SDC VERIFIER

Tutorial

Structural Checks according to Standards

Updated on: December 13th, 2023

Tested with: SDC Verifier 2023 R2.1

Content

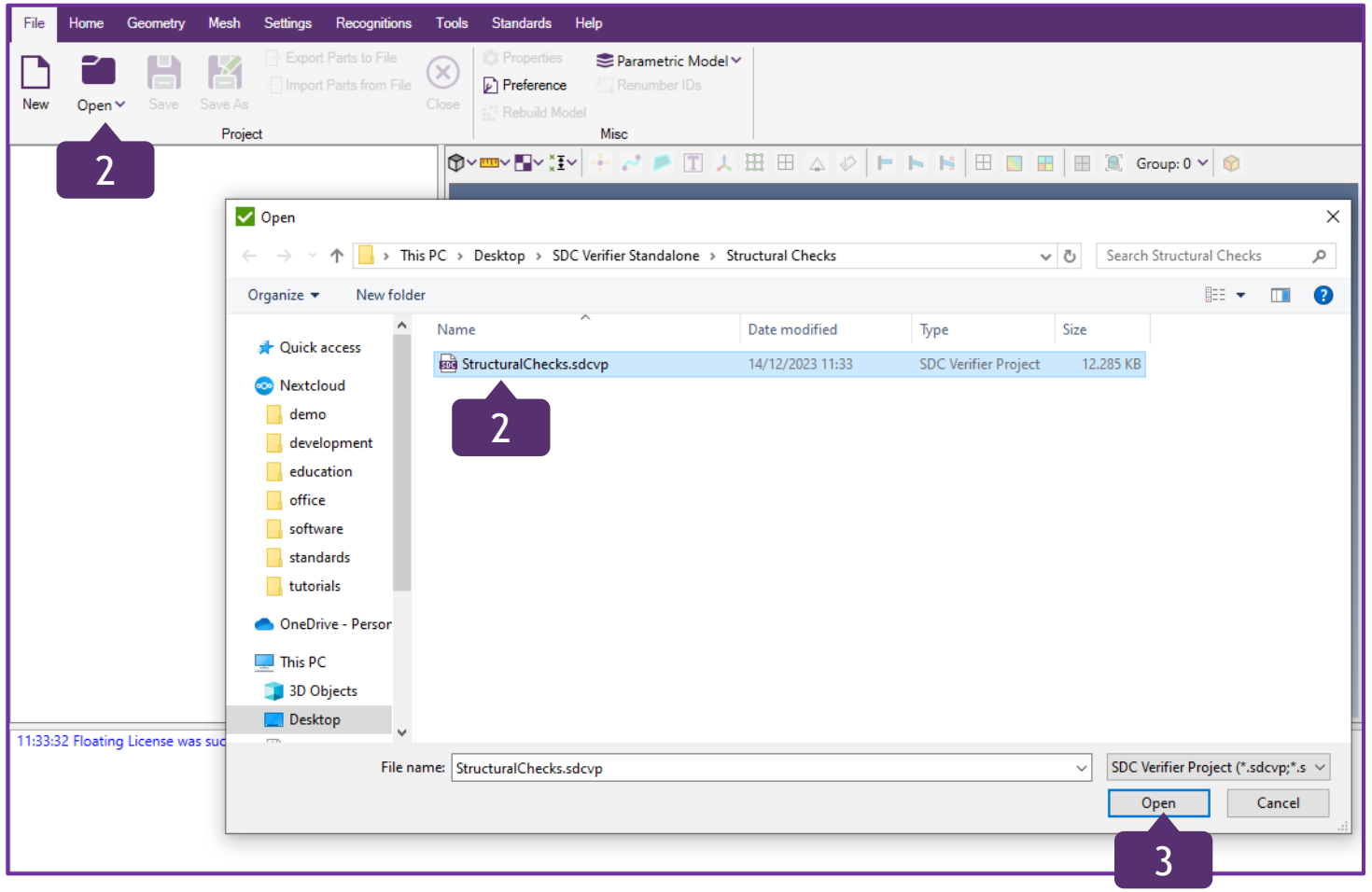
SDC Verifier is a powerful all-in-one software solution for structural design, FEA analysis, and verification according to standards.

This step-by-step tutorial is designed to ***get*** you ***started*** with the main SDC Verifier features.
You will learn how to:

- Launch SDC Verifier;
- Recognize Beam Members;
- Analyse the model with Nastran solver
- Add two Standards: AISC 360-22 Members (2022) and Eurocode3 Fatigue (EN 1993-1-9, 2005);
- Run Beam Member Check;
- Recognise and preview Welds;
- Run Fatigue Check;
- Create Criteria Plot for fatigue Check

Open the Starter Model

1. **Launch SDC Verifier 2023 R2.1**
2. **Press Open and select project *StructuralChecks***
3. **Press *Open***

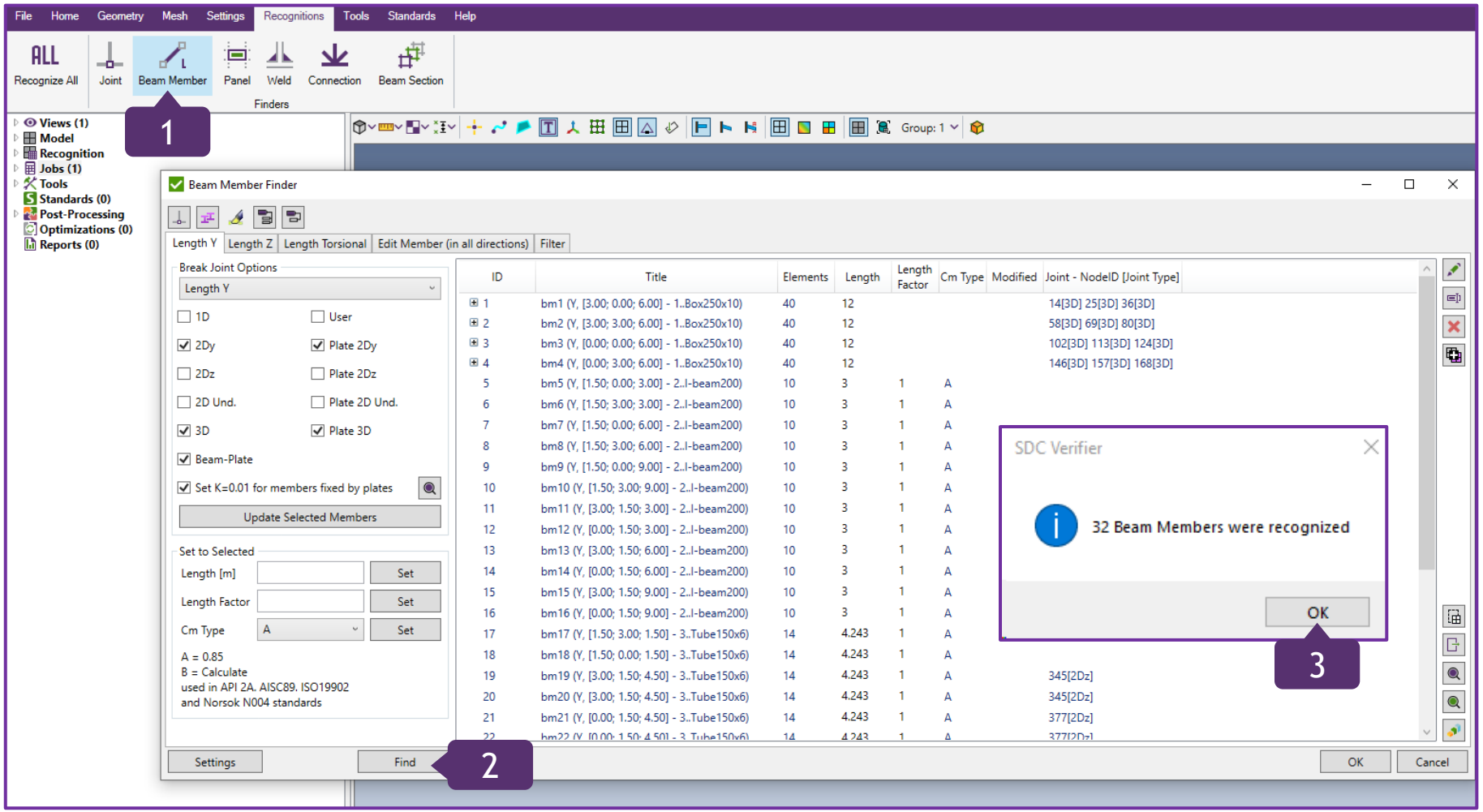


Beam Members Recognition

1. In *Recognitions* tab, press on *Beam Member*
2. Press *Find*
3. Press *OK*

The Recognitions tab provides users with a variety of Recognition Tools to define such structural members as Joints, Beam Members, Panels, Welds, Connections and Beam Sections. Recognize All command allows to define all structural members at once and for a short period of time.

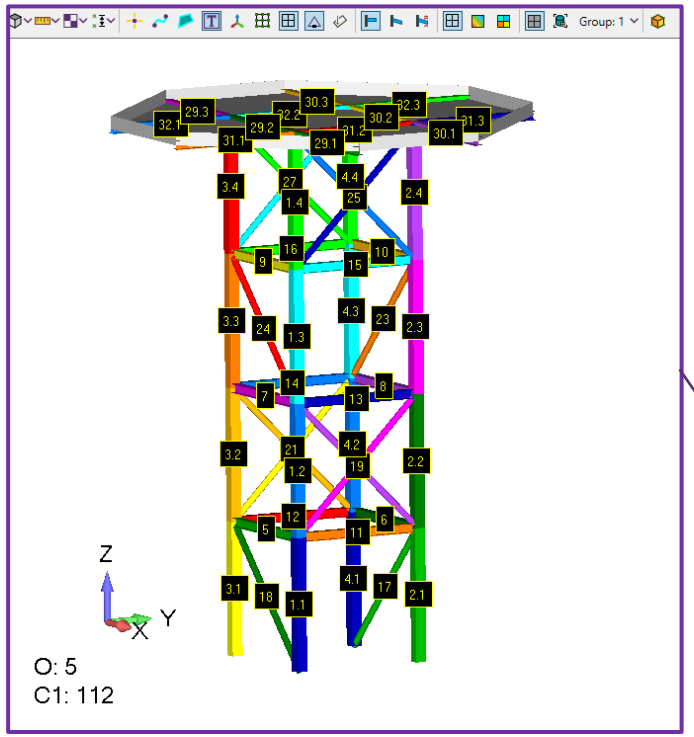
The Beam Member Finder Tool detects the beams on the model in all directions: Length Y, Length Z and Length Torsional.



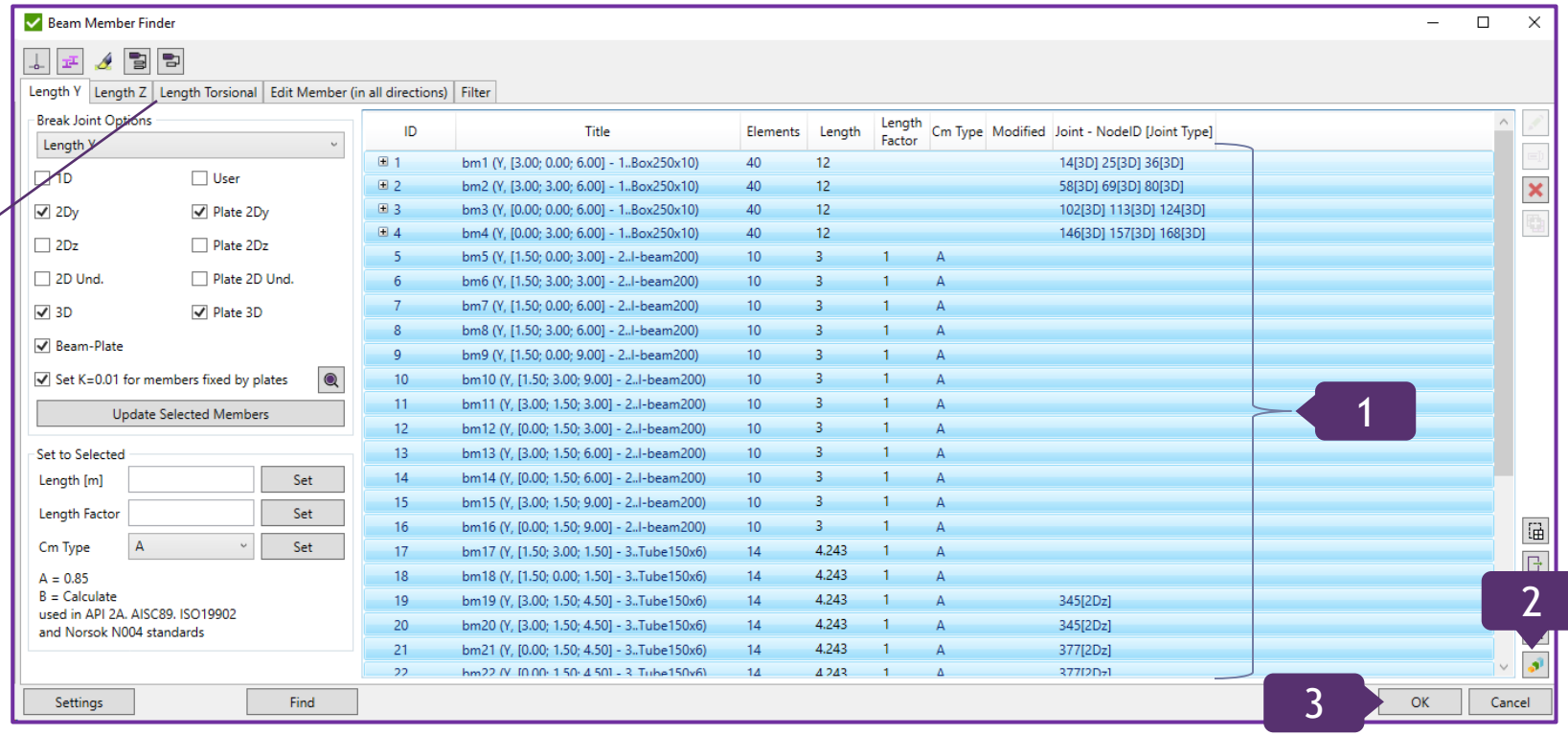
Plot Beam Members

1. In Length Y section, with Ctrl+A combination, select all Beam Members
2. Press  and select *Plot Members ID Labels*;
3. Press *OK*

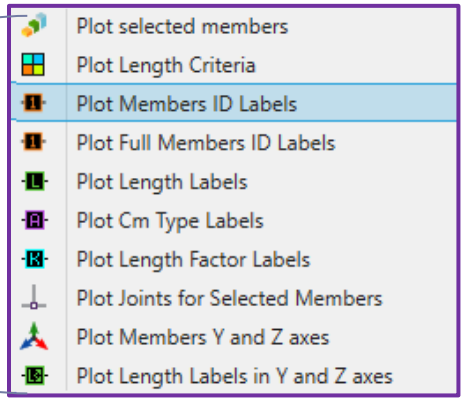
Plotting can be done in Length Z and Length Torsional sections as well.



The members have been recognized and the forces will been summarized.



In order to make sure that the recognition has been carried out properly, other Plotting options can be selected .



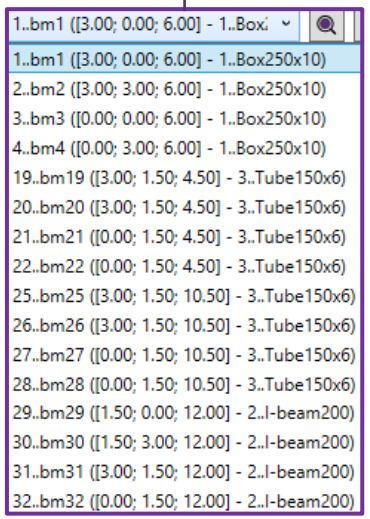
Beam Member Finder Editing Functionality

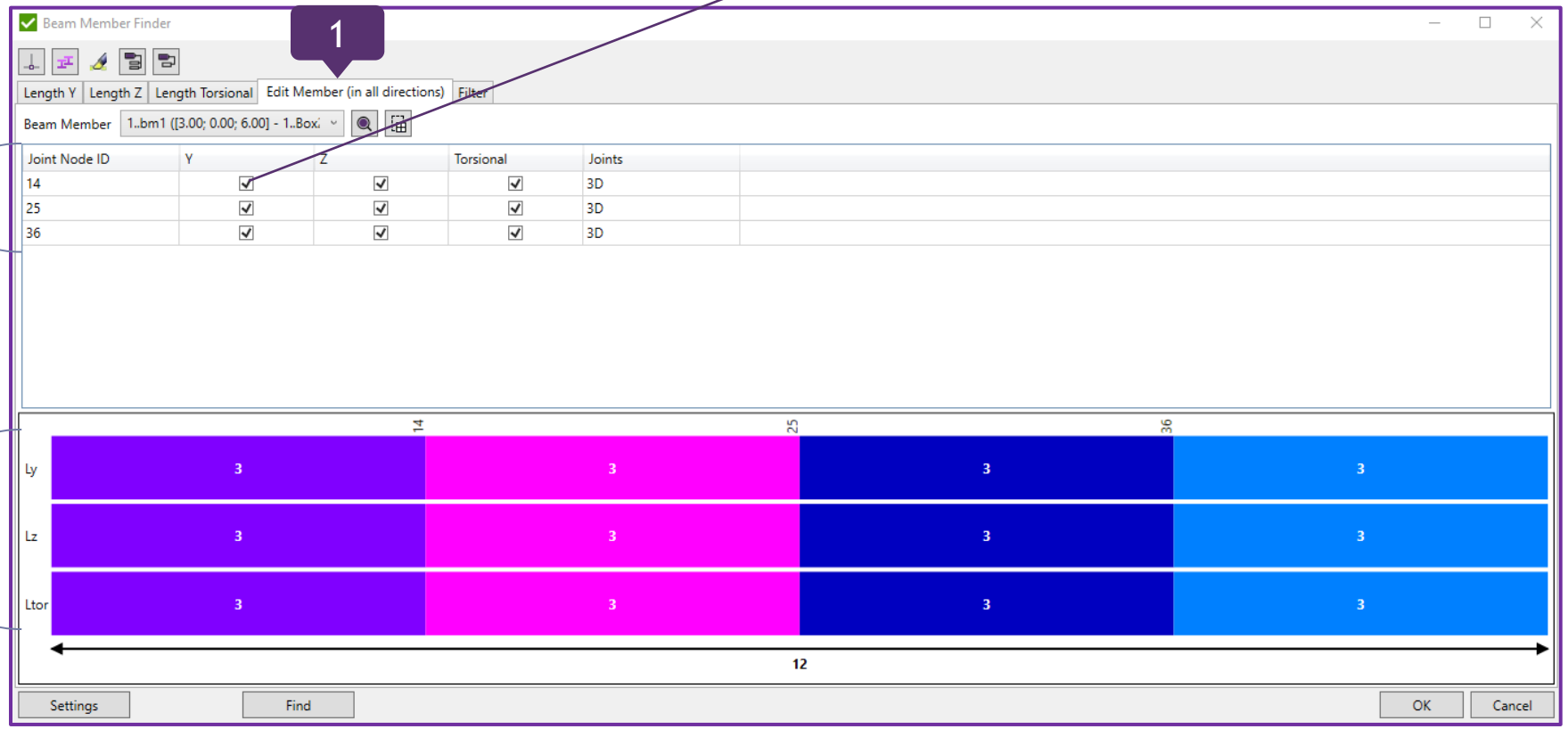
1 **Press *Edit Member (in all directions)* section to modify the configurations**

If necessary, the connections can be added or removed in the relevant points to split them manually.

In this case, the big member is split into four sub-members in Joint Node ID 14, 25 and 36

The specific Members can be edited by nodes.



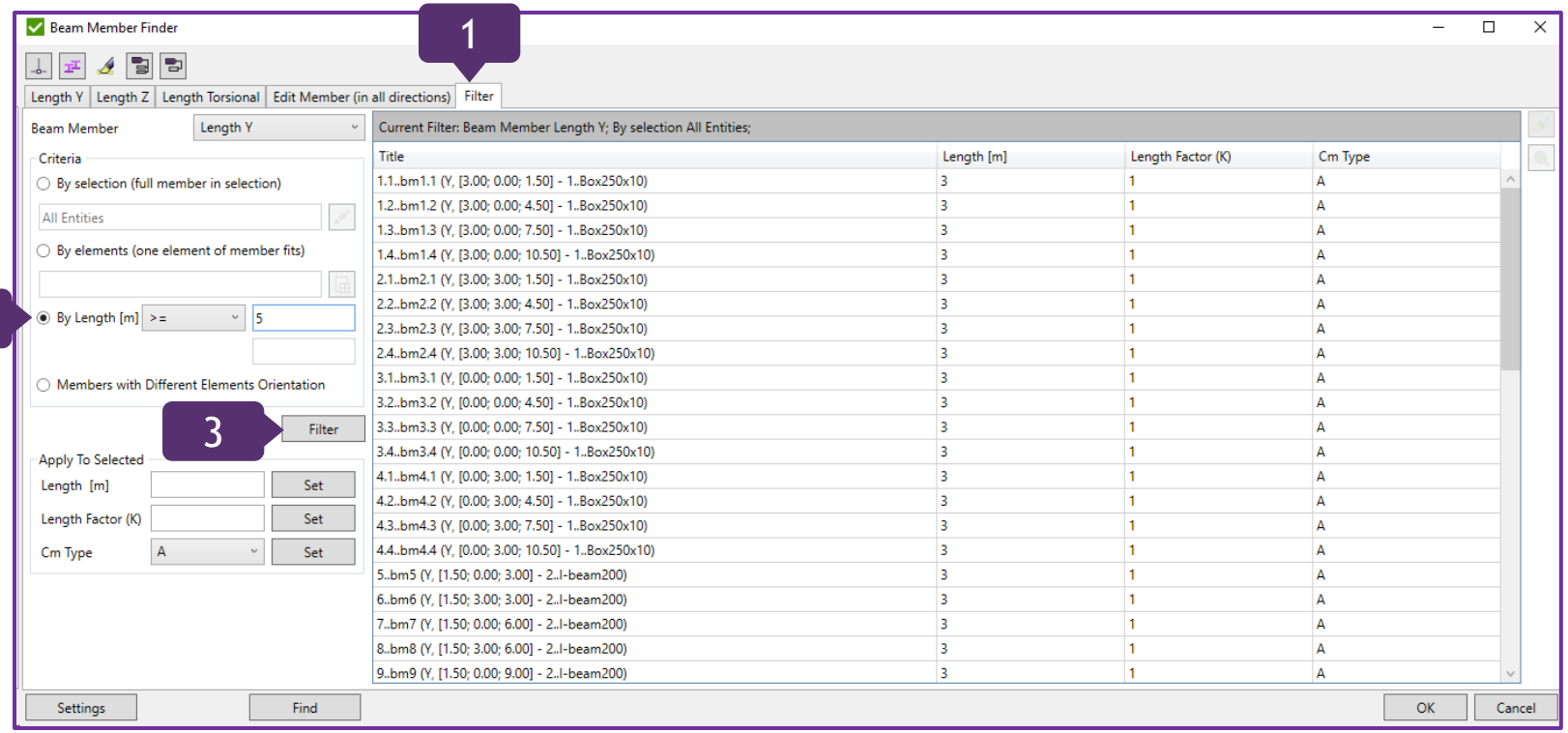


Beam Member Finder Filter Functionality

This slide is devoted to demonstrative purposes of Filter section functionality.

Filter section allows to single out the groups of beams with the similar parameters.

1. Press *Filter* section
2. *By Length [m]* is *ON*; Select >= and *5*
3. Press *Filter*



The filtered members by Length

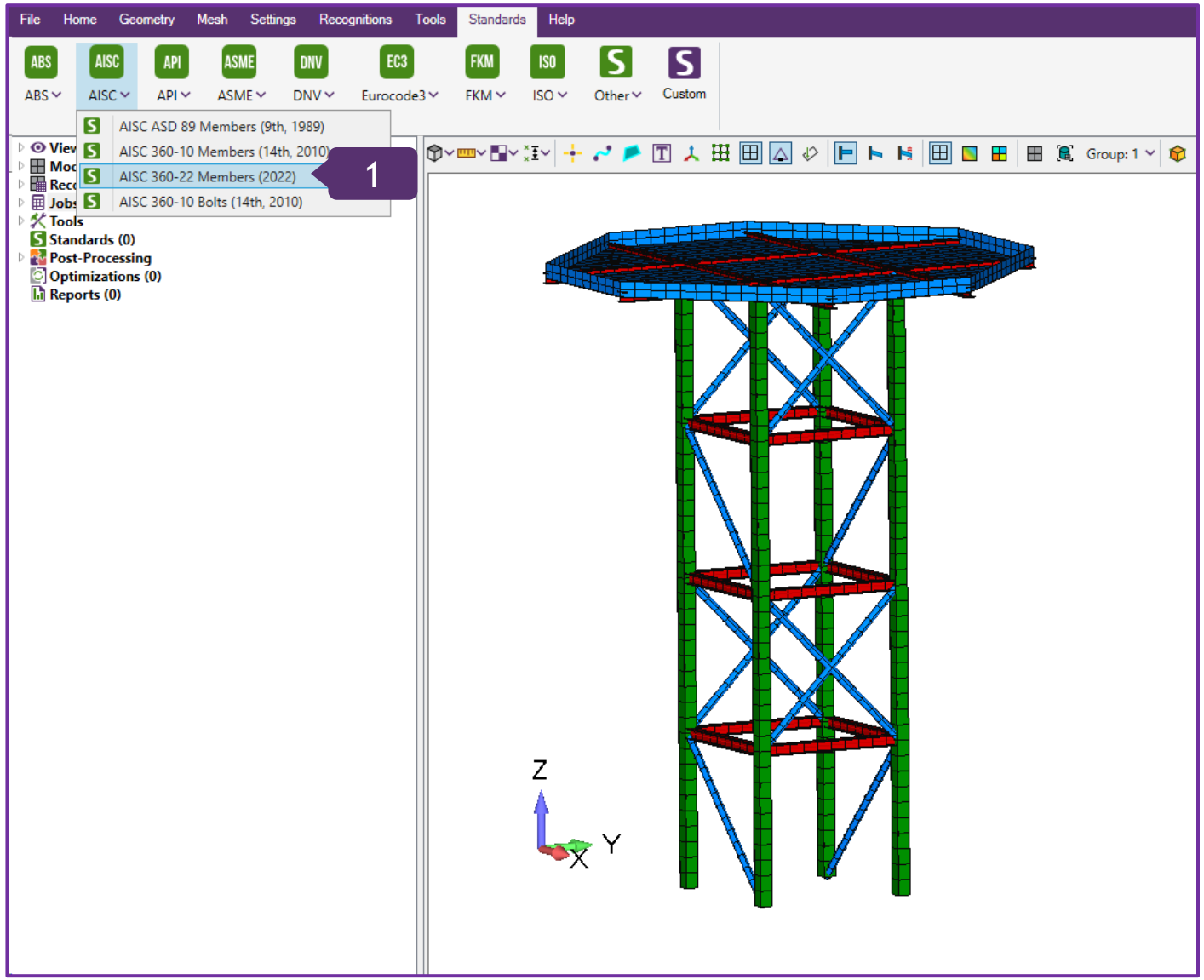
Current Filter: Beam Member Length Y; By Length>= 5

Title	Length [m]	Length Factor (K)	Cm Type
1..bm1 (Y, [3.00; 0.00; 6.00] - 1..Box250x10)	12	1	A
2..bm2 (Y, [3.00; 3.00; 6.00] - 1..Box250x10)	12	1	A
3..bm3 (Y, [0.00; 0.00; 6.00] - 1..Box250x10)	12	1	A
4..bm4 (Y, [0.00; 3.00; 6.00] - 1..Box250x10)	12	1	A
29..bm29 (Y, [1.50; 0.00; 12.00] - 2..I-beam200)	9	1	A
30..bm30 (Y, [1.50; 3.00; 12.00] - 2..I-beam200)	9	1	A
31..bm31 (Y, [3.00; 1.50; 12.00] - 2..I-beam200)	9	1	A
32..bm32 (Y, [0.00; 1.50; 12.00] - 2..I-beam200)	9	1	A

Add AISC 360-22 Members (2022) Standard

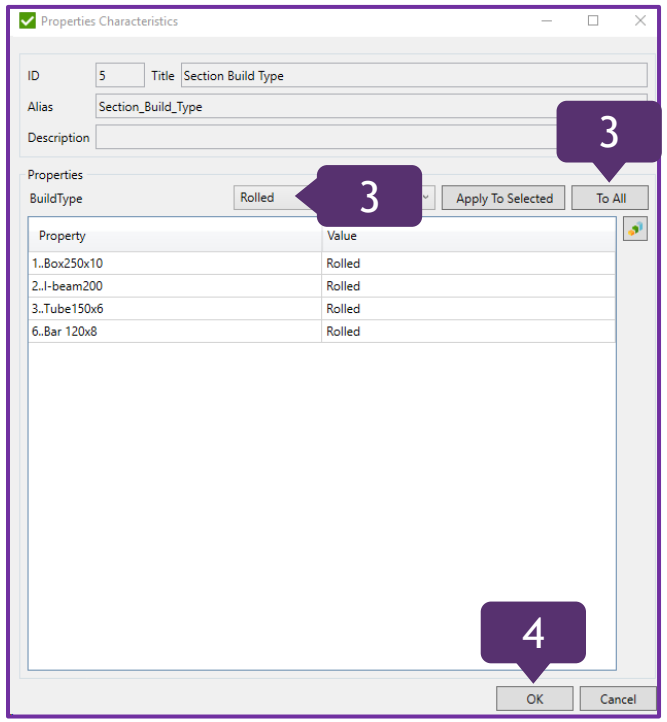
1. In *Standards* section of the *Ribbon*, press on *AISC* and select *AISC 360-22 Members (2022)*

Standards can be added either through the Model Tree, or in the Ribbon – Standards section.

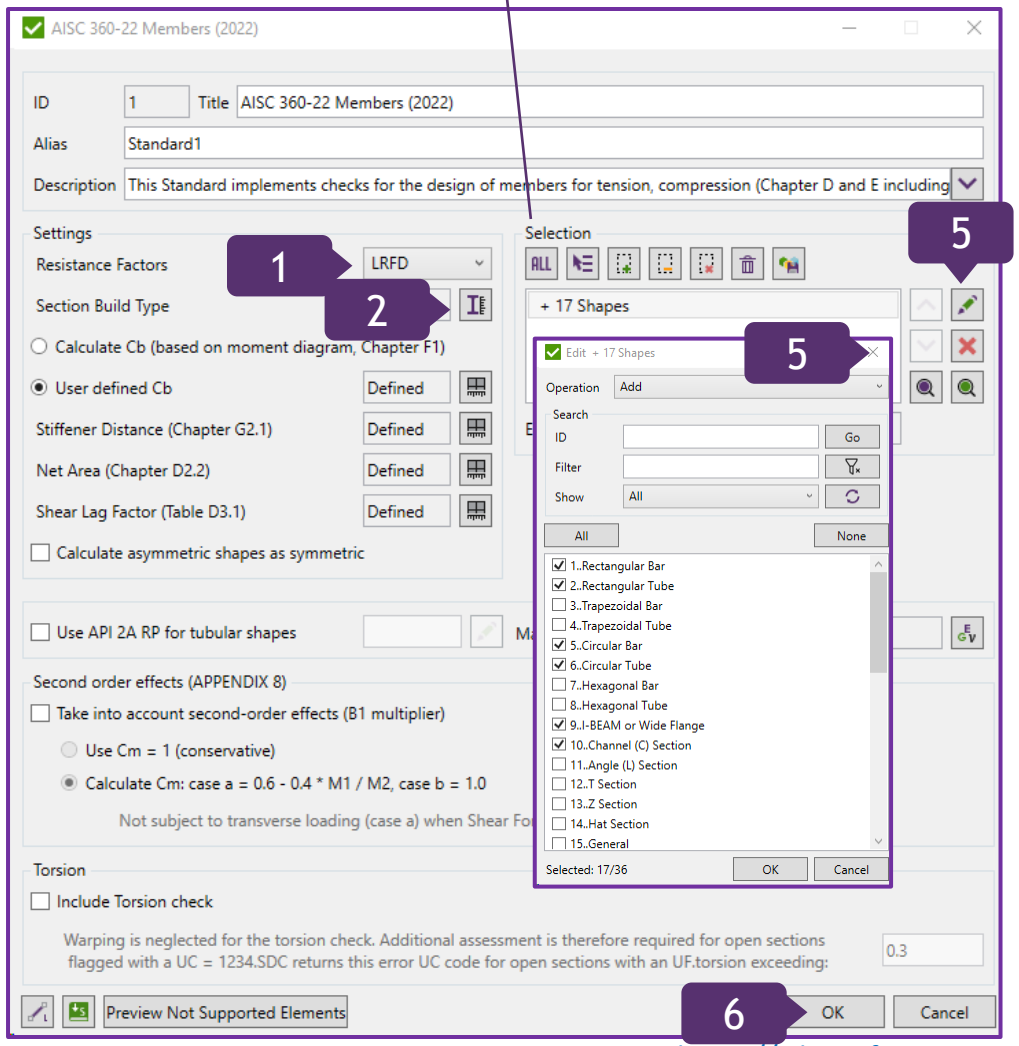


Define AISC 360-22 Members (2022) Standard

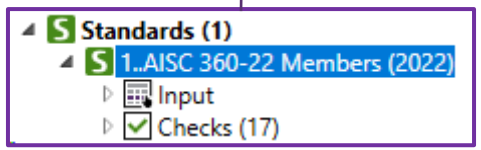
1. Resistance Factors: *LRFD*
2. In *Section Build Type*, press 
3. In *Properties*, *Build Type: Rolled* and press *To All*
4. Press *OK*
5. Press  to check the number of supported shapes;
   Close the window
6. Press *OK*



A selection section gives a possibility to define a certain part of the model to be verified.



The Standard has been added.

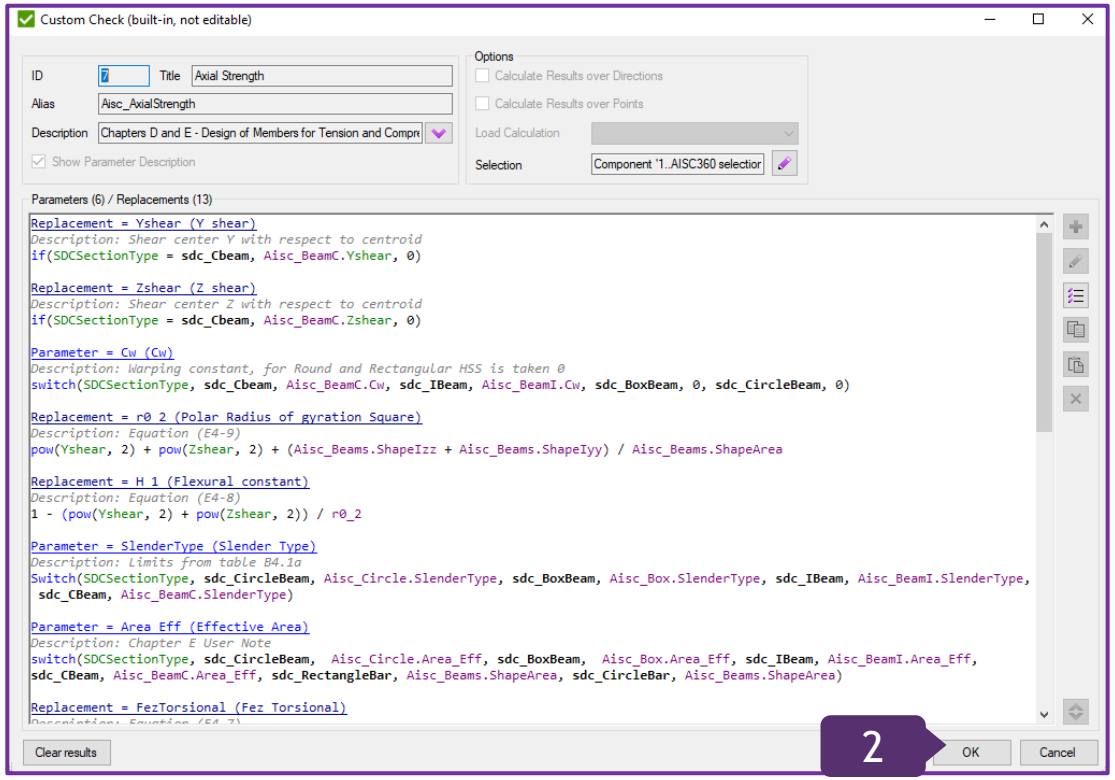


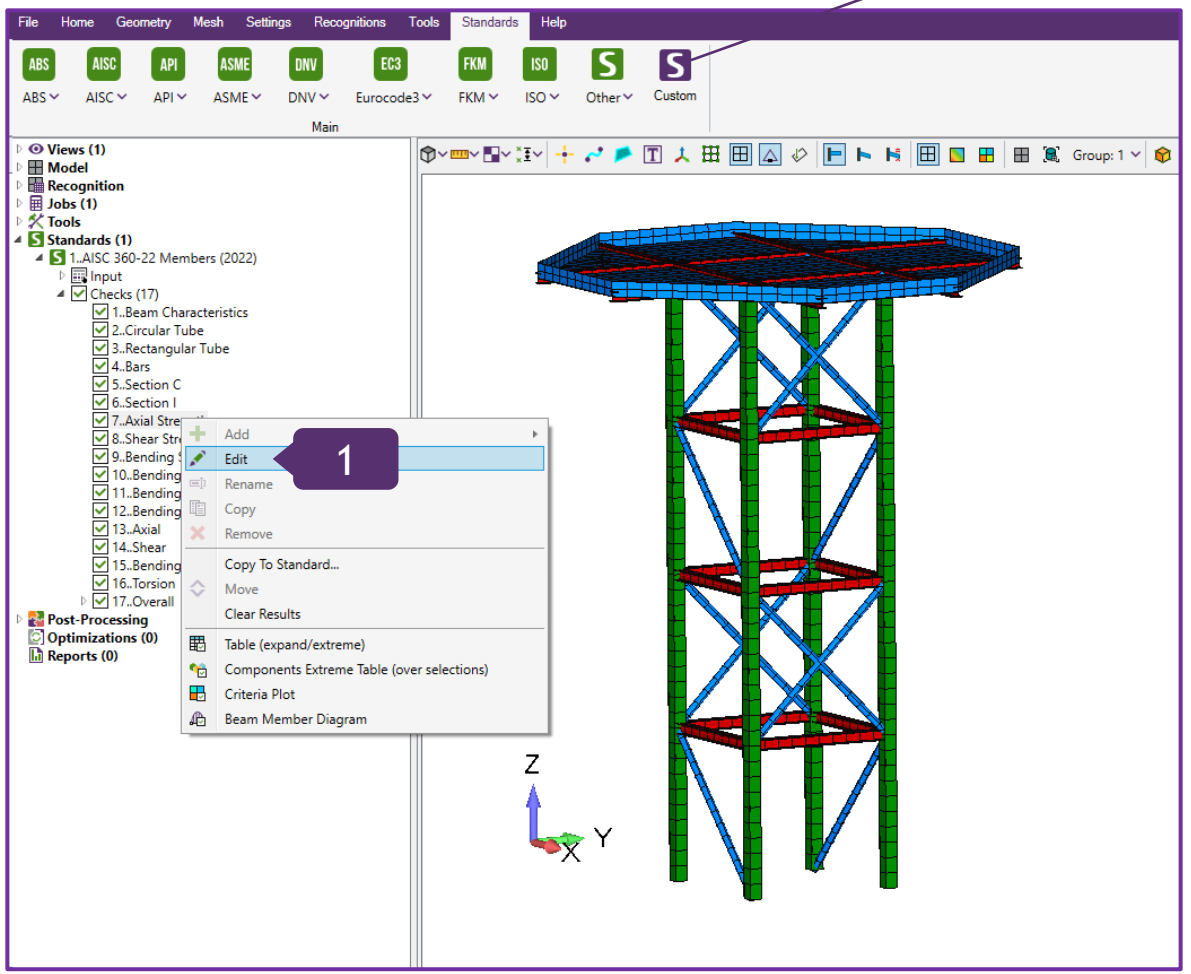
When defining the Standard, SDC Verifier informative Help page might be helpful. Press F1 to open it.

The Access to Formulas in Custom Check

1. Execute right click on *7..Axial Strength* and select *Edit*
2. Press *OK*

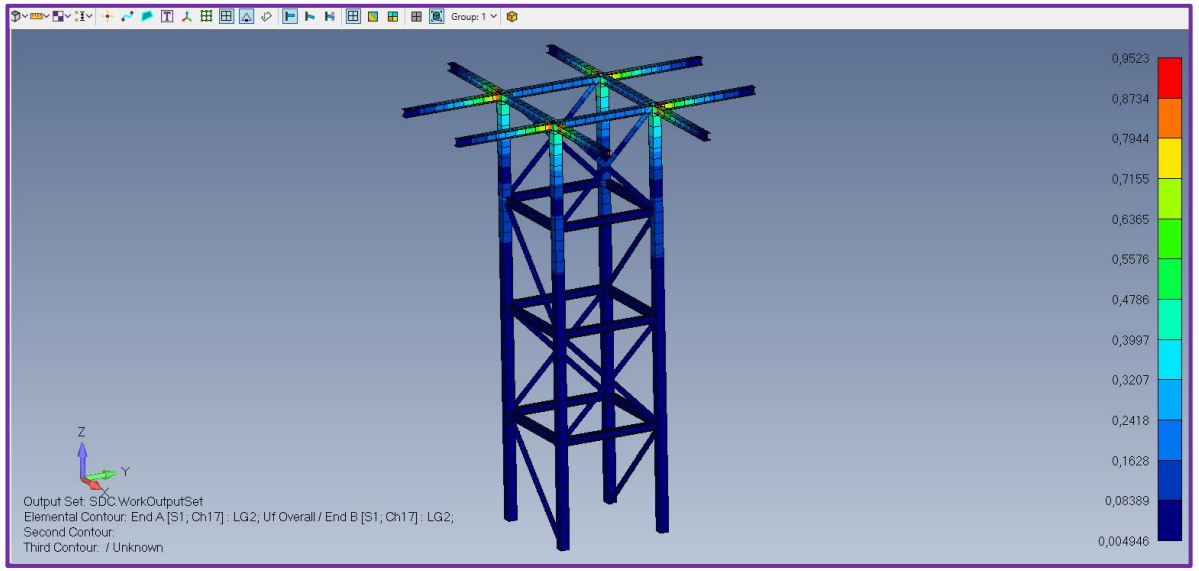
The formulas and the calculation procedure of the Checks are open. Every Parameter has a description, in which the source Standard the formula has been taken from is listed. Also, the formulas can be edited and modified, but they need to be converted to Custom Check. To conclude, the formulas can be written from scratch by selecting Custom feature.

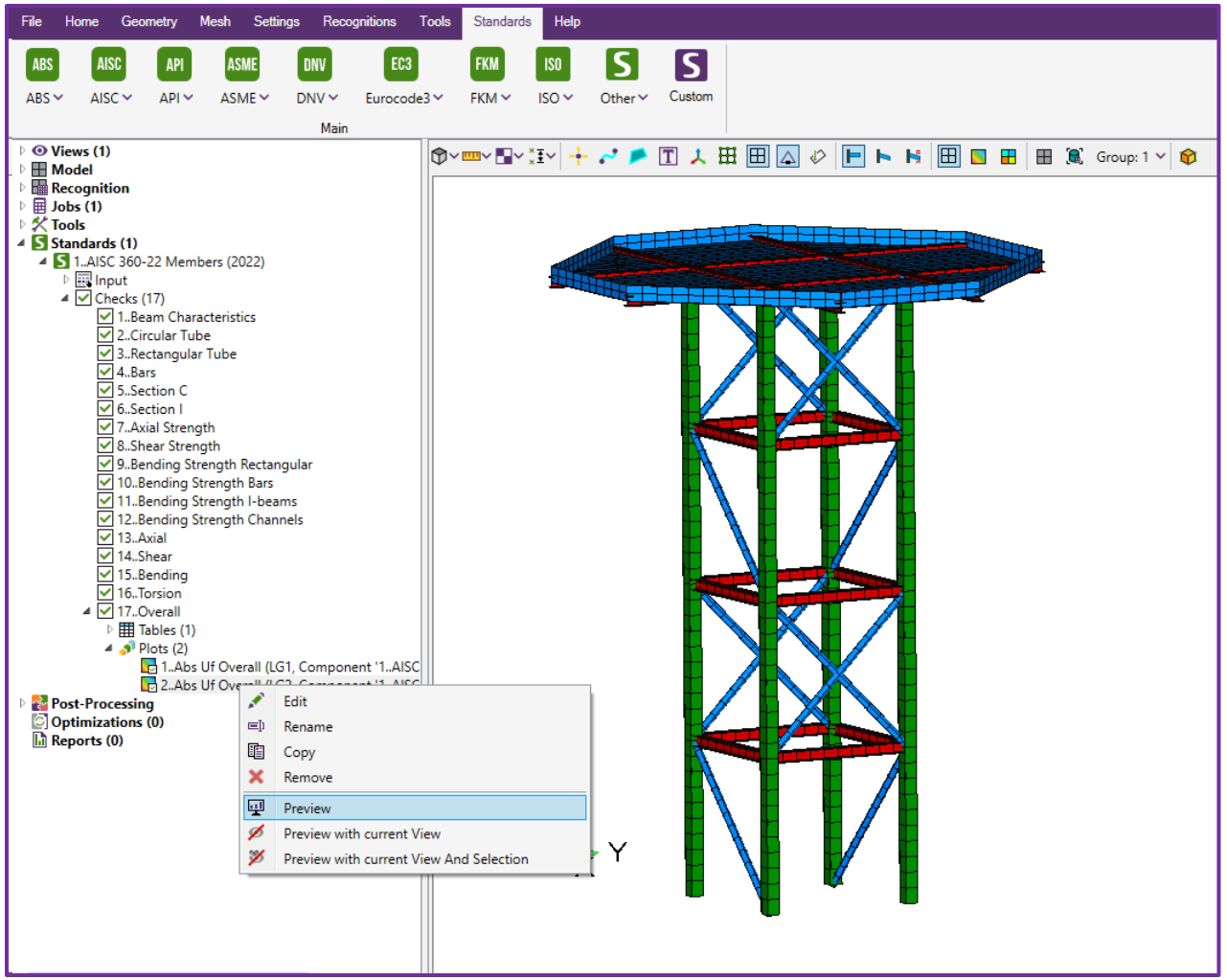




Preview the Results of the Checks

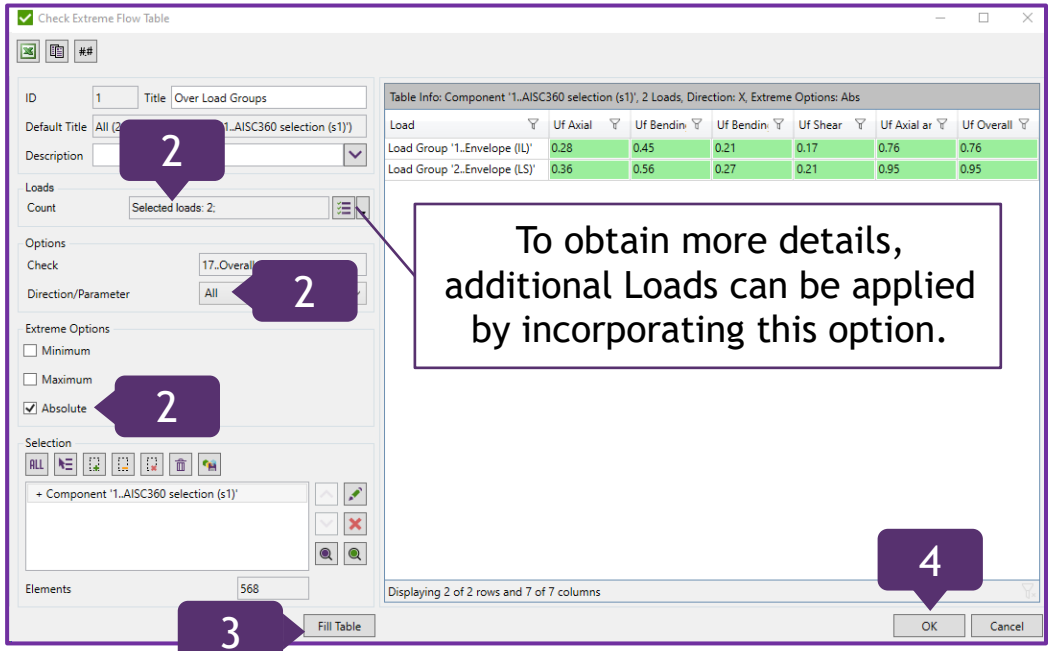
1. Expand *17..Overall* => *Plots*, and execute right click on *2..Abs Uf Overall*
2. Select *Preview*

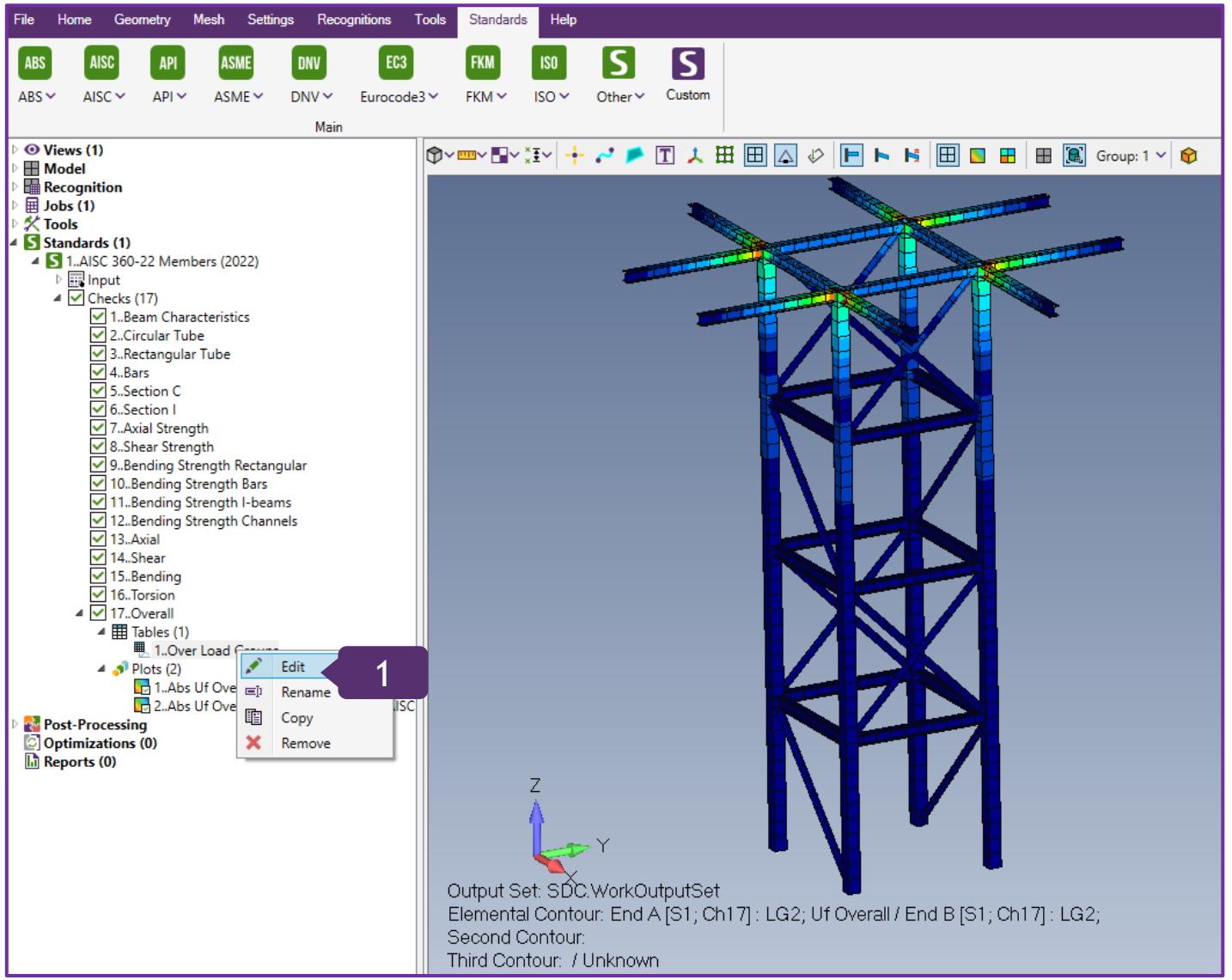




Create a Table

1. Expand *Tables*, and execute right click on *1..Over Load Groups*; Select *Edit*
2. Loads Count: *Selected loads: 2*; Direction/Parameter: *All*; Extreme Options: *Absolute*
3. Press *Fill Table*
4. Press *OK*

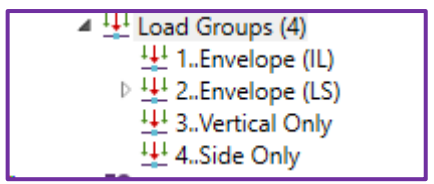


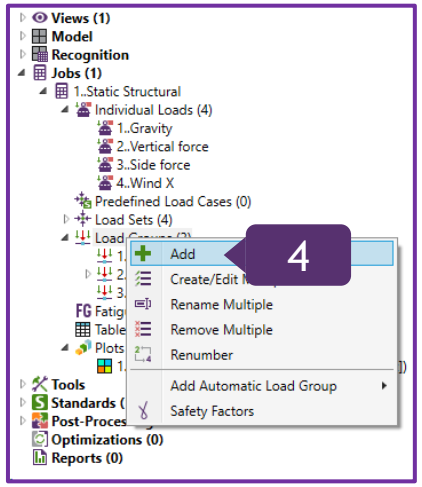


Create Additional Load Groups

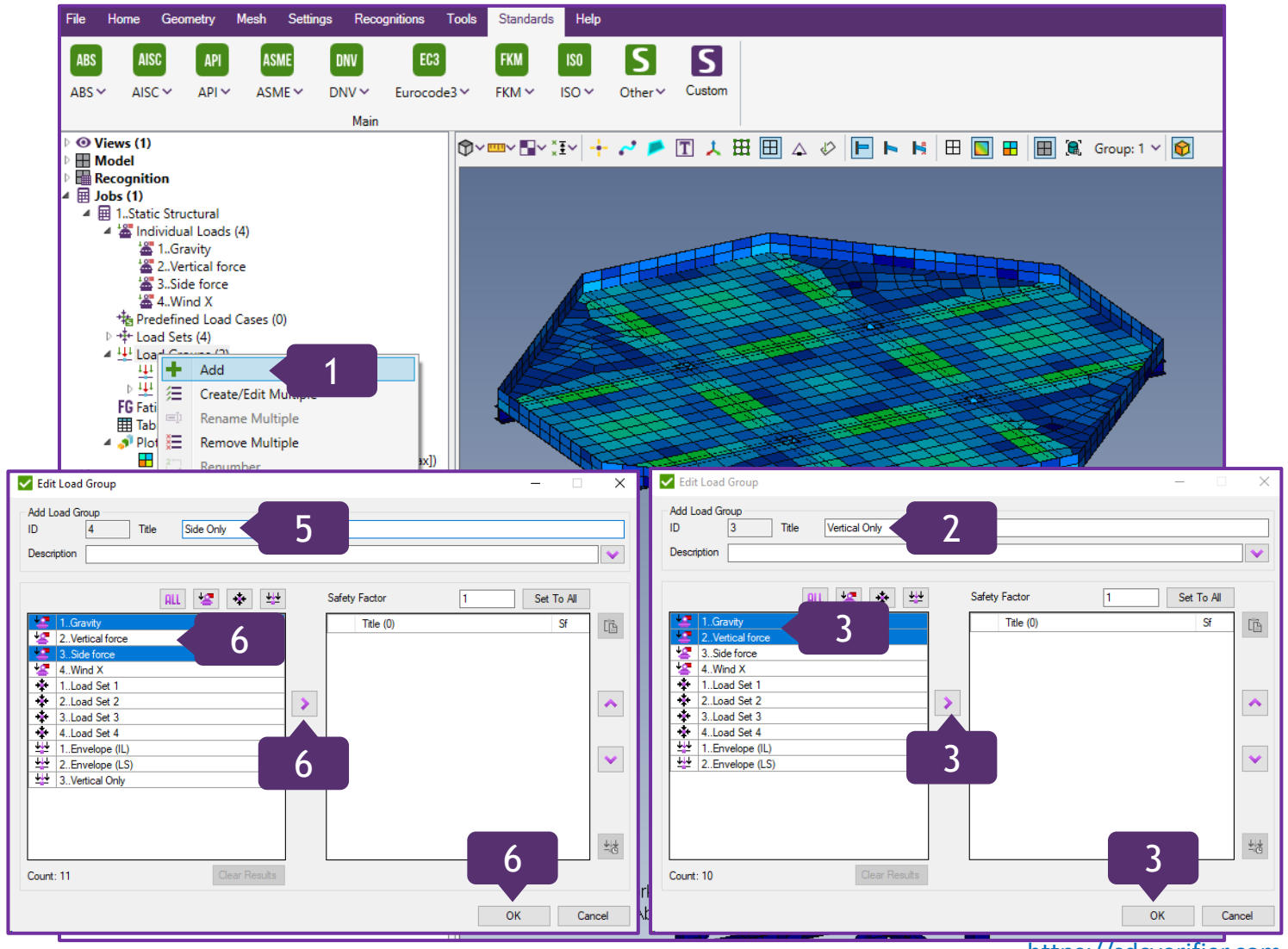
1. Select *Load Groups*;
   Execute right click and select *Add*
2. Title: *Vertical Only*
3. Select *1..Gravity* and *2..Vertical force*;
   Press ›
   Press *OK*
4. Select *Load Groups* one more time;
   Execute right click and select *Add*
5. Title: *Side Only*
6. Select *1..Gravity* and *3..Side force*;
   Press ›
   Press *OK*

Created Load Groups



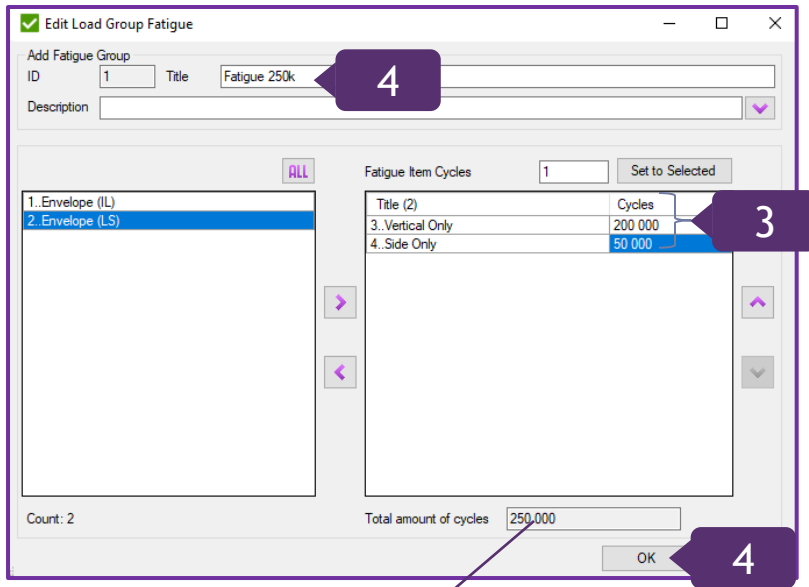


Vertical Only and Side Only loading cycles will be included in the Fatigue Analysis.

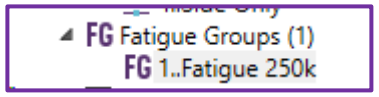


Create Fatigue Group

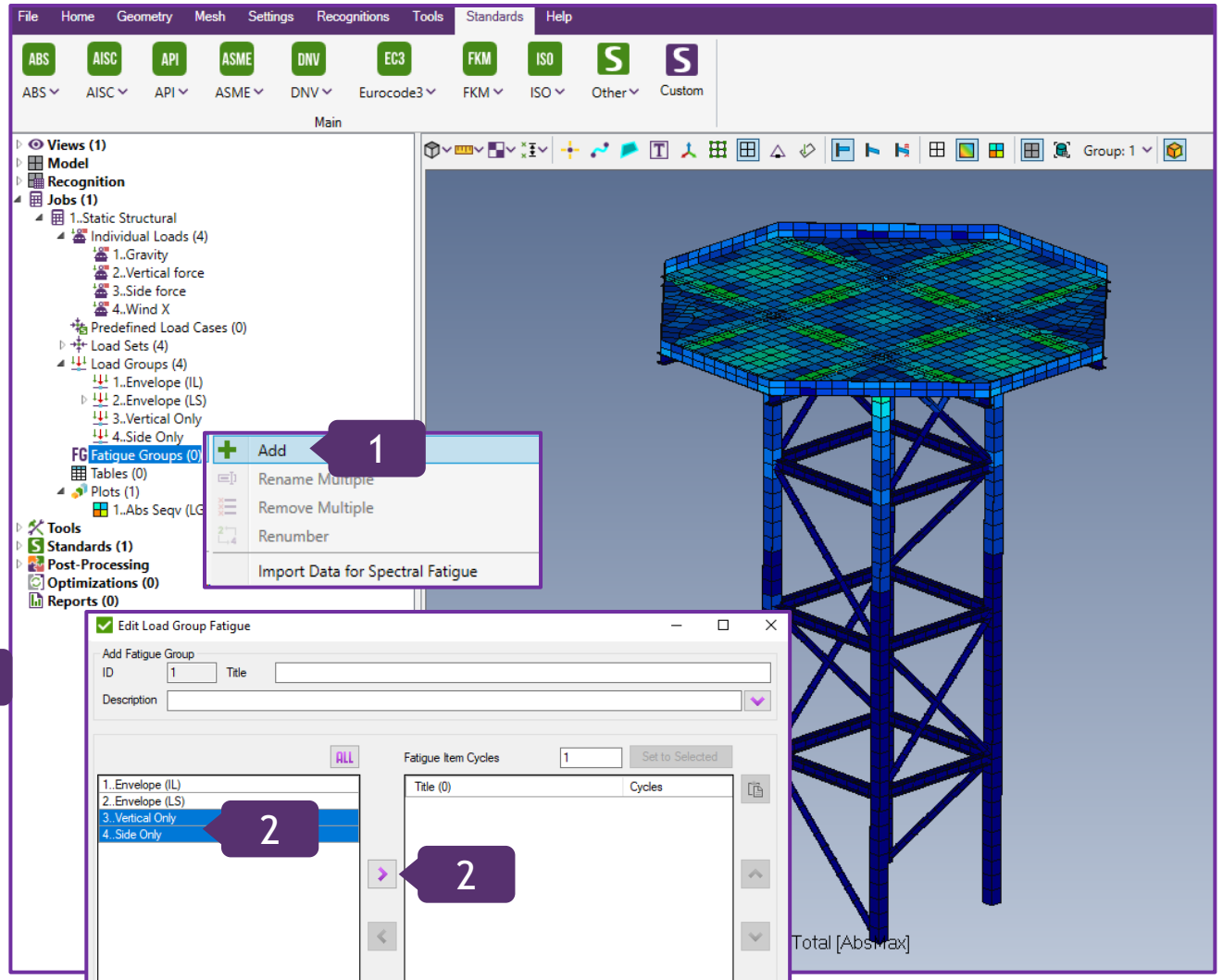
1. Select *Fatigue Groups*;
   Execute right click and select *Add*
2. Select *3..Vertical Only* and *4..Side Only*;
   Press ›
3. *3..Vertical Only:* 200 000 cycles;
   4..Side Only: 50 000 cycles
4. Title: *Fatigue 250k*;
   Press *OK*



Created Fatigue Group

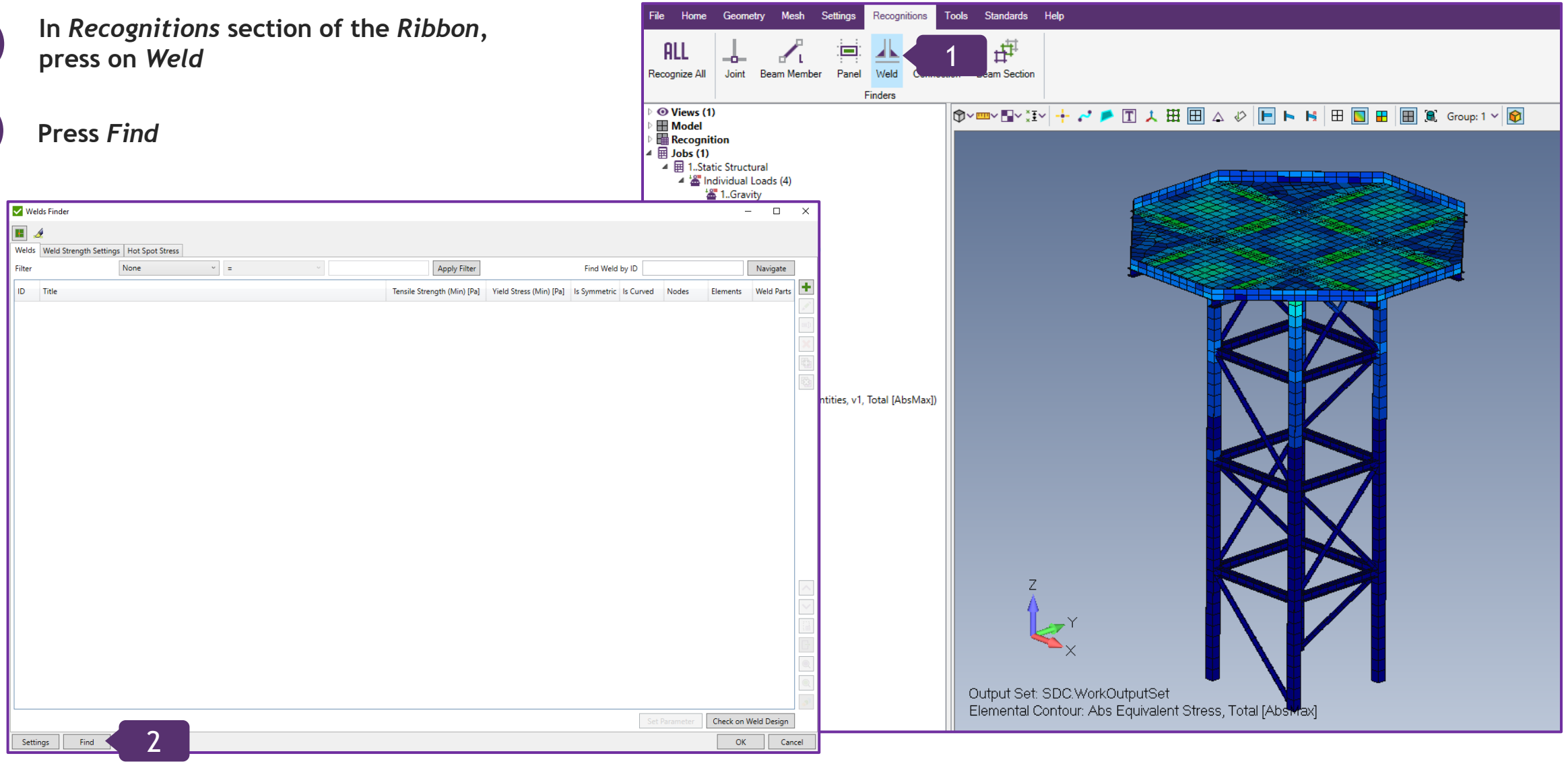


Total amount of cycles has been calculated automatically.



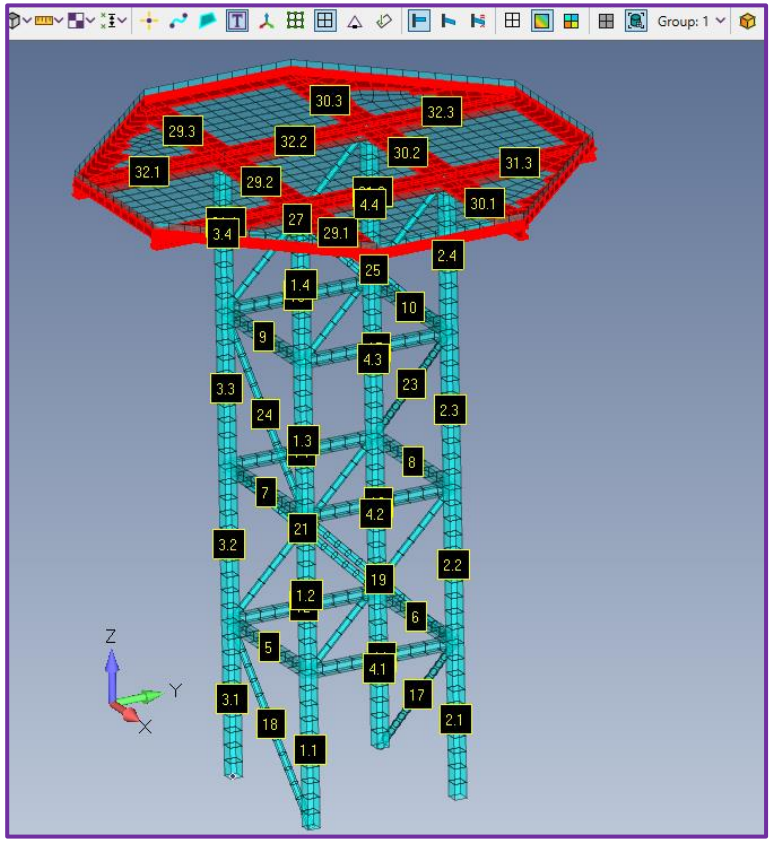
Recognize Welds

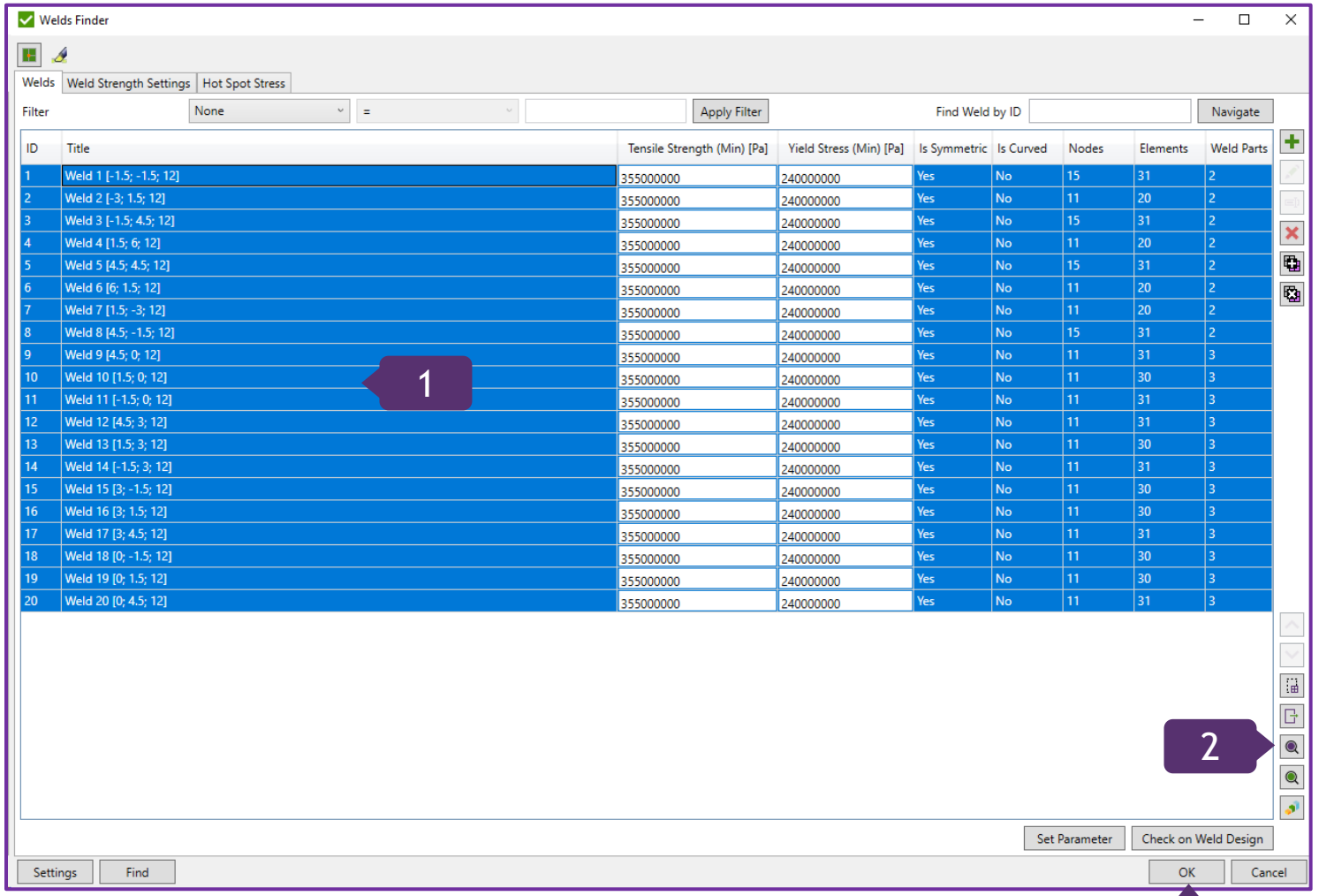
1. In *Recognitions* section of the *Ribbon*, press on *Weld*
2. Press *Find*



Preview Welds

1. In *Welds* section, select all *Welds*
2. To preview Welds, click on 
3. Press *OK*



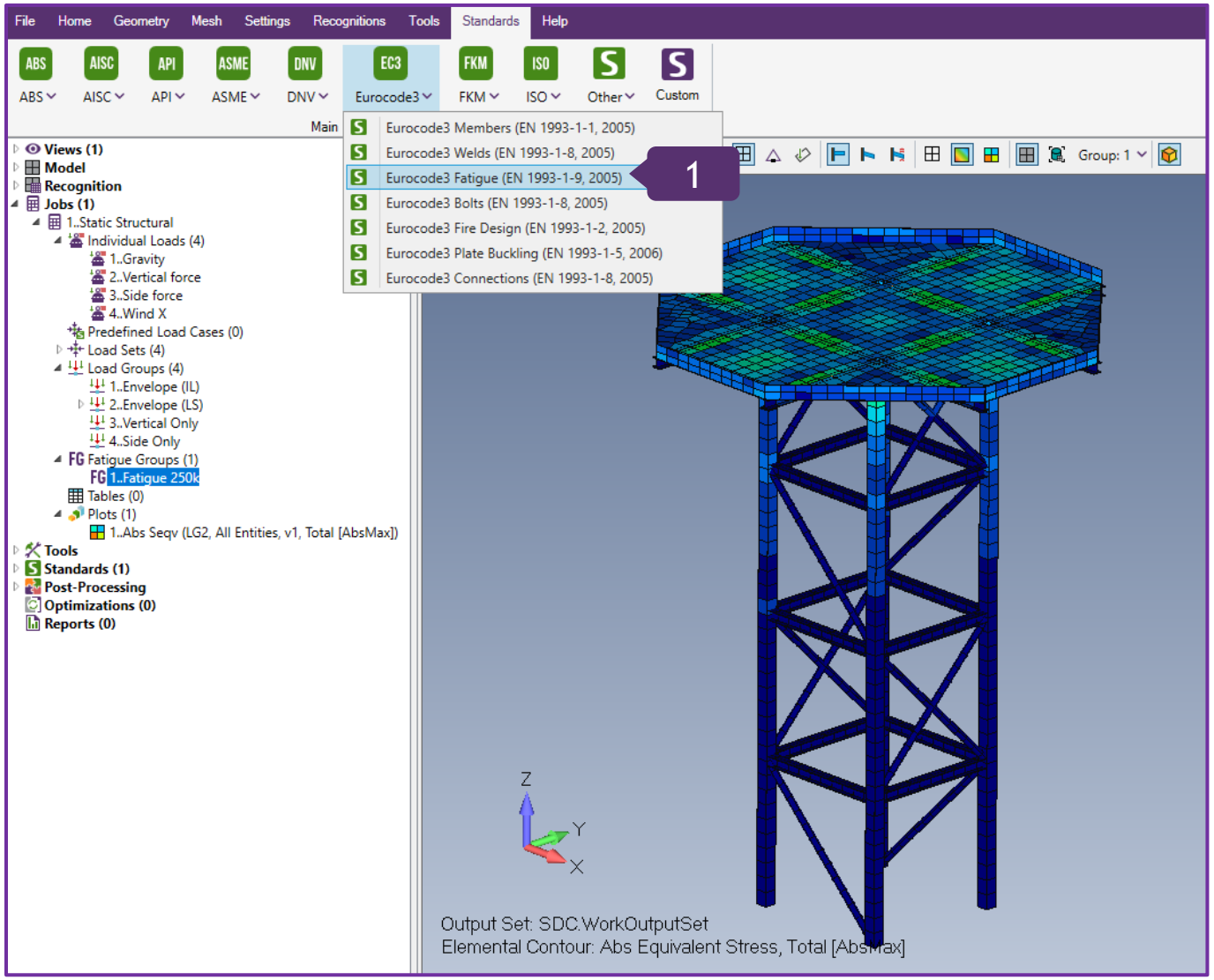


All Property, Material and Thickness changes have been recognized, along with the connection of a certain angle as welded elements.

Add Eurocode3 Fatigue (EN 1993-1-9, 2005) Standard

1

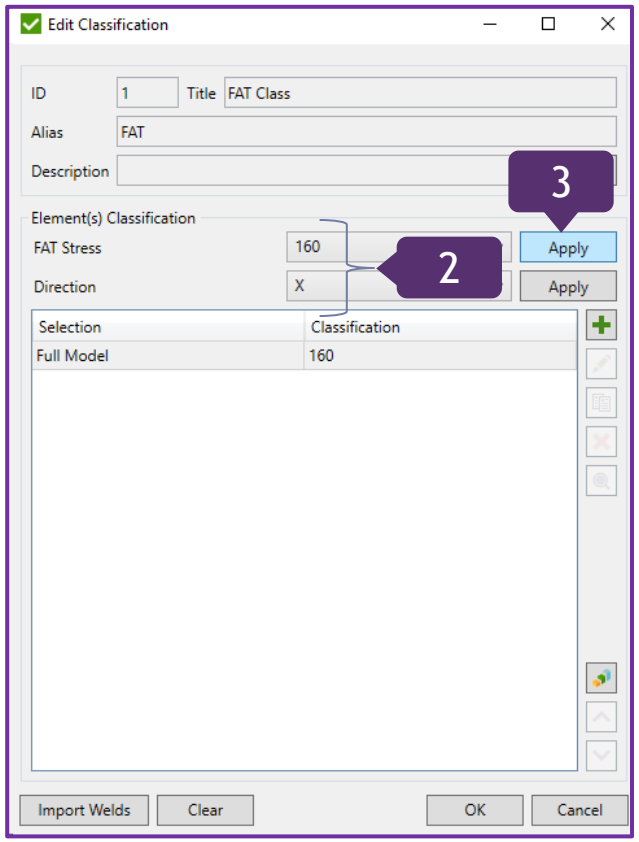
In *Standards* section of the *Ribbon*, press on *Eurocode3* and select *Eurocode3 Fatigue (EN 1993-1-9, 2005)*

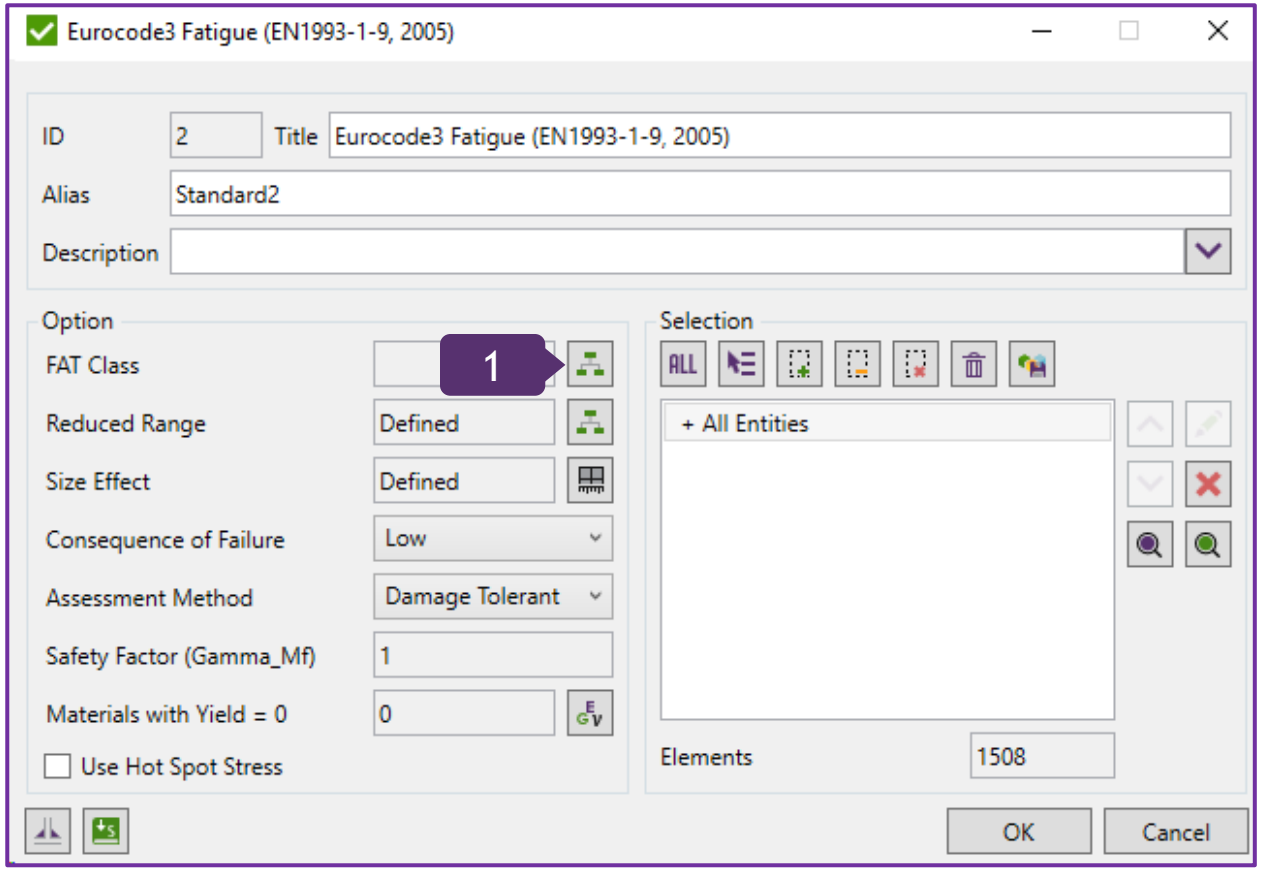


Define FAT Class

1. In *FAT Class*, press 
2. FAT Stress: *160*;
   Direction: *X*
3. Press *Apply*

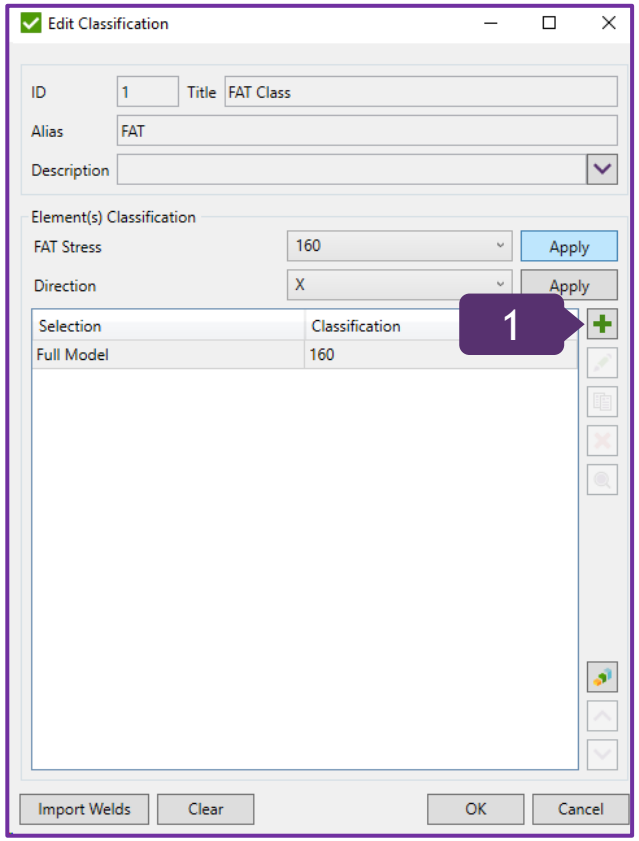
FAT Class is the fatigue strength for nominal stress ranges. It is represented by a series of $(\log \Delta\sigma_R) - (\log N)$ curves and $(\log \Delta\tau_R) - (\log N)$ curves (S-N-curves), which correspond to typical detail categories. Each detail category is designated by a number, which represents in N/mm² the reference value $\Delta\sigma_C$ and $\Delta\tau_C$ for the fatigue strength at 2 million cycles.

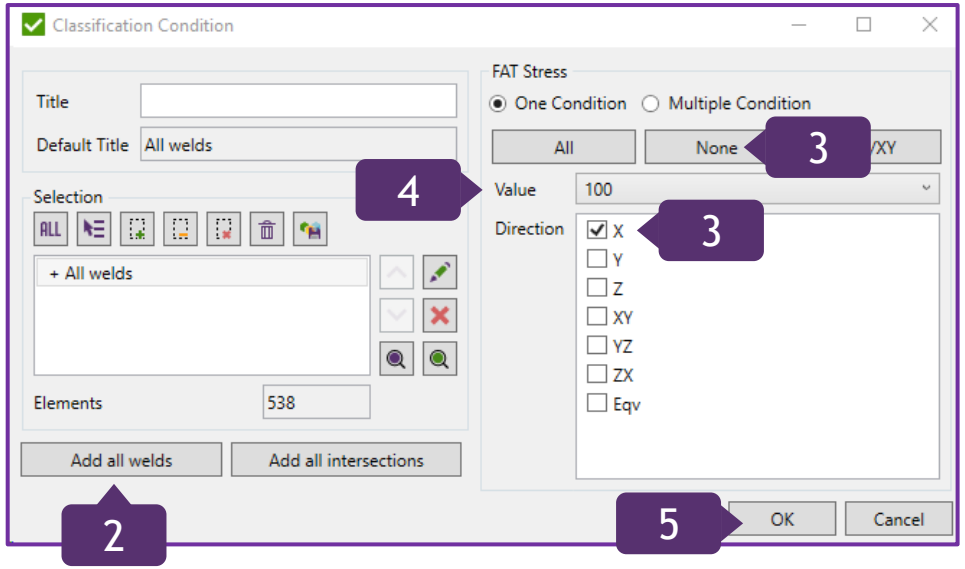




Define Welds for X Direction

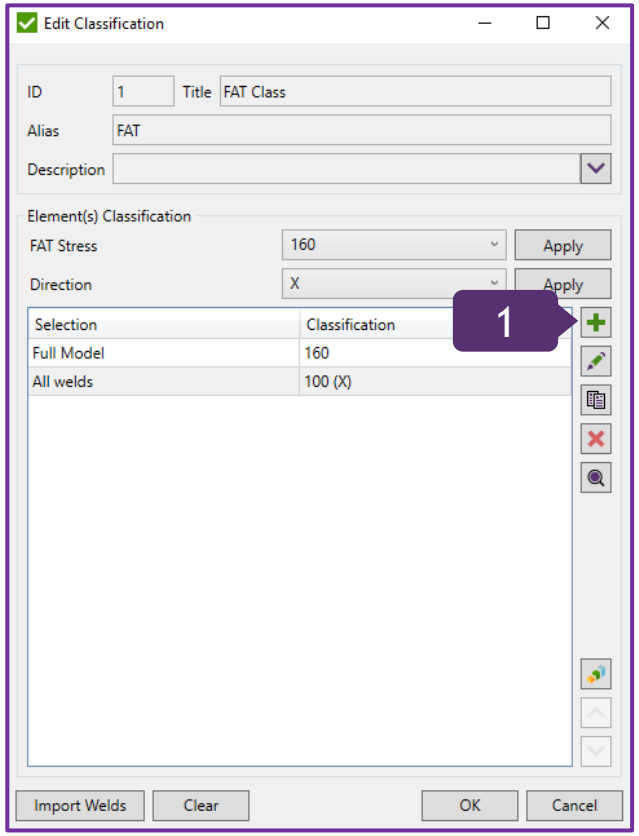
1. Press  to define new condition
2. Press *Add all Welds*
3. Press *None*, and then select *Direction: X*
4. *Value: 100*
5. Press *OK*

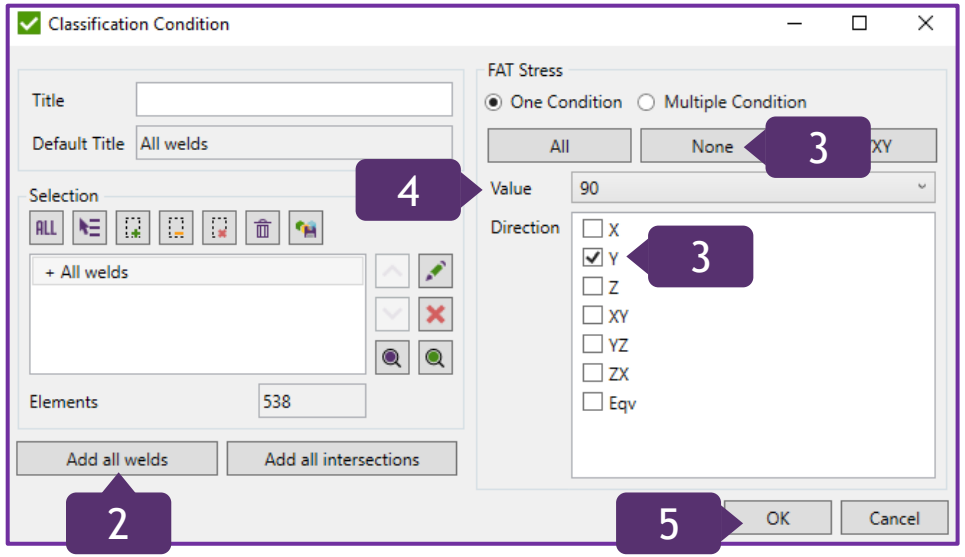




Define Welds for Y Direction

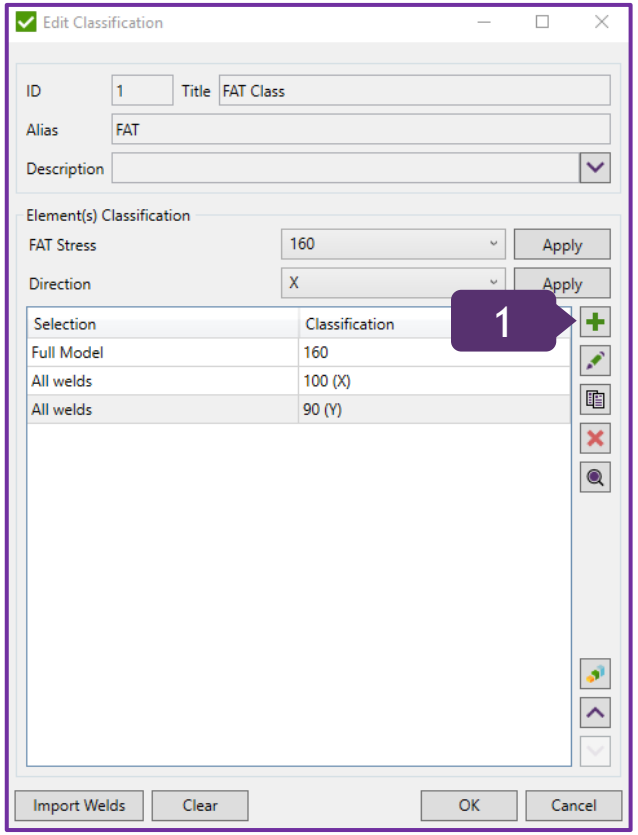
1. Press  to define new condition
2. Press *Add all Welds*
3. Press *None*, and then select *Direction: Y*
4. *Value: 90*
5. Press *OK*

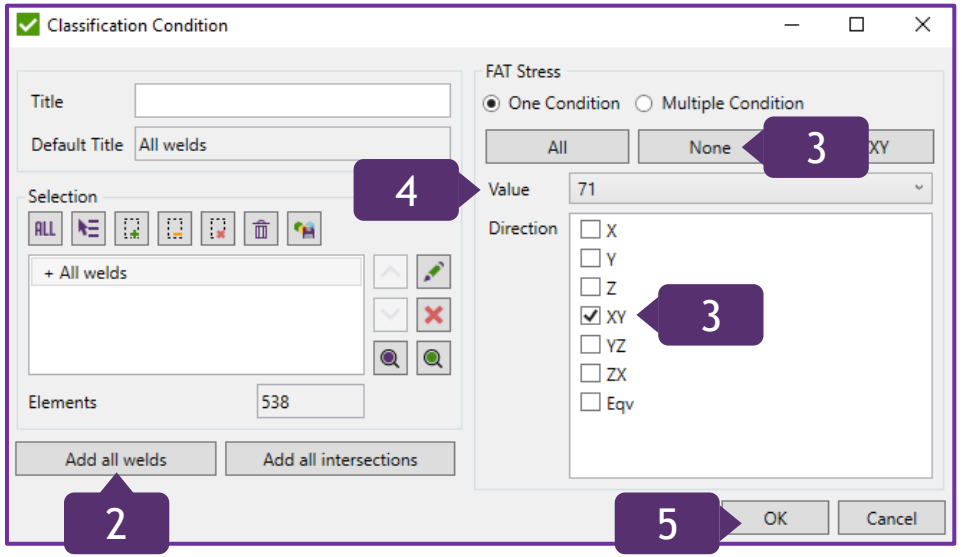




Define Welds for XY Shear Direction

1. Press  to define new condition
2. Press *Add all Welds*
3. Press *None*, and then select *Direction: XY*
4. *Value: 71*
5. Press *OK*





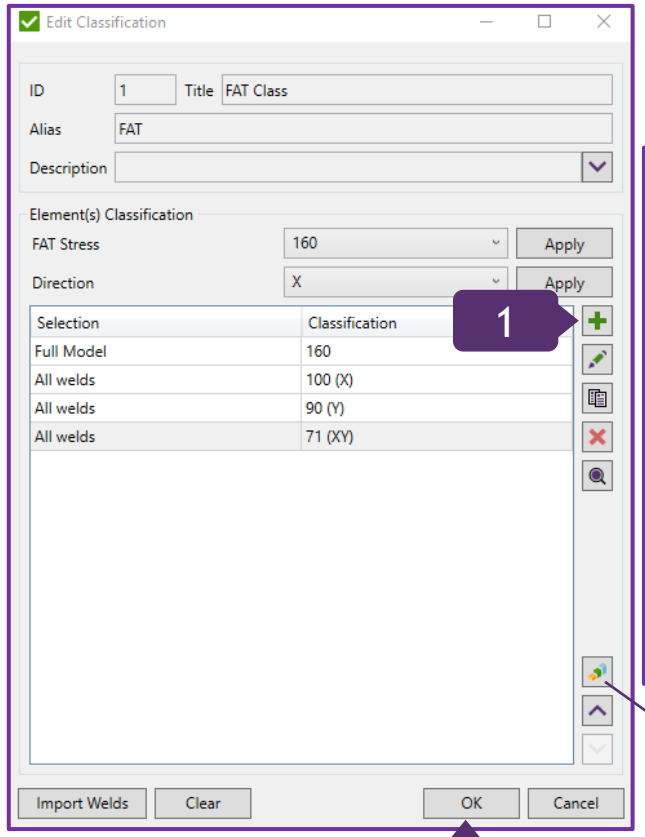
Define All Welds Intersections

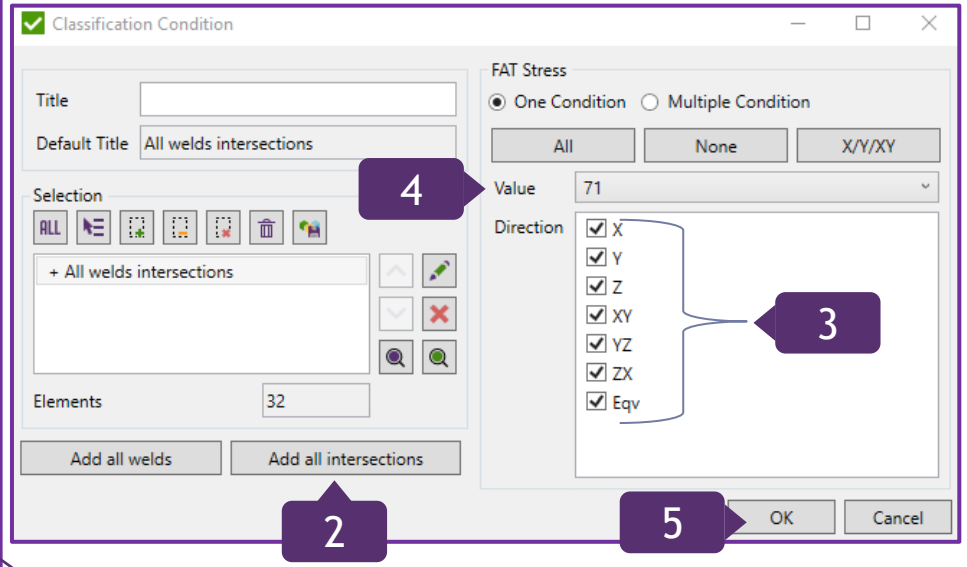
1. Press  to define new condition
2. Press *Add all intersections*
3. Direction: *All*
4. Value: *71*
5. Press *OK*

Classification has been defined.

Note: Every successive rule overwrites the previous one.

Selection	Classification
Full Model	160
All welds	100 (X)
All welds	90 (Y)
All welds	71 (XY)
All welds intersections	71 (All Directions)



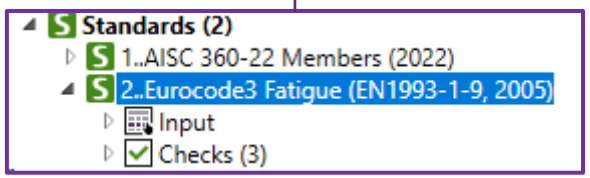


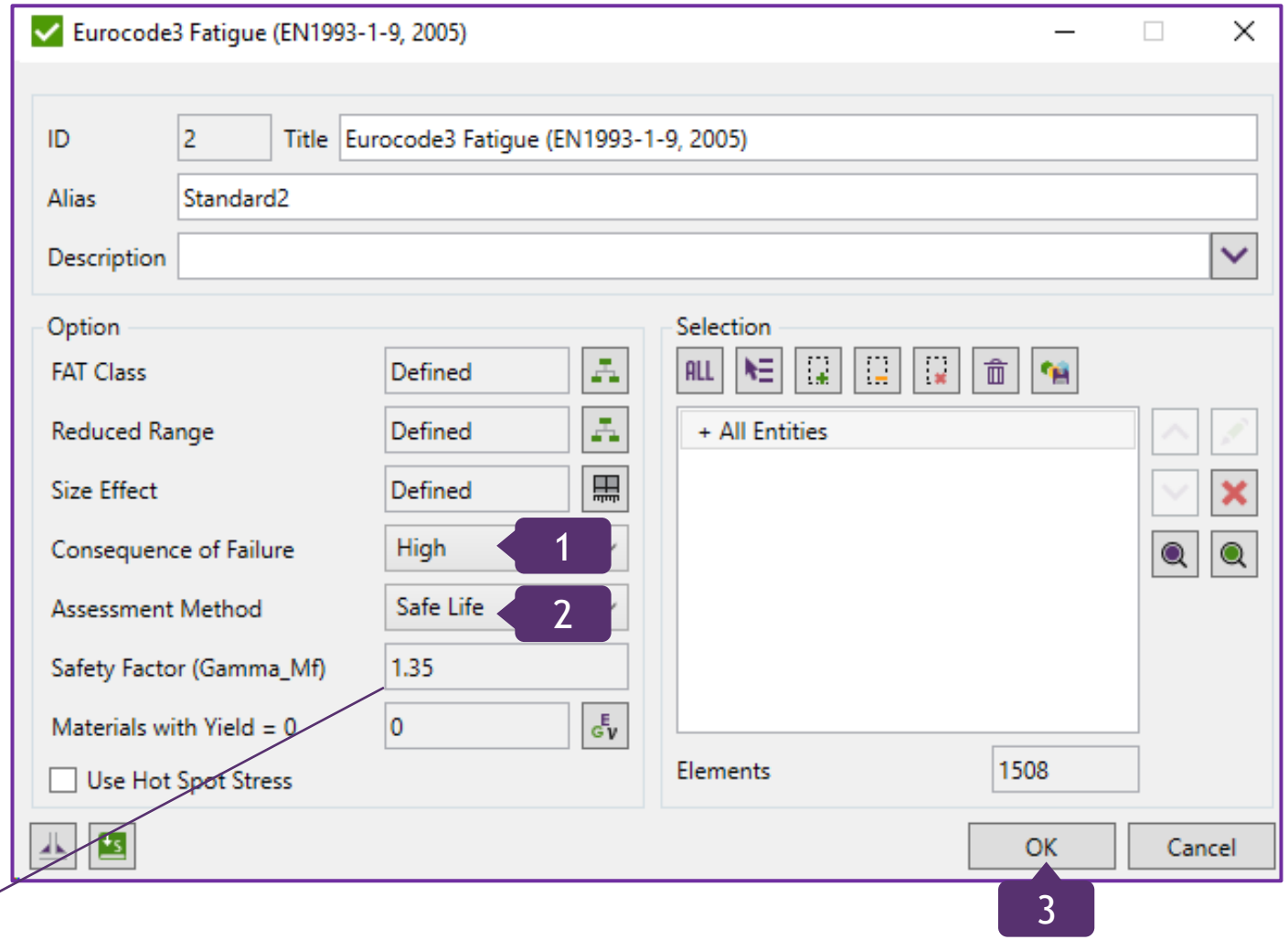
Full Model and All Welds can be previewed and plotted by pressing 

Define Consequence of Failure and Assessment Method

1. Consequence of Failure: *High*
2. Assessment Method: *Safe Life*
3. Press *OK*

The Standard has been added.



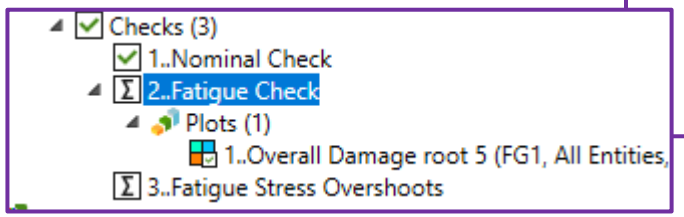


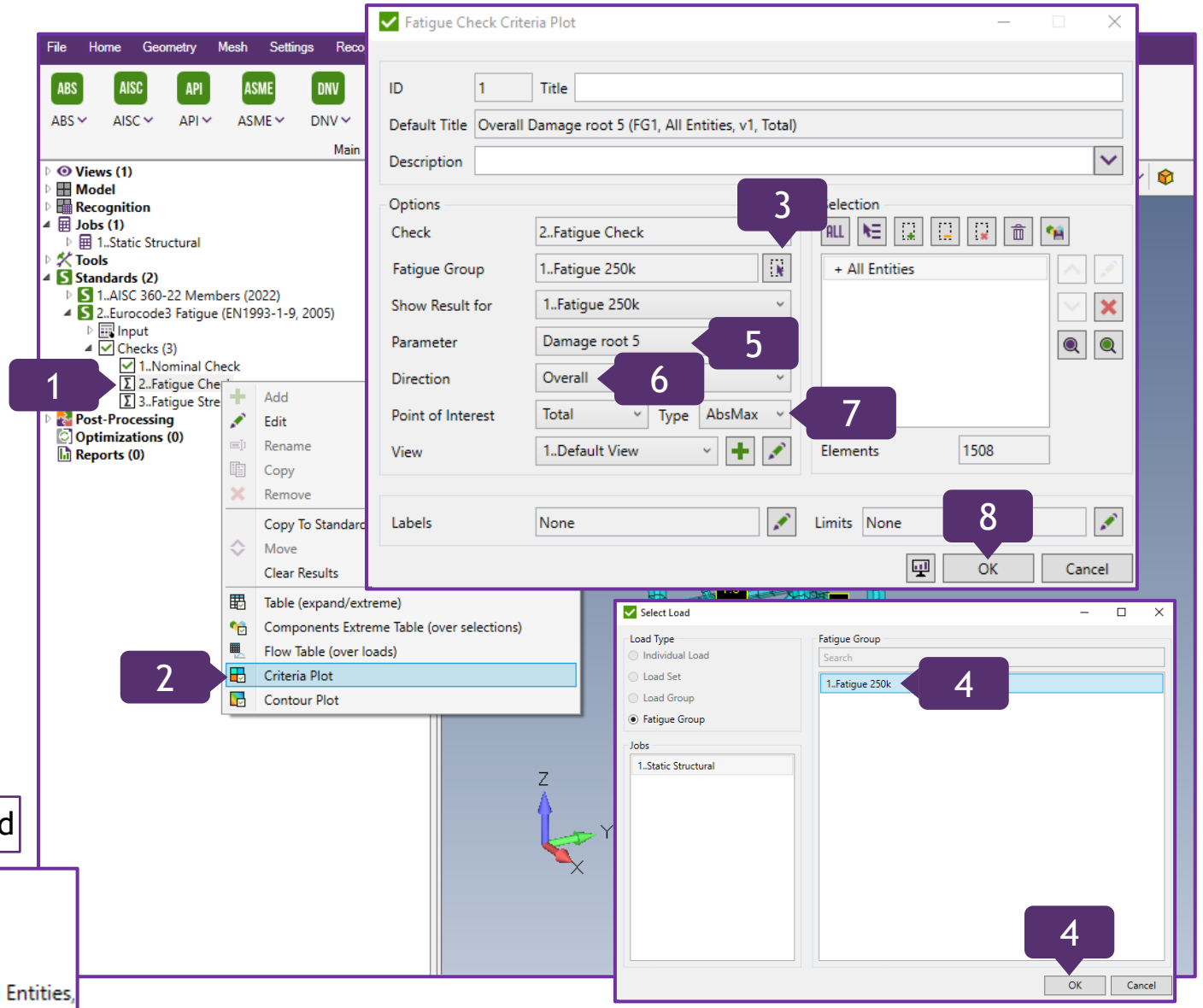
Note: The value of Safety Factor (Gamma_Mf) shifts in accordance to the configurations of Consequence of Failure and Assessment Method.

Criteria Plot for Fatigue Check

1. Expand *Checks*, and execute right click on *2..Fatigue Check*
2. Select *Criteria Plot*
3. Press  to select *Fatigue Group*
4. Select *1.. Fatigue 250k* and press *OK*
5. Parameter: *Damage root 5*
6. Direction: *Overall*
7. Point of Interest: *Total*;
   Type: *AbsMax*
8. Press *OK*

The Criteria Plot has been created

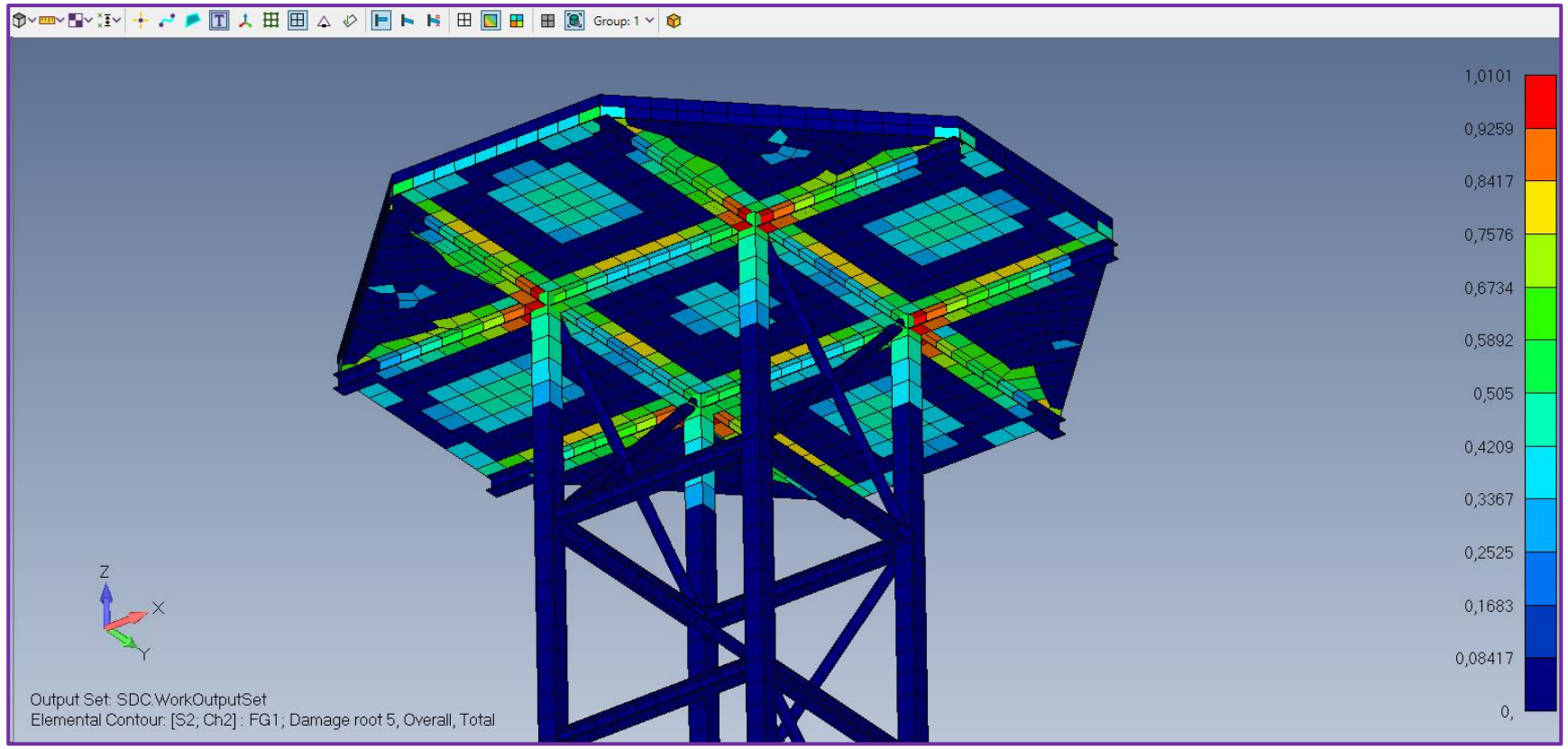


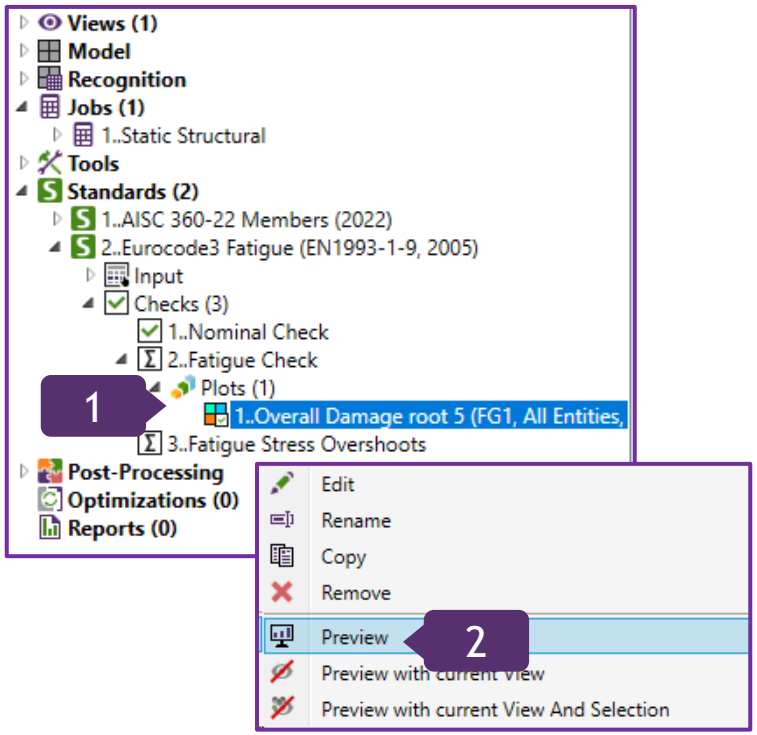


Preview the Plot

1. Expand *Plots*, and execute right click on *1..Overall Damage root 5 (FG1, All Entities, v1, Total)*

2. Select *Preview*





As it might be seen on the plot, the structure is above the safe value for fatigue damage in its specific parts. Therefore, the modifications are required, and they can be carried out with incorporation of Optimizations Tool or manually.

Additional Modifications

1. In *Model* section, expand *Properties* and select *2..I-beam200*
2. Execute right click and select *Edit*
3. Press on *Shape*
4. Make the required modifications in *Cross Section Definition* window
5. Close the window

There is a separate tutorial “Modelling with SDC Verifier”, in which the creation and modification of Properties are described in details (slides 24-25; 29-31)