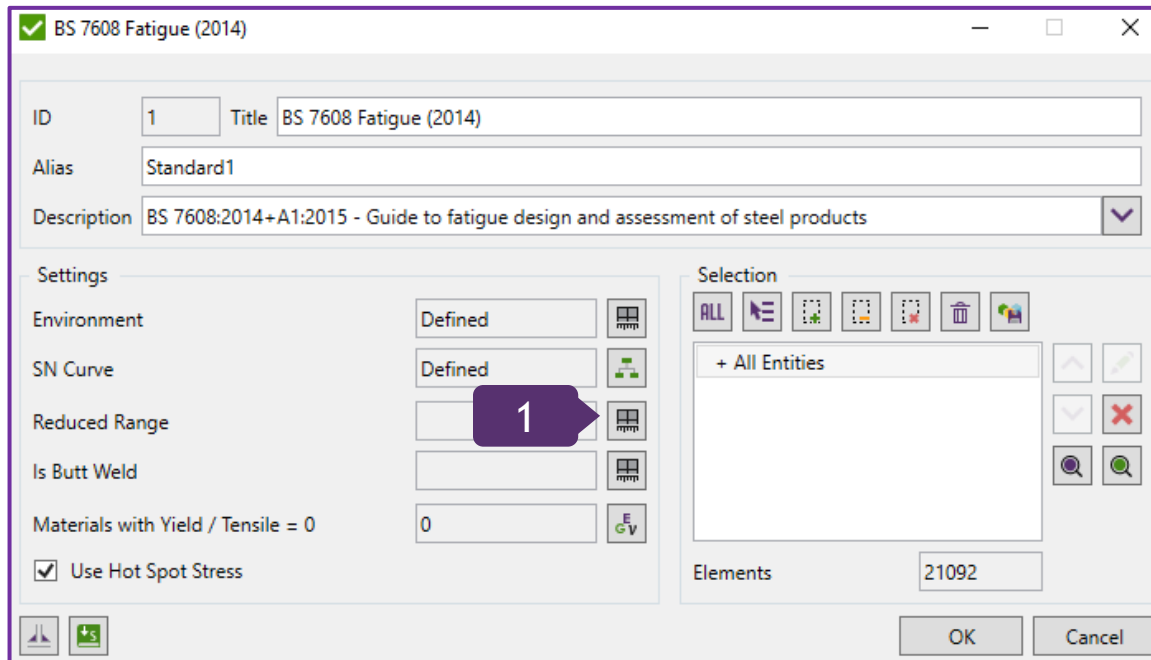
Define Reduced Range

1 Press  to define *Reduced Range*

2 Reduced Type: Reduced;
Press *To All*

3 Press *OK*

Reduced range - when the resultant stress range involves stress reversals through zero, the effective stress range to be used in the fatigue assessment should be obtained by adding 60% of the range from zero stress to maximum compressive stress of that part of the range from zero stress to maximum tensile stress. Clause 15.4 and 16.3.6;



BS 7608 Fatigue (2014)

ID: 1 Title: BS 7608 Fatigue (2014)

Alias: Standard1

Description: BS 7608:2014+A1:2015 - Guide to fatigue design and assessment of steel products

Settings

Environment: Defined

SN Curve: Defined

Reduced Range: **1**

Is Butt Weld:

Materials with Yield / Tensile = 0: 0

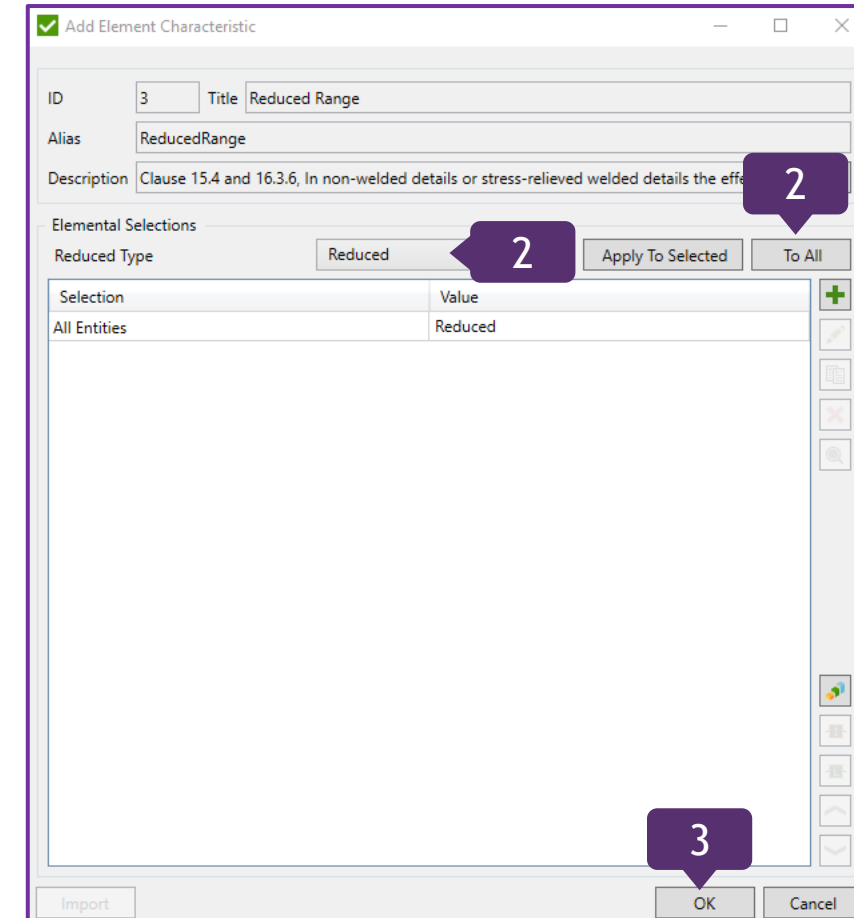
☒ Use Hot Spot Stress

Selection

+ All Entities

Elements: 21092

OK Cancel



Add Element Characteristic

ID: 3 Title: Reduced Range

Alias: ReducedRange

Description: Clause 15.4 and 16.3.6, In non-welded details or stress-relieved welded details the effective stress range is the reduced range

Elemental Selections

Reduced Type: Reduced **2** Apply To Selected To All

Selection	Value
All Entities	Reduced

3 OK Cancel

Define Is Butt Weld for all Entities

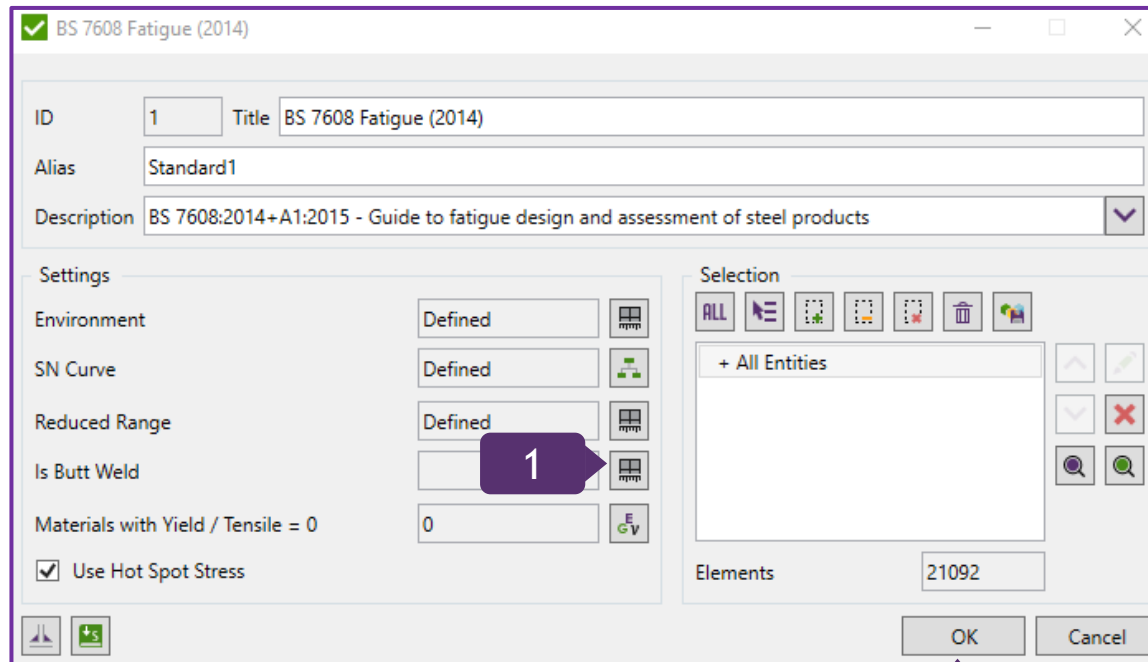
1 Press  to define *Is Butt Weld*

Is Butt Weld - select elements defined as butt welds. Used in calculations of thickness factor (formulas 6 and 7). Clause 16.3.2;

2 YesNoEnum: *No*;
Press *To All*

3 Press *OK*

4 Press *OK*



BS 7608 Fatigue (2014)

ID: 1 Title: BS 7608 Fatigue (2014)

Alias: Standard1

Description: BS 7608:2014+A1:2015 - Guide to fatigue design and assessment of steel products

Settings

Environment: Defined

SN Curve: Defined

Reduced Range: Defined

Is Butt Weld:  (1)

Materials with Yield / Tensile = 0: 0

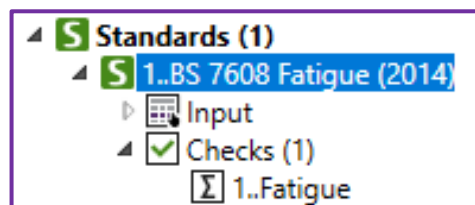
☒ Use Hot Spot Stress

Selection

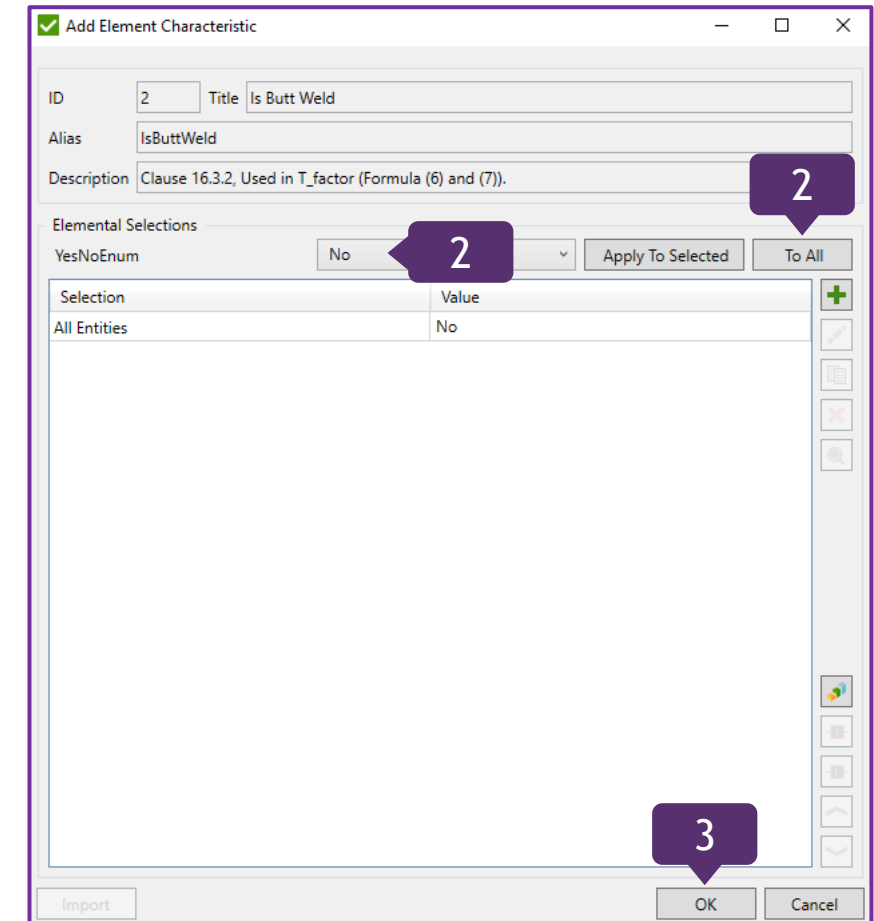
+ All Entities

Elements: 21092

OK Cancel



The Standard was added



Add Element Characteristic

ID: 2 Title: Is Butt Weld

Alias: IsButtWeld

Description: Clause 16.3.2, Used in T_factor (Formula (6) and (7)). (2)

Elemental Selections

YesNoEnum: No (2) Apply To Selected To All

Selection	Value
All Entities	No

OK Cancel

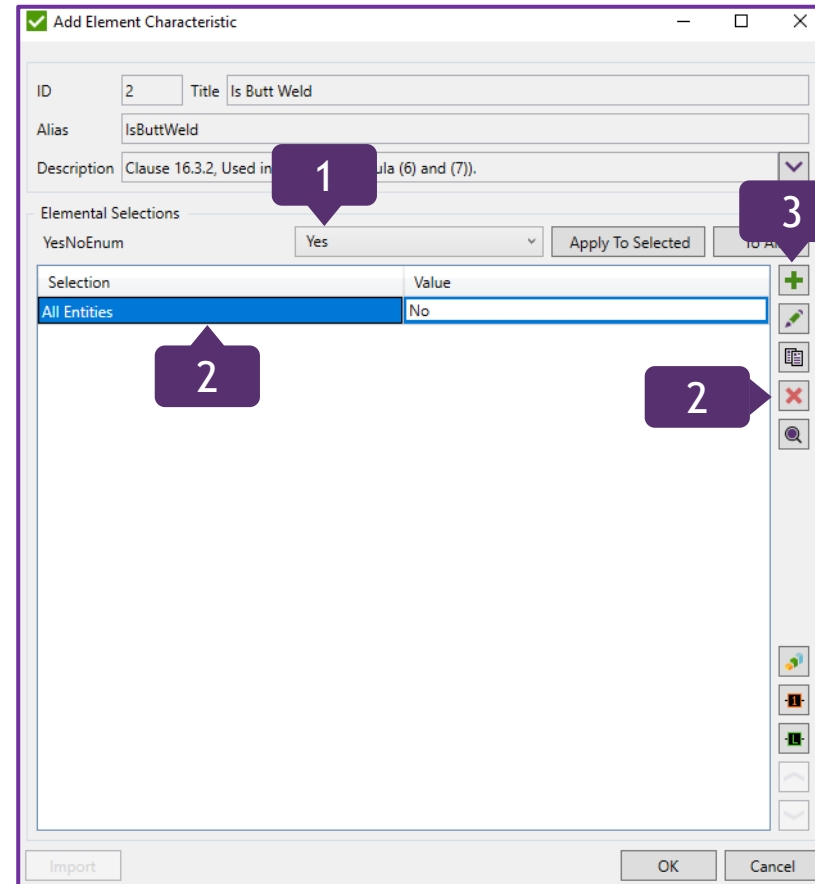
Define Is Butt Weld for Butt Welds (Optionally)

1 YesNoEnum: Yes

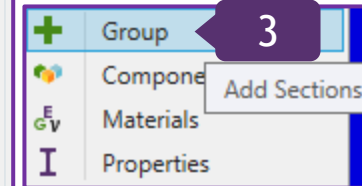
2 Select All Entities and press  to remove them

3 Press  and select *Group*

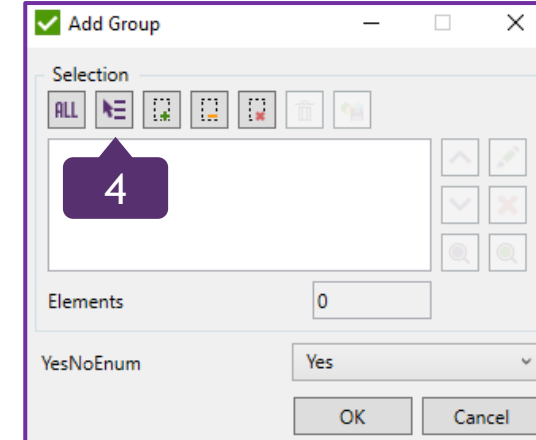
4 Press  and select Welds → By Weld Type



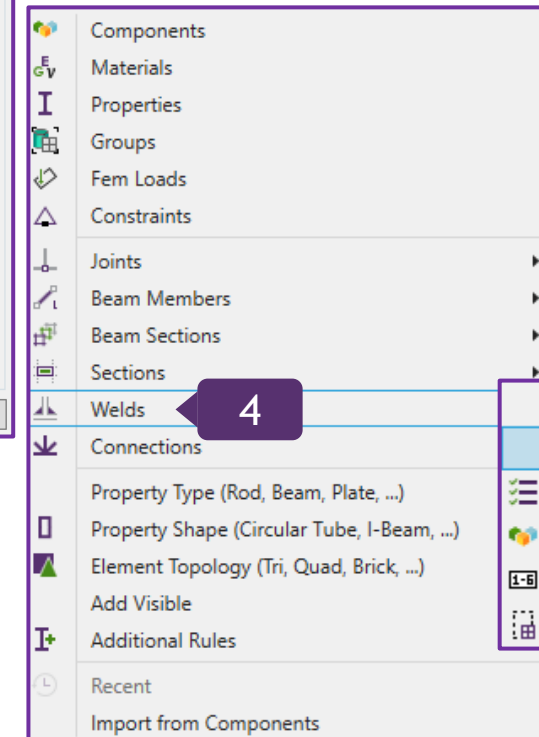
The 'Add Element Characteristic' dialog box is shown. It has fields for ID (2), Title (Is Butt Weld), Alias (IsButtWeld), and Description (Clause 16.3.2, Used in formula (6) and (7)). Below these is a table for 'Elemental Selections' with columns 'Selection' and 'Value'. The first row is 'All Entities' with a value of 'No'. A red 'X' icon is next to this row. The 'YesNoEnum' dropdown is set to 'Yes'. There are 'Apply To Selected' and 'To All' buttons. At the bottom are 'Import', 'OK', and 'Cancel' buttons.



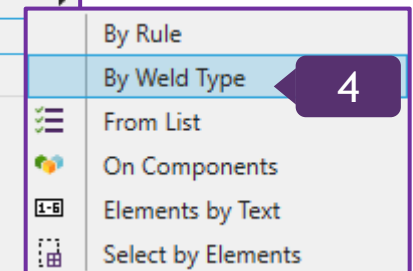
A menu is open with the 'Group' option selected. Other options include 'Components', 'Materials', and 'Properties'. A red 'X' icon is next to the 'Group' option.



The 'Add Group' dialog box is shown. It has a 'Selection' dropdown set to 'ALL'. Below it is a list of 'Elements' (0). The 'YesNoEnum' dropdown is set to 'Yes'. There are 'OK' and 'Cancel' buttons.



A menu is open with the 'Welds' option selected. Other options include 'Connections', 'Property Type (Rod, Beam, Plate, ...)', 'Property Shape (Circular Tube, I-Beam, ...)', 'Element Topology (Tri, Quad, Brick, ...)', 'Add Visible', 'Additional Rules', 'Recent', and 'Import from Components'.



A sub-menu is open with the 'By Weld Type' option selected. Other options include 'By Rule', 'From List', 'On Components', 'Elements by Text', and 'Select by Elements'.

The purpose of this slide is to show the steps on how to add Butt Welds to the Selection and set YesNoEnum YES.

Define Is Butt Weld for Butt Welds (Optionally) (Continuation)

5

Operation: *Add*;
Weld Type: *Butt Welds*

6

Press *OK*

7

Press *OK*

8

Press *OK*

The purpose of this slide is to show the steps on how to add Butt Welds to the Selection and set YesNoEnum YES.

Welds By Type Condition

Operation: Add

Weld Type: Butt Welds

Weld Parts Count: = 2

Angle Between Weld Parts: <: 5

OK Cancel

Add Group

Selection

+ Butt Welds

Elements: 122

YesNoEnum: Yes

OK Cancel

7

Add Element Characteristic

ID: 2 Title: Is Butt Weld

Alias: IsButtWeld

Description: Clause 16.3.2, Used in T_factor (Formula (6) and (7)).

Elemental Selections

YesNoEnum: Yes Apply To Selected To All

Selection	Value
Butt Welds	Yes

Import OK Cancel

8

Create Extreme Table

1 Execute right click on 1..Fatigue and select *Table (expand/extreme)*

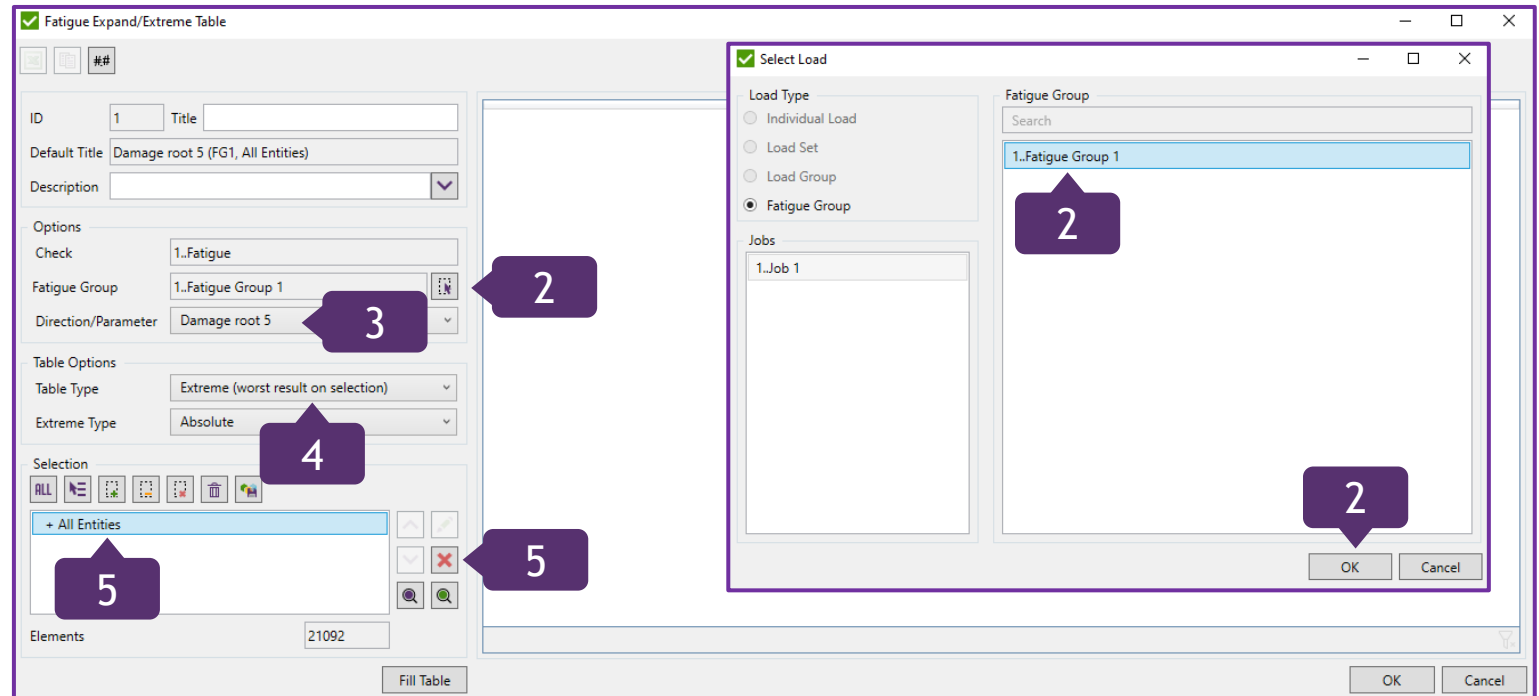
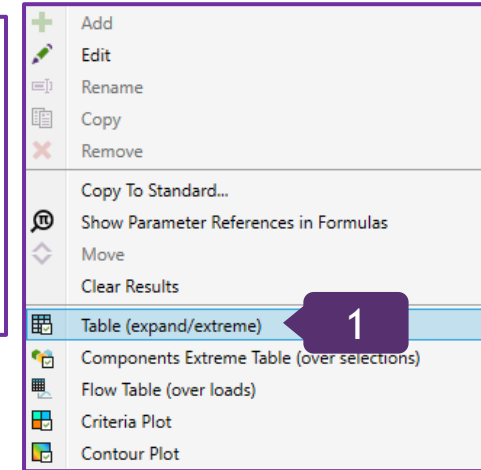
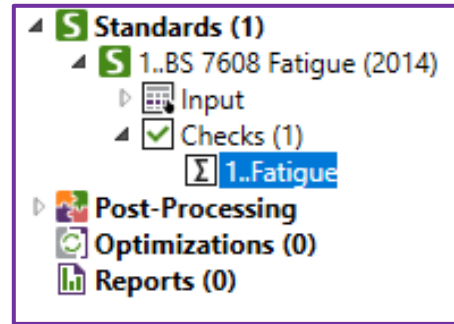
2 Load Group: *Fatigue Group* and press *OK*

Fatigue check supports only Load Groups. If only one load group exist in the project it will be selected automatically.

3 Direction/Parameter: *Damage root 5*

4 Table Type: *Extreme (worst results on selection)*

5 Select *+All Entities* and press  to remove them



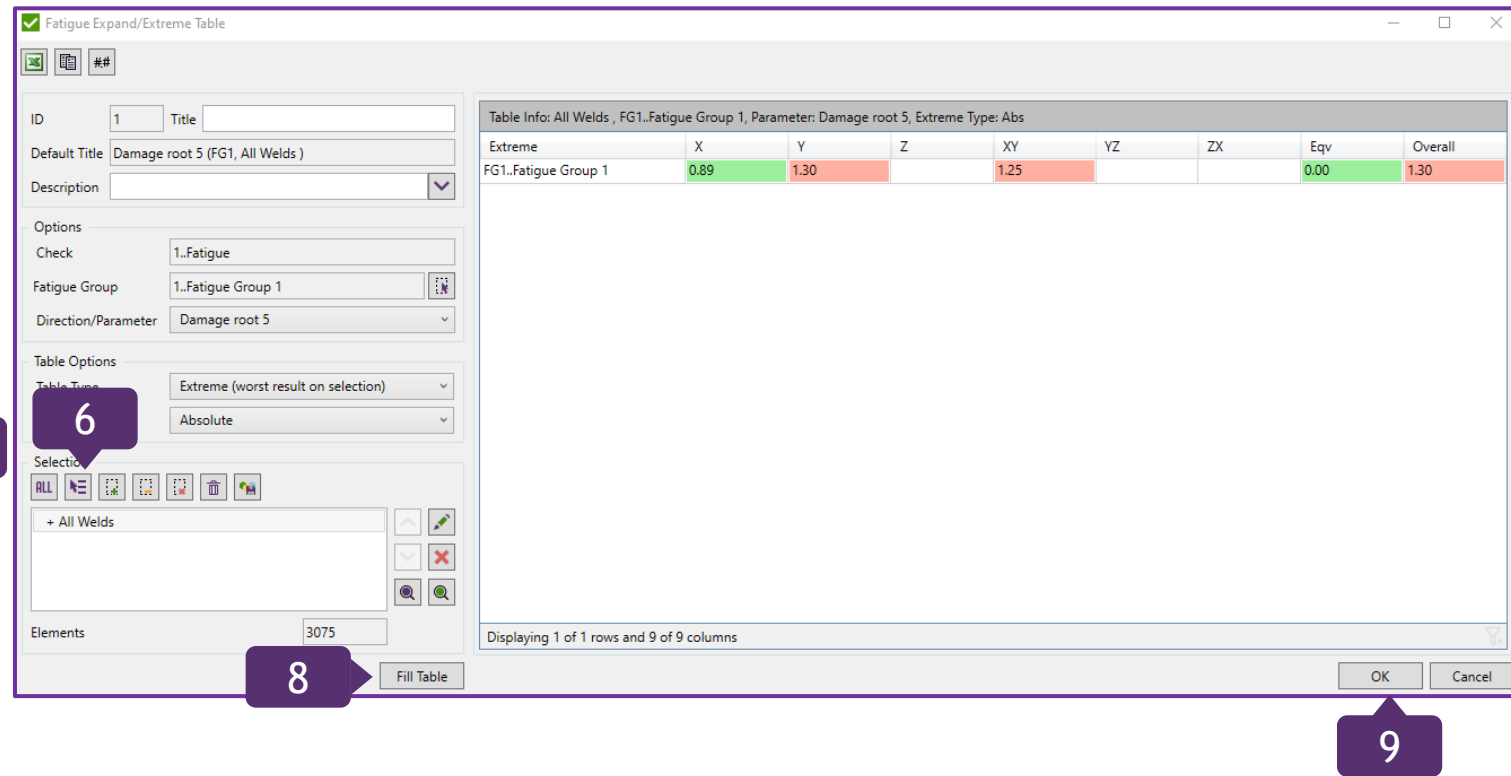
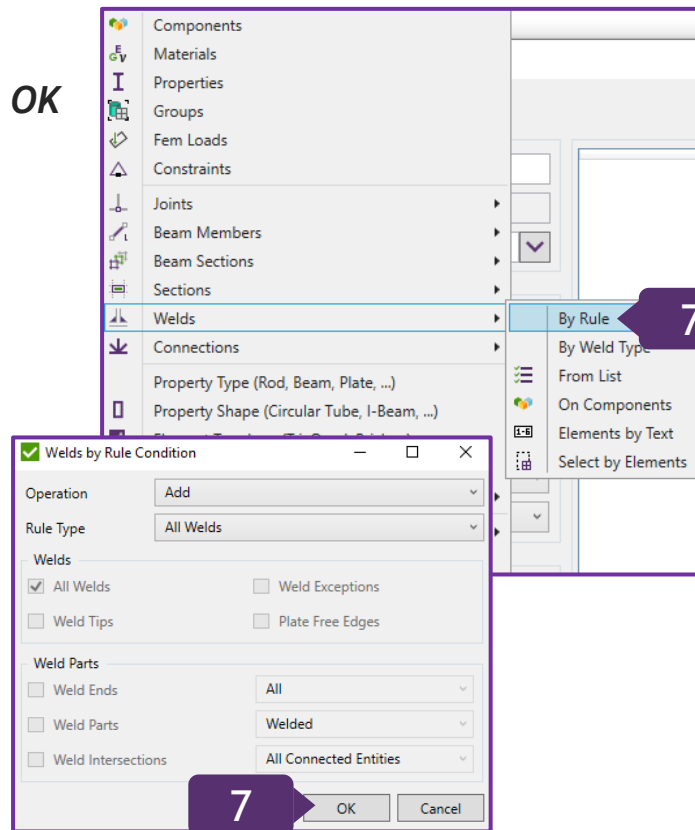
Create Extreme Table (Continuation)

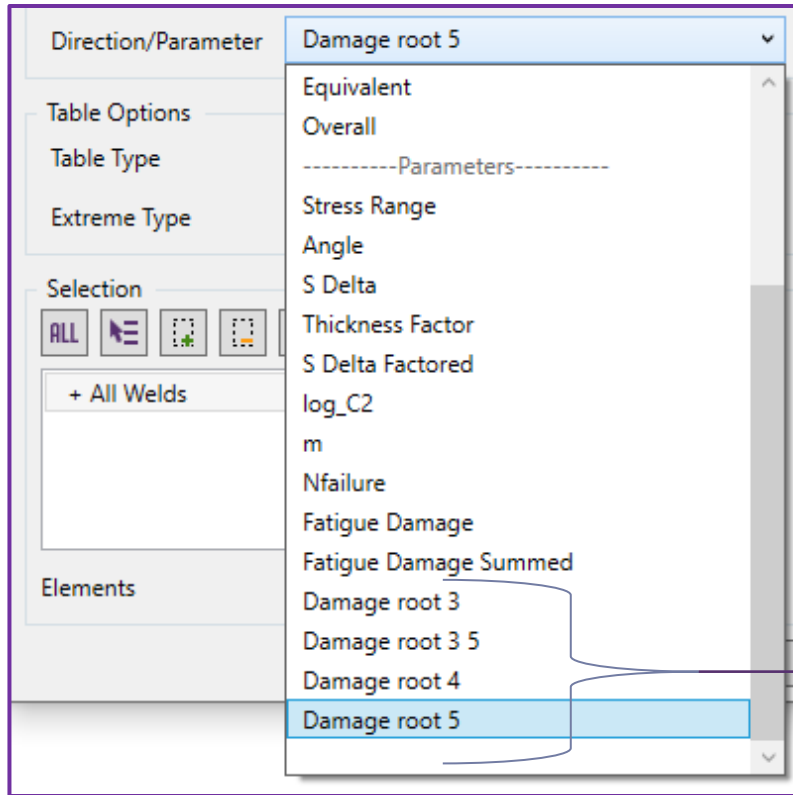
6 In Selection, press 

7 Select *Welds* => *By Rule* and press OK

8 Press *Fill Table*

9 Press OK





```
Parameter = Nfailure (Nfailure)
Description: Clause 16.2.1, Amount of cycles to failure
All: pow(10, log_C2 - m * log10(Units.GetInMPa(SDeltaFactored)))

Parameter = Fd (Fatigue Damage)
All: ItemNumberOfCycles / Nfailure

Summation = FdSummed (Fatigue Damage Summed)
All: Fd
Equivalent: absmax(me.x, me.y, me.xy)
Overall: absmax(me.x, me.y, me.xy)

Fatigue Group Parameter = Fd root 3 (Damage root 3)
Description: This parameter is used to estimate stress overshoots for m = 3
All: root(Fdsummed, 3)
Eqv: 0
Overall: AbsMax(me.x, me.y, me.z, me.xy, me.yz, me.zx)

Fatigue Group Parameter = Fd root 3 5 (Damage root 3 5)
Description: This parameter is used to estimate stress overshoots for m = 3.5
All: root(Fdsummed, 3.5)
Eqv: 0
Overall: AbsMax(me.x, me.y, me.z, me.xy, me.yz, me.zx)

Fatigue Group Parameter = Fd root 4 (Damage root 4)
Description: This parameter is used to estimate stress overshoots for m = 4
All: root(Fdsummed, 4)
Eqv: 0
Overall: AbsMax(me.x, me.y, me.z, me.xy, me.yz, me.zx)

Fatigue Group Parameter = Fd root 5 (Damage root 5)
Description: This parameter is used to estimate stress overshoots for m = 5
All: root(Fdsummed, 5)
Eqv: 0
Overall: AbsMax(me.x, me.y, me.z, me.xy, me.yz, me.zx)
```

When calculating Fatigue Damage (and later Fatigue Damage Summed), the formulas according to Standards usually include raising the power of “m” (the slope of the SN Curve).

Damage root X parameters allow engineers to check for more practical results (how much it is required to lower the stresses in order to obtain acceptable results.)

Create Criteria Plot for All Welds

1 Execute right click on 1..Fatigue and select Criteria Plot

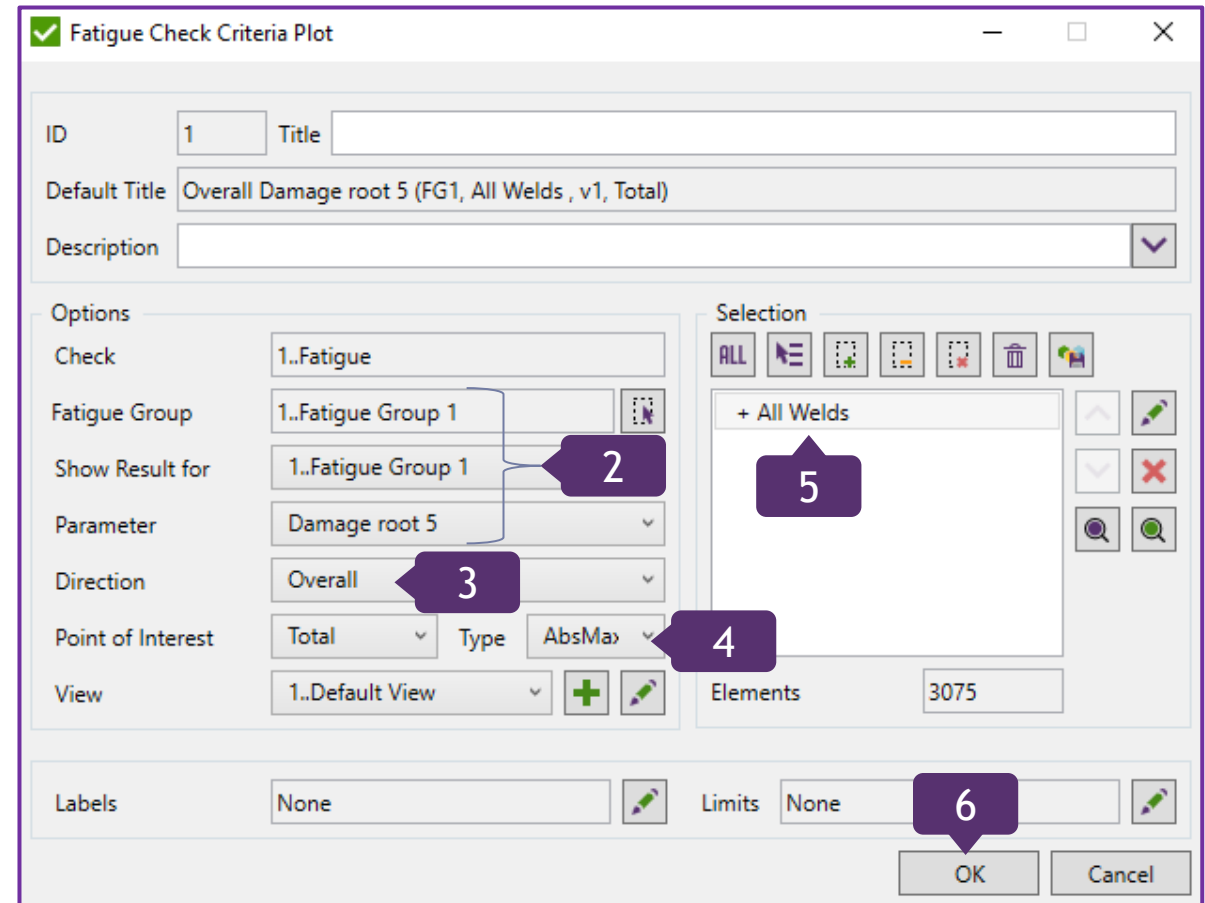
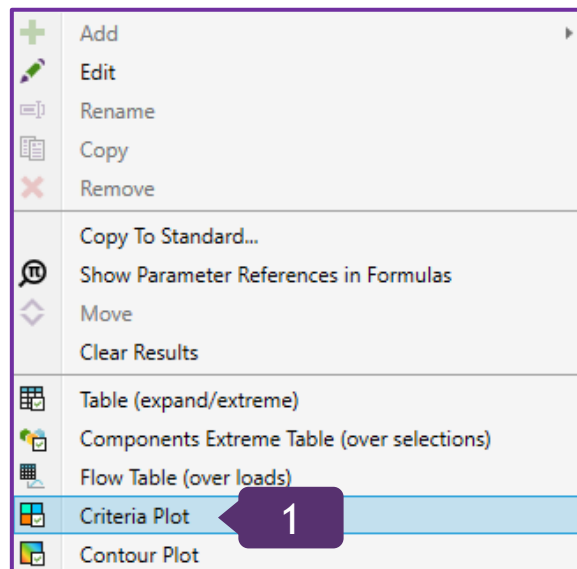
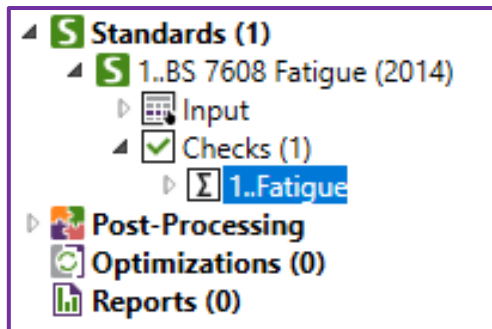
2 Load Group and Show Results for:
1..Fatigue Group 1;
Parameter: *Damage root 5*

3 Direction: *Overall*

4 Point of interest: Total; Type: *AbsMax*

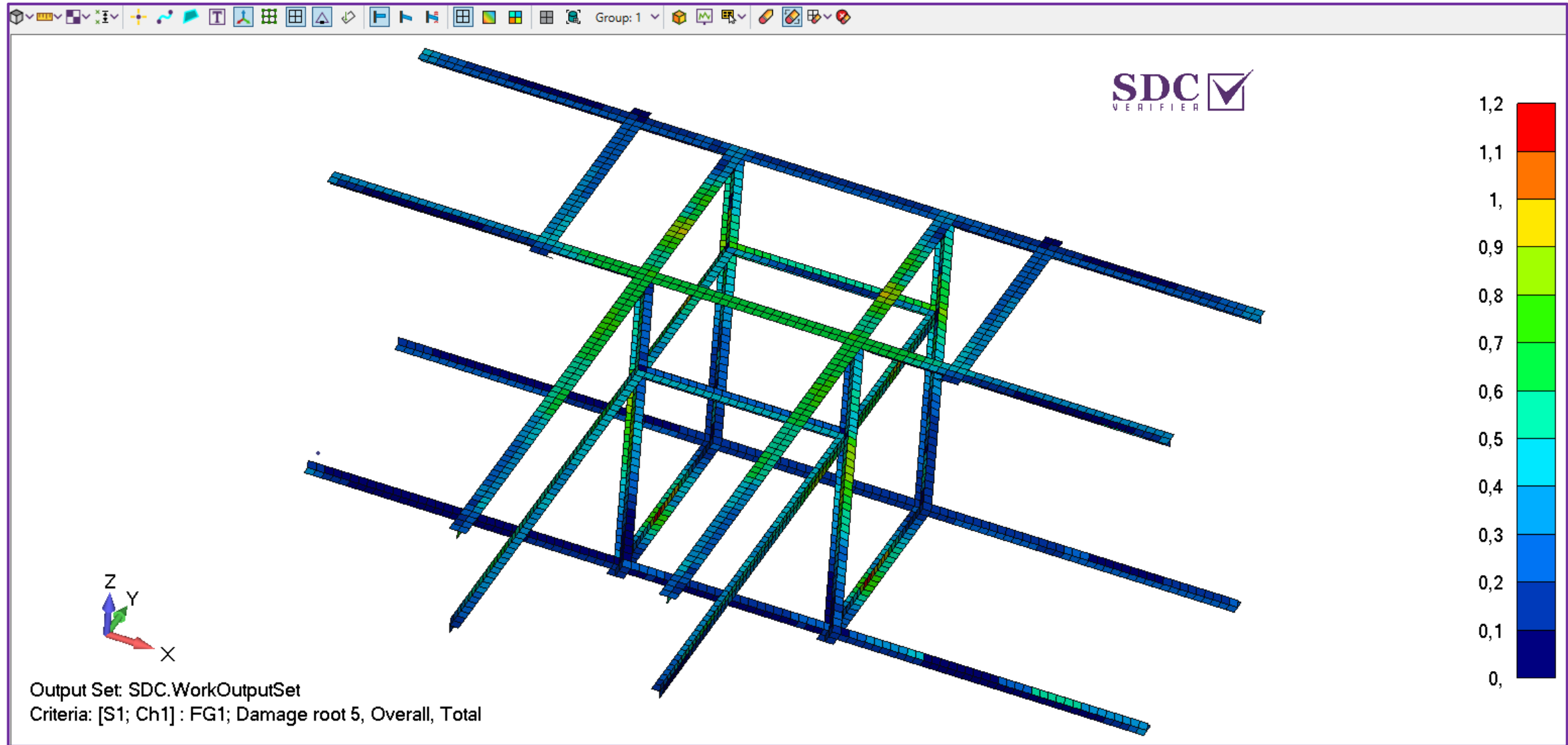
5 Selection: + *All Welds*

6 Press *OK*



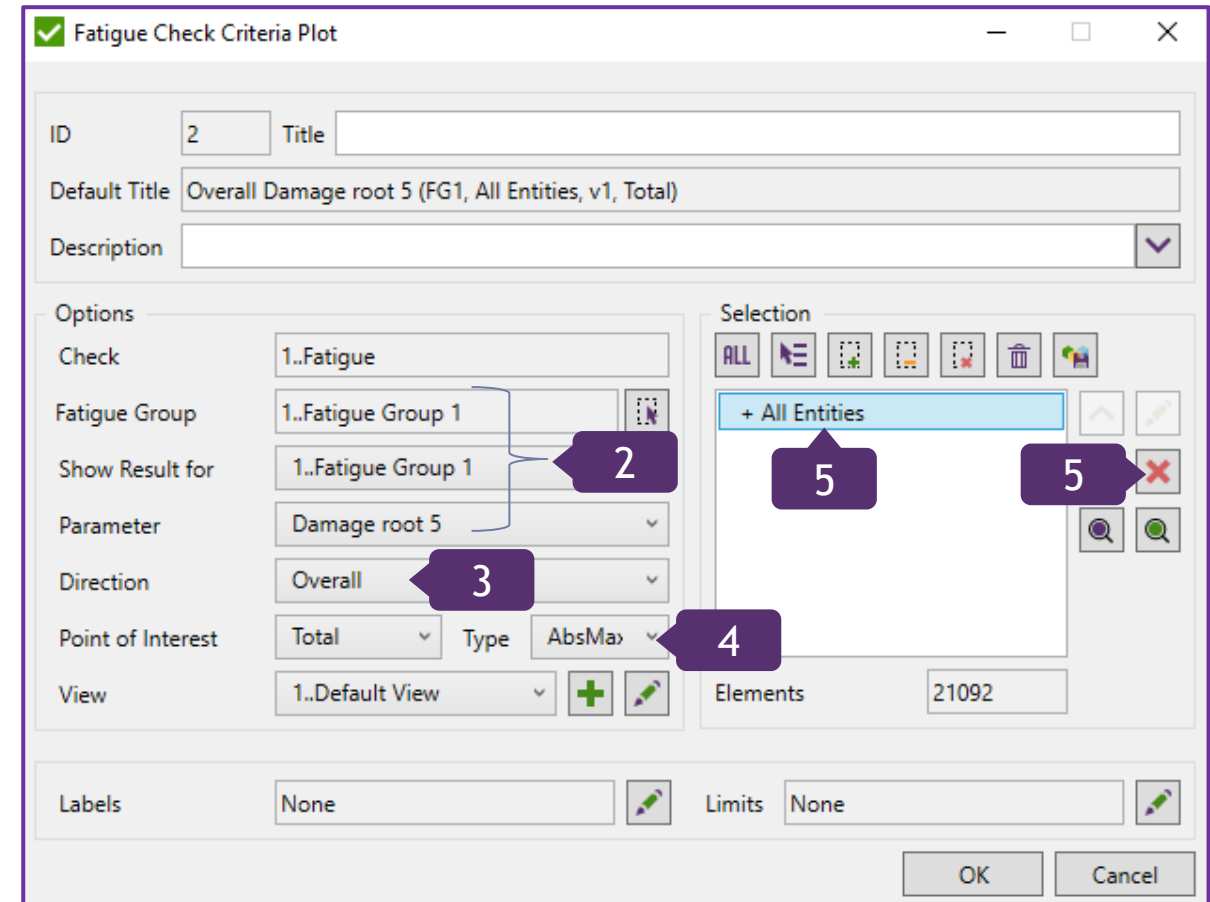
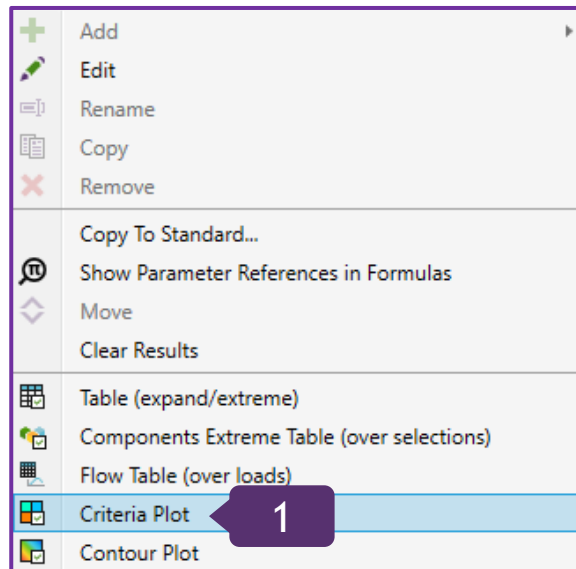
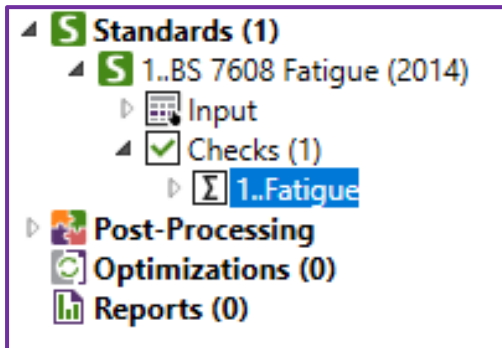
Point of interest = AbsMax Total is an absolute maximum of utilization factors among all point of interest.

Criteria Plot Results for All Welds



Create Criteria Plot for Property Shape (Plate)

- 1 Execute right click on 1..Fatigue and select Criteria Plot
- 2 Load Group and Show Results for: 1..Fatigue Group 1; Parameter: *Damage root 5*
- 3 Direction: *Overall*
- 4 Point of interest: Total; Type: *AbsMax*
- 5 Select *+All Entities* and press  to remove them



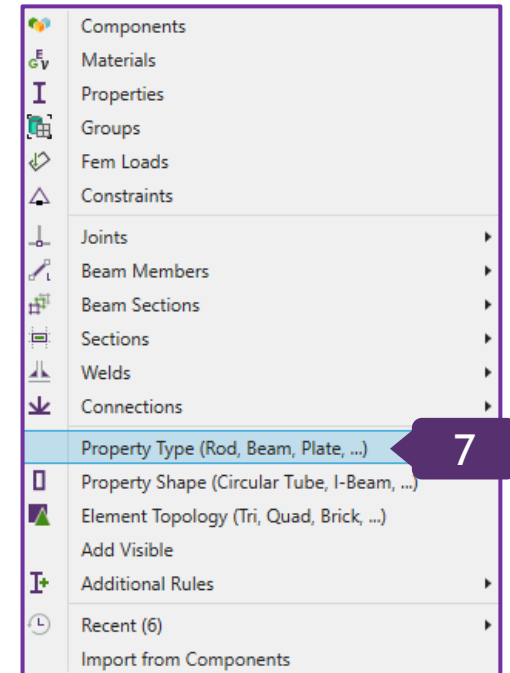
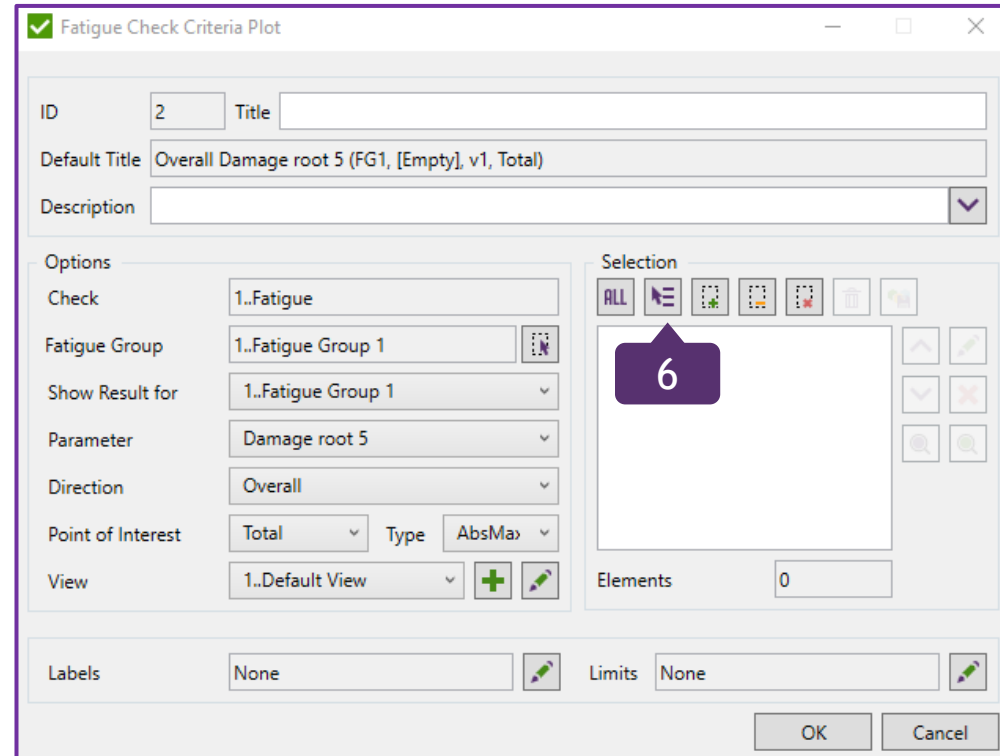
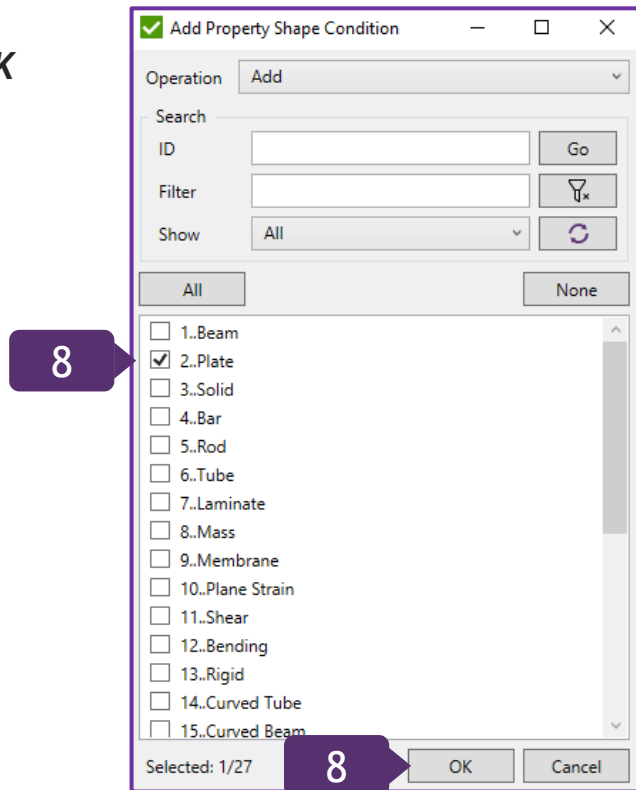
Create Criteria Plot for Property Shape (Plate) (Continuation)

6 In Selection, press 

7 Select *Property Type (Rod, Beam, Plate,...)*

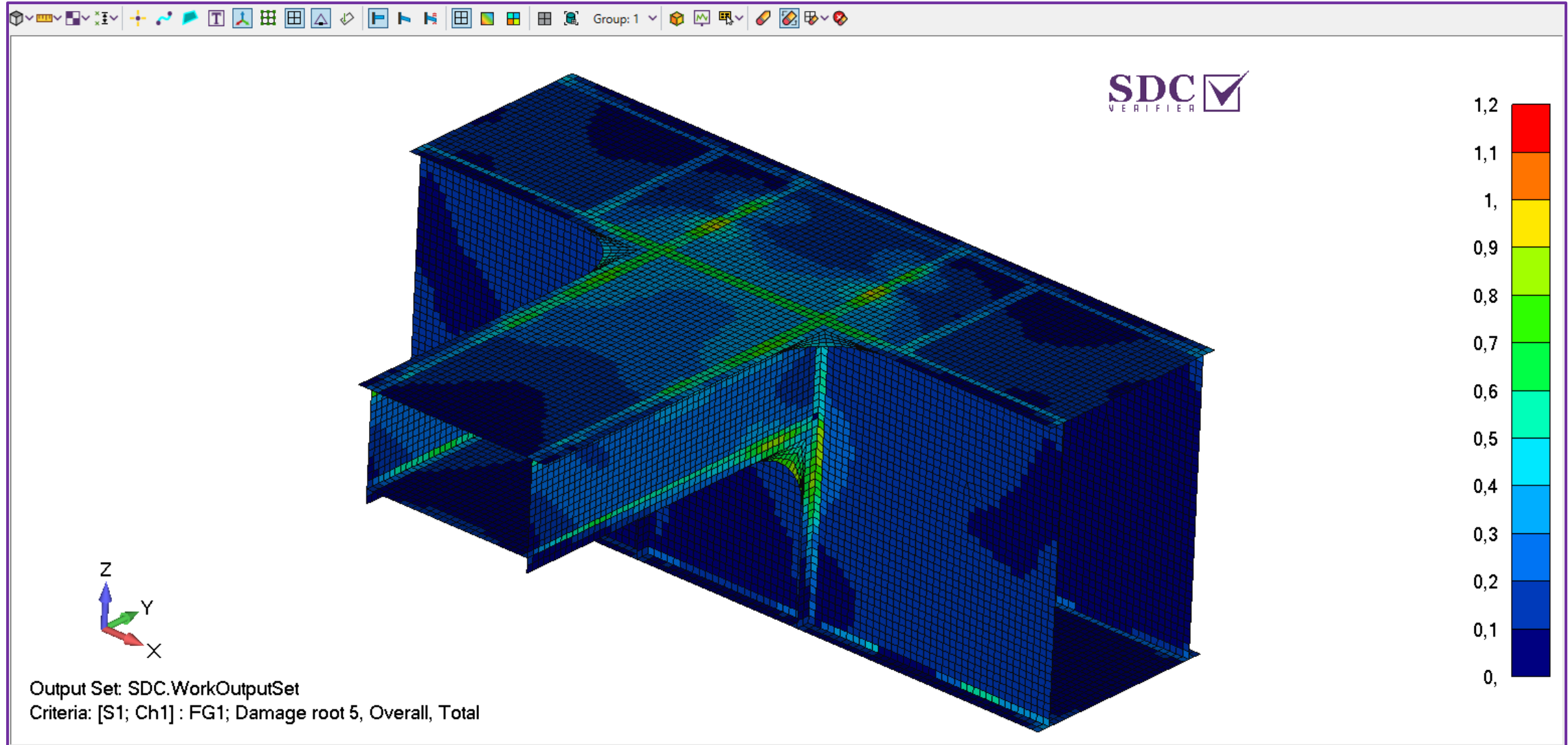
8 Select *2..Plate* and press OK

9 Press OK



Criteria Plot type shows that each element is coloured, based on a single output value for the element.

Criteria Plot Results for Property Shape (Plate)



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

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