

SDC
V E R I F I E R



Tutorial

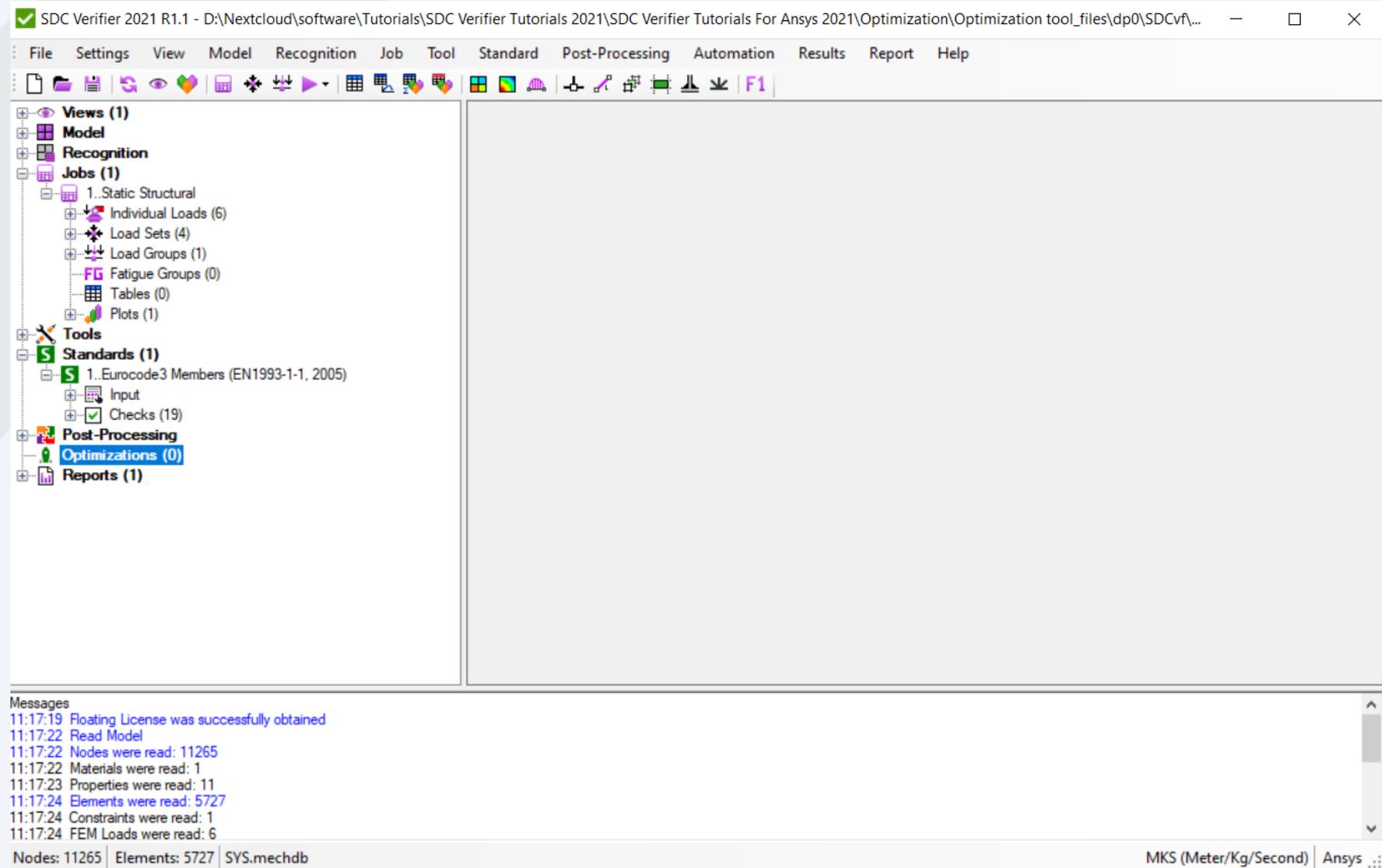
Optimization

Updated on: 05.10.2021

Tested with: SDC Verifier 2021R1.1

Femap 2021.1

- This step-by-step tutorial demonstrates the interface of SDC Verifier Optimization
- Jacket Model members are Optimized based on AISC 360-10 results;
- Shape Library Overview;
- Optimization Rules Overview;
- Results Comparison;
- Automatic Beam Cross Section Change.

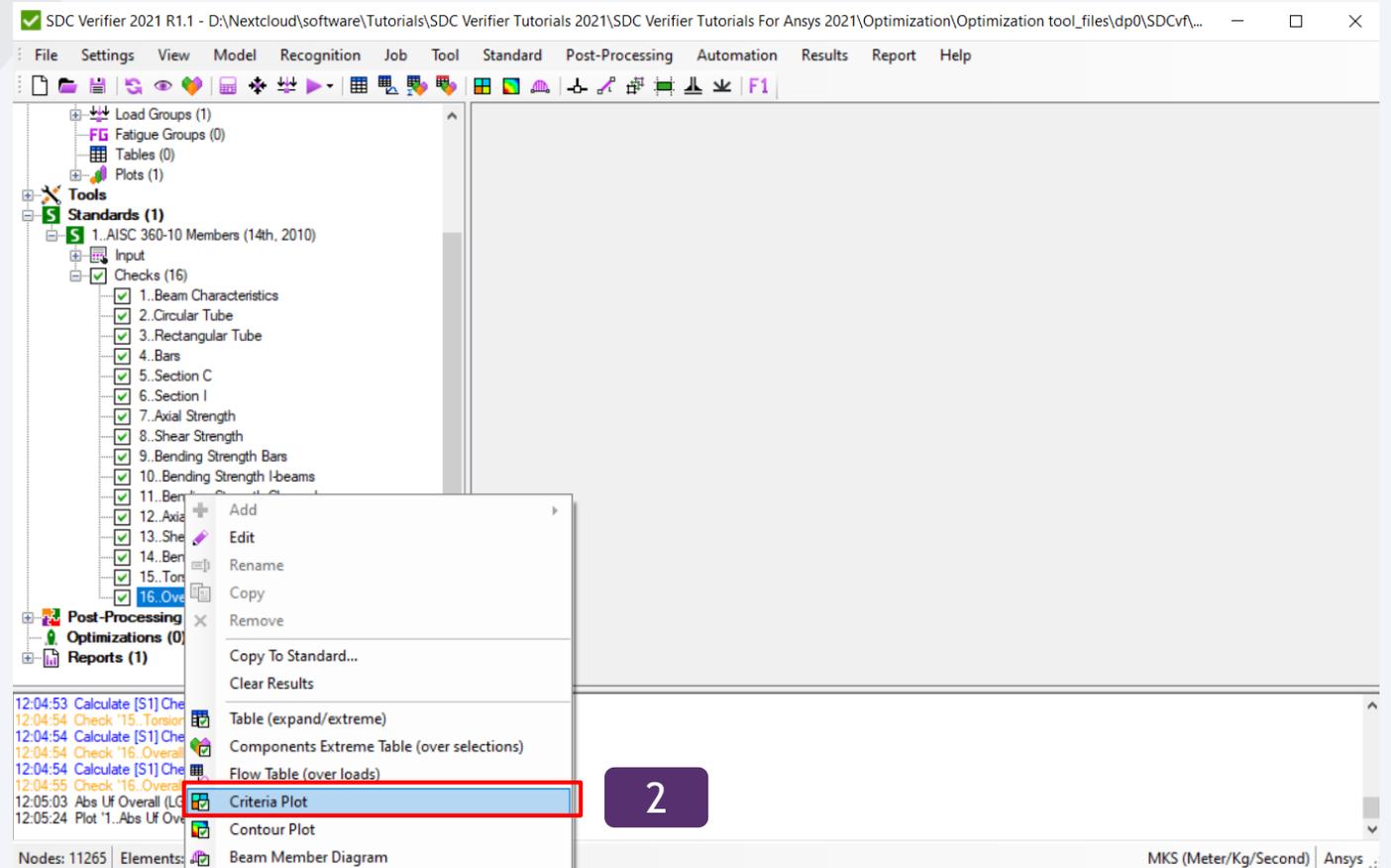


This SDC Verifier project has predefined loading combinations, recognition of beam members, and AISC 360-10 Members check.

1 Select AISC 360-10 Members > Checks > Overall

2 Right Click and Select Criteria Plot

Let's create a plot to preview the results of AISC Members check and pick the members for Optimization



AISC Results Plot

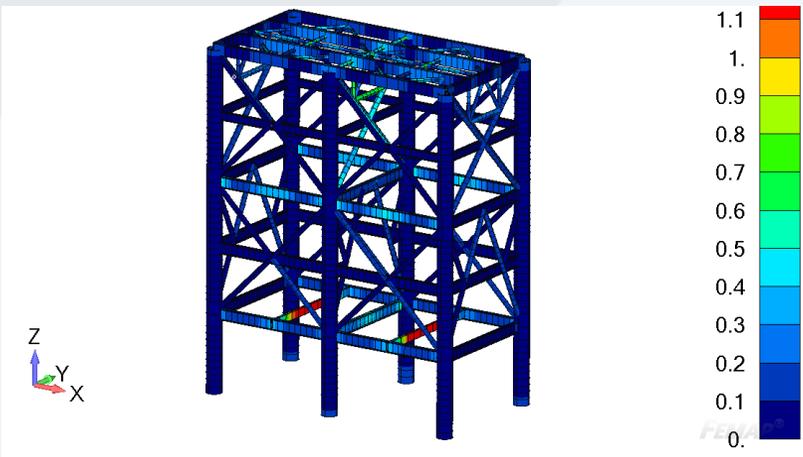
1 Selection: All Entities

2 Parameter: UF Overall

Creating a plot to see the Overall UF result on a full model

3 Press Plot

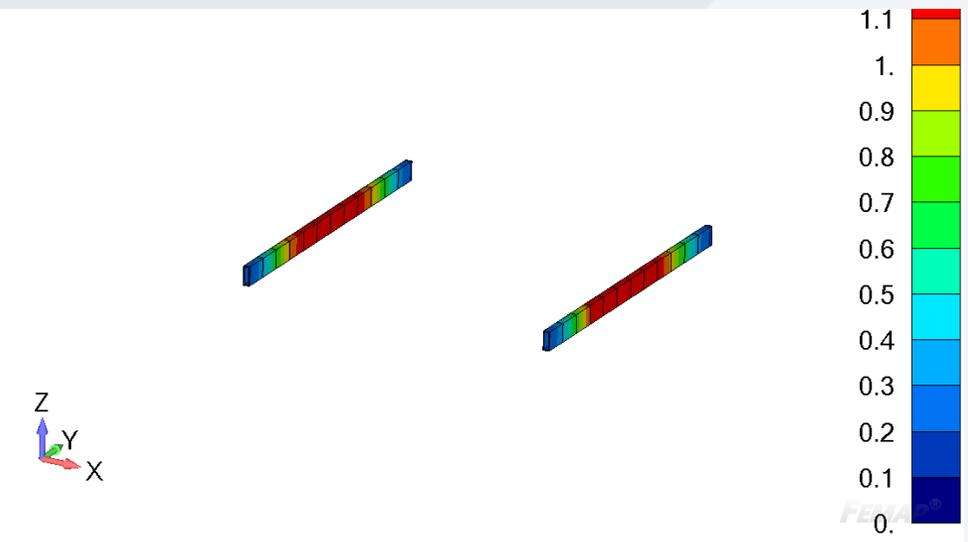
Plot will be displayed in Ansys Mechanical Window



Let's preview the plot for one property

- 1 Selection: Property Beam 11..300x10
- 2 Press Plot

Plot will be displayed in Ansys Mechanical Window

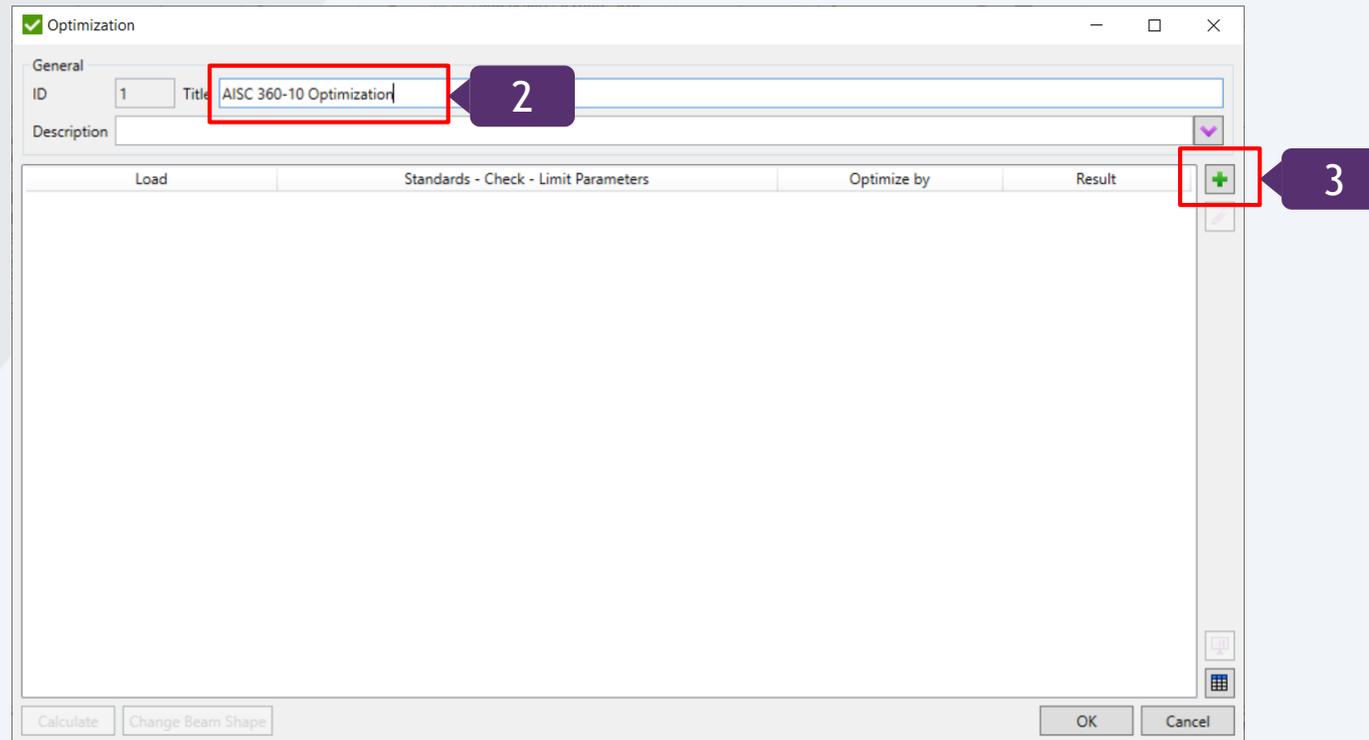
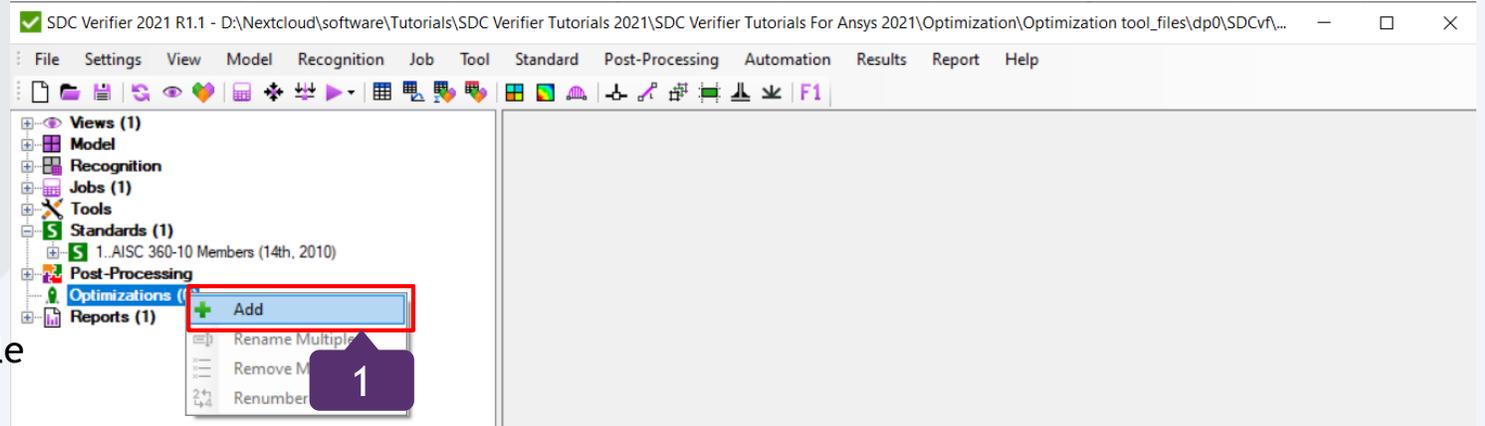


Some members of property '11..300x10' have UF Overall value above 1. We're now going to create an Optimization rule for this members

1 Select Optimizations > Add

2 Title: AISC 360-10 Optimization

3 Press  To create your first Optimization Rule



Optimization Rule

1

Click on **Select Load**

In the opened window select Load Group 1

2

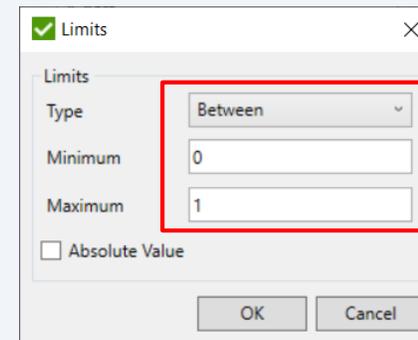
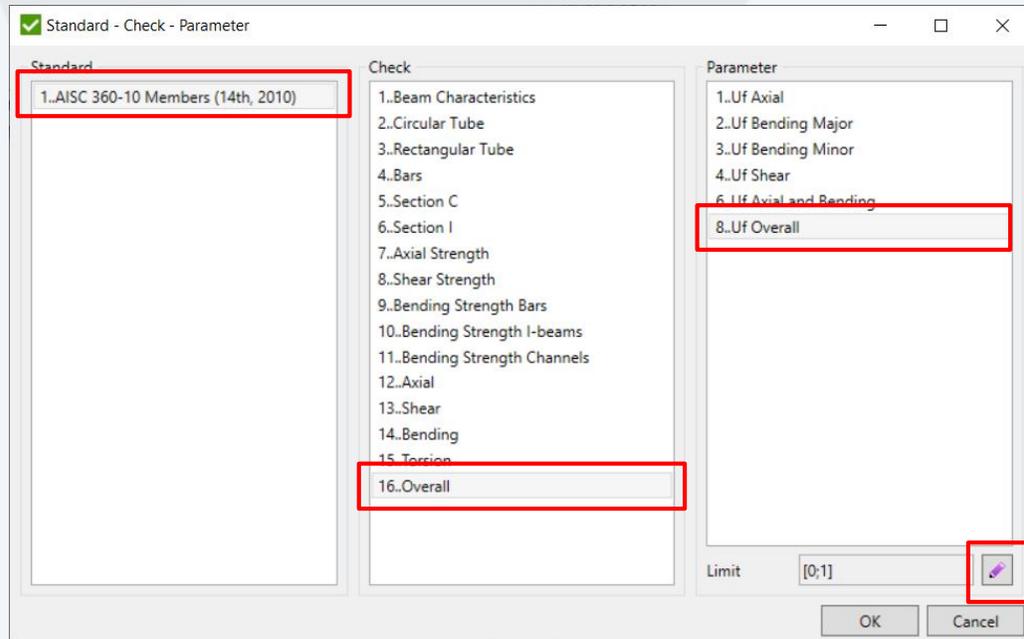
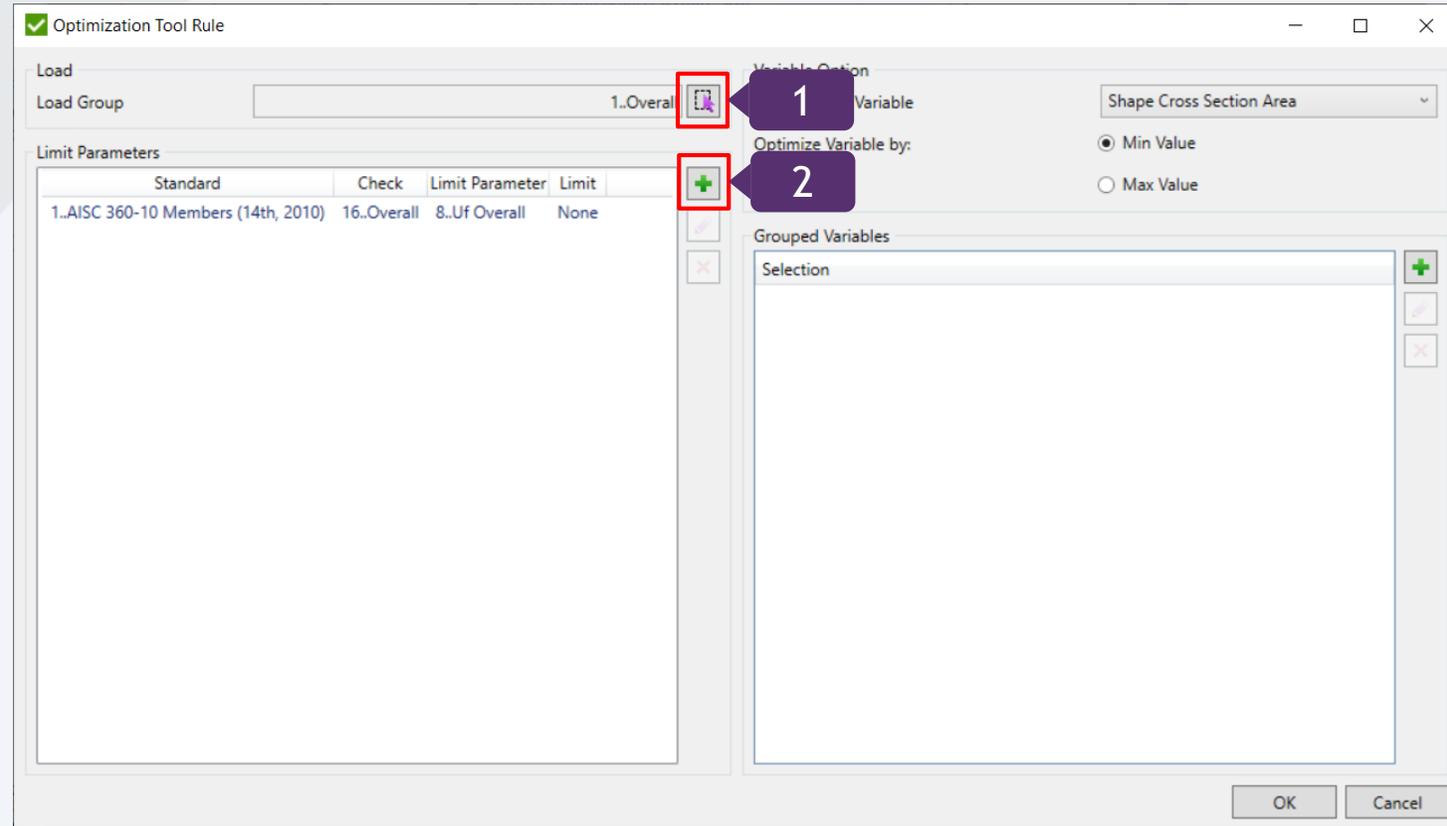
Click on **Select Limit Parameters**

3

In the opened window select Standard / Check / Parameter as shown below

4

Click on **Limits**. Set Between 0 and 1



Note: If you have multiple Standards calculated in your SDC Verifier Project you will have all of them listed in **Select Limit Parameters**

1

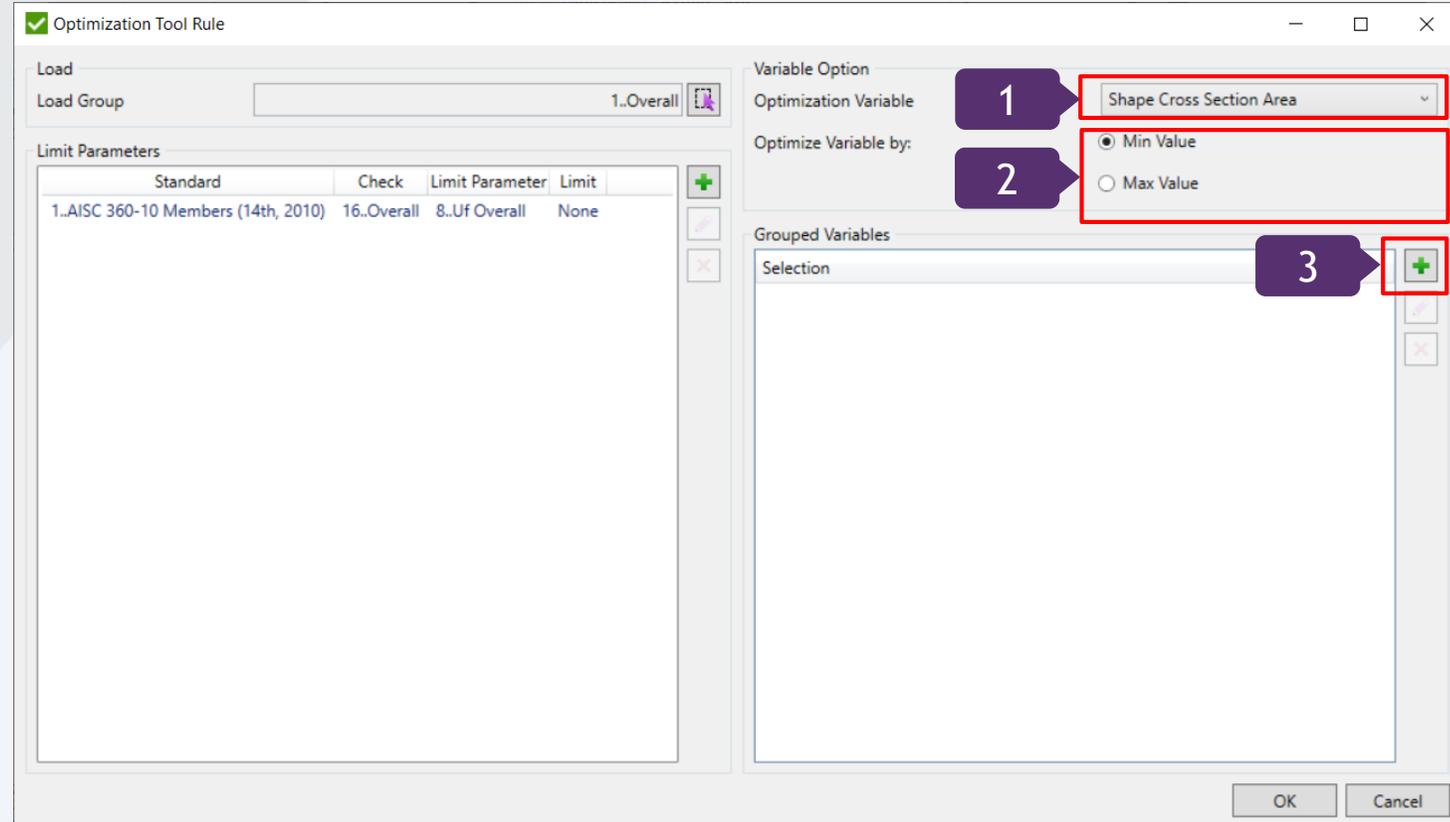
Set *Optimization Variable*:
Shape Cross Section Area

2

Set *Optimize Variable By*:
Min Value

3

Click on  to Select the
Variables to be Optimized

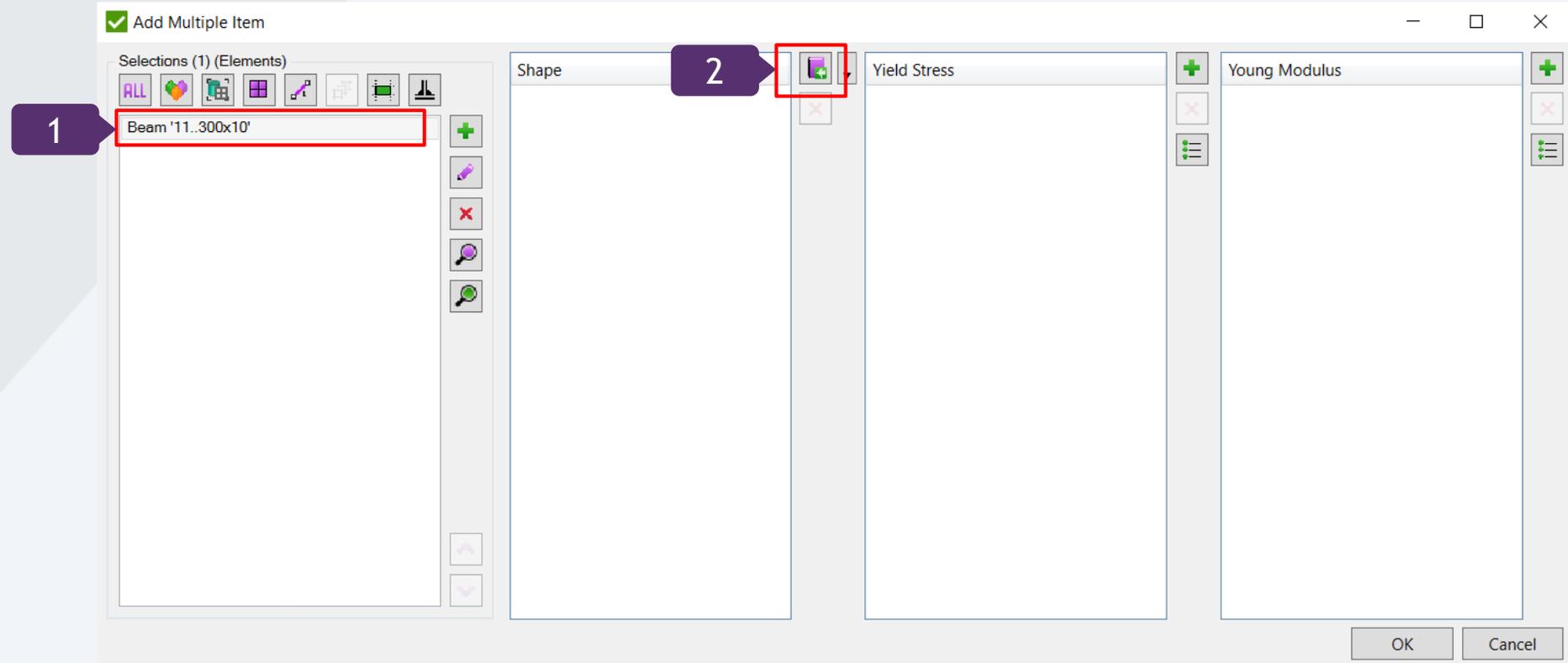


1

Using *Rule Based Selector*
Pick Property '11..300x10'

2

Click on  to open
Shape Library



Shape Library contains a list of predefined or user defined shapes that can be used in the Optimization, Shapes can be filtered, Organized in Lists, Added or Modified.

Shape Library

Filter by Name Shape Lists All

Name	Type	Width, [m]	Height, [m]	Area, [m ²]	lyy, [m ⁴]	lzz, [m ⁴]
<input type="checkbox"/> W44X335	I-Beam	0.40	1.12	0.06	0.01	4.952e-04
<input type="checkbox"/> W44X290	I-Beam	0.40	1.11	0.06	0.01	4.333e-04
<input type="checkbox"/> W44X262	I-Beam	0.40	1.10	0.05	0.01	3.893e-04
<input type="checkbox"/> W44X230	I-Beam	0.40	1.09	0.04	0.01	3.344e-04
<input type="checkbox"/> W40X593	I-Beam	0.42	1.09	0.11	0.02	1.052e-03
<input type="checkbox"/> W40X503	I-Beam	0.42	1.07	0.10	0.02	8.498e-04
<input type="checkbox"/> W40X431	I-Beam	0.41	1.05	0.08	0.01	6.996e-04
<input checked="" type="checkbox"/> W40X397	I-Beam	0.41	1.04	0.08	0.01	6.396e-04
<input type="checkbox"/> W40X372	I-Beam	0.41	1.03	0.07	0.01	5.959e-04
<input type="checkbox"/> W40X362	I-Beam	0.41	1.03	0.07	0.01	5.733e-04
<input type="checkbox"/> W40X324	I-Beam	0.40	1.02	0.06	0.01	5.063e-04
<input type="checkbox"/> W40X297	I-Beam	0.40	1.01	0.06	0.01	4.528e-04
<input type="checkbox"/> W40X277	I-Beam	0.40	1.01	0.05	0.01	4.333e-04
<input type="checkbox"/> W40X249	I-Beam	0.40	1.00	0.05	0.01	3.893e-04
<input type="checkbox"/> W40X215	I-Beam	0.40	0.99	0.04	0.01	3.344e-04
<input type="checkbox"/> W40X199	I-Beam	0.40	0.98	0.04	0.01	2.933e-04
<input type="checkbox"/> W40X392	I-Beam	0.31	1.06	0.07	0.01	3.375e-04
<input type="checkbox"/> W40X331	I-Beam	0.31	1.04	0.06	0.01	2.710e-04
<input type="checkbox"/> W40X327	I-Beam	0.31	1.04	0.06	0.01	2.643e-04
<input type="checkbox"/> W40X294	I-Beam	0.30	1.03	0.06	0.01	2.332e-04
<input type="checkbox"/> W40X278	I-Beam	0.30	1.02	0.05	0.01	2.187e-04
<input type="checkbox"/> W40X264	I-Beam	0.30	1.02	0.05	0.01	2.037e-04
<input type="checkbox"/> W40X235	I-Beam	0.30	1.01	0.04	0.01	1.857e-04
<input type="checkbox"/> W40X211	I-Beam	0.30	1.00	0.04	0.01	1.626e-04
<input type="checkbox"/> W40X183	I-Beam	0.30	0.99	0.03	0.01	1.373e-04
<input type="checkbox"/> W40X167	I-Beam	0.30	0.98	0.03	4.841e-03	1.180e-04

Selected Shape W40X397

Area, [m²] 0.08 Y Shear Area, [m²] 0

Moment of Inertia, Izz, [m⁴] 6.396e-04 Z Shear Area, [m²] 0

Moment of Inertia, Iyy, [m⁴] 0.01 Nonstructural Mass/length, [kg/m] 0

Moment of Inertia, Izy, [m⁴] 0 Warping Constant, [m⁶] 1.530e-04

Torsional Constant, [m⁴] 6.039e-05 Perimeter, [m] 0

OK Cancel

Show Selected Shapes (0) Displaying 6744 of 6744 shapes

1

Filter the shapes by name or type

2

Select the cross sections to be used for the optimization

3

Click OK to close the Shape Library

4

Click OK to close the Variables Selector And OK to close Optimization Rule

Now Optimization Rule is ready to be calculated

The screenshot shows the 'Shape Library' window with a list of shapes. A red box highlights the filter and the list. A purple arrow labeled '1' points to the filter box. A purple arrow labeled '2' points to the list. The list contains various HSS shapes, with 'HSS10X10X.188' selected. To the right, the 'Selected Shape HSS10X10X.188' properties are shown, including Area, Moment of Inertia, and Torsional Constant. A diagram of the selected shape is shown with dimensions 0.254 and 0.0047625. A purple arrow labeled '3' points to the 'OK' button.

Name	Type	Width, [m]	Height, [m]	Area, [m^2]	I _{yy} , [m^4]	I _{zz} , [m^4]
<input type="checkbox"/> HSS12X6X.250	Rectangular Tube	0.15	0.30	0.01	6.509e-05	2.210e-05
<input checked="" type="checkbox"/> HSS12X6X.313	Rectangular Tube	0.15	0.30	0.01	7.988e-05	2.692e-05
<input type="checkbox"/> HSS12X6X.375	Rectangular Tube	0.15	0.30	0.01	9.413e-05	3.148e-05
<input checked="" type="checkbox"/> HSS12X6X.500	Rectangular Tube	0.15	0.30	0.01	1.211e-04	3.987e-05
<input type="checkbox"/> HSS12X4X.500	Rectangular Tube	0.10	0.30	0.01	9.529e-05	1.553e-05
<input checked="" type="checkbox"/> HSS12X6X.625	Rectangular Tube	0.15	0.30	0.01	1.460e-04	4.734e-05
<input type="checkbox"/> HSS12X8X.250	Rectangular Tube	0.20	0.30	0.01	7.852e-05	4.203e-05
<input type="checkbox"/> HSS12X8X.313	Rectangular Tube	0.20	0.30	0.01	9.649e-05	5.145e-05
<input type="checkbox"/> HSS12X8X.375	Rectangular Tube	0.20	0.30	0.01	1.139e-04	6.048e-05
<input checked="" type="checkbox"/> HSS12X8X.500	Rectangular Tube	0.20	0.30	0.01	1.468e-04	7.742e-05
<input type="checkbox"/> HSS12X8X.625	Rectangular Tube	0.20	0.30	0.01	1.776e-04	9.291e-05
<input type="checkbox"/> HSS12X10X.250	Rectangular Tube	0.25	0.30	0.01	9.195e-05	6.953e-05
<input type="checkbox"/> HSS12X8X.188	Rectangular Tube	0.20	0.30	4.412e-03	5.961e-05	3.203e-05
<input type="checkbox"/> HSS12X4X.375	Rectangular Tube	0.10	0.30	0.01	7.440e-05	1.253e-05
<input type="checkbox"/> HSS12X4X.313	Rectangular Tube	0.10	0.30	0.01	6.327e-05	1.082e-05
<input type="checkbox"/> HSS12X4X.250	Rectangular Tube	0.10	0.30	4.670e-03	5.166e-05	8.981e-06
<input checked="" type="checkbox"/> HSS10X10X.188	Rectangular Tube	0.25	0.25	4.412e-03	4.582e-05	4.582e-05
<input type="checkbox"/> HSS10X10X.250	Rectangular Tube	0.25	0.25	0.01	6.027e-05	6.027e-05
<input type="checkbox"/> HSS10X10X.313	Rectangular Tube	0.25	0.25	0.01	7.397e-05	7.397e-05
<input type="checkbox"/> HSS10X10X.375	Rectangular Tube	0.25	0.25	0.01	8.717e-05	8.717e-05
<input type="checkbox"/> HSS10X10X.500	Rectangular Tube	0.25	0.25	0.01	1.121e-04	1.121e-04
<input type="checkbox"/> HSS10X10X.625	Rectangular Tube	0.25	0.25	0.01	1.352e-04	1.352e-04
<input type="checkbox"/> HSS12X2X.188	Rectangular Tube	0.05	0.30	3.065e-03	2.923e-05	1.508e-06
<input type="checkbox"/> HSS12X2X.250	Rectangular Tube	0.05	0.30	4.069e-03	3.823e-05	1.886e-06
<input checked="" type="checkbox"/> HSS12X2X.313	Rectangular Tube	0.05	0.30	0.01	4.666e-05	2.201e-06
<input type="checkbox"/> HSS12X3X.188	Rectangular Tube	0.08	0.30	3.290e-03	3.429e-05	3.700e-06

1 Execute *Calculate* to run the Optimization

The screenshot shows the 'Optimization' dialog box with the following details:

- General**
 - ID: 1
 - Title: AISC 360-10 Optimization
 - Description: (empty)
- Table:**

Load	Standards - Check - Limit Parameters	Optimize by	Result
LG1..Overall	1..AISC 360-10 Members (14th, 2010) 16..Overall - 8..Uf Overall, Limit: [0;1]	Min Shape Cross Section Area	

At the bottom of the dialog, the 'Calculate' button is highlighted with a red box and a callout '1'. Other buttons include 'Change Beam Shape', 'OK', and 'Cancel'.

1 Click on **Table > All results**

Results for all variables

Group	Yield Stress	Young Modulus	Shape	1..AISC 360-10 Members (1-16..Overall 8..Uf Overall)
Beam '11..300x10'	Original Model	Original Model	Original Model	1.51
Beam '11..300x10'			HSS20X8X.625 - Rectangular	0.58
Beam '11..300x10'			HSS20X4X.500 - Rectangular	1.66
Beam '11..300x10'			HSS20X4X.313 - Rectangular	2.50
Beam '11..300x10'			HSS16X8X.250 - Rectangular	1.63
Beam '11..300x10'			HSS14X10X.250 - Rectangular	1.37

Load	Standards - Check - Limit Parameters	Optimize by	Result
LG1..Overall	1..AISC 360-10 Members (14th, 2010) 16..Overall - 8..Uf Overall, Limit: [0;1]	Min Shape Cross Section Area	Calculated

Optimal result is Beam HSS20x8x625. It will be used for changing the Beam shape

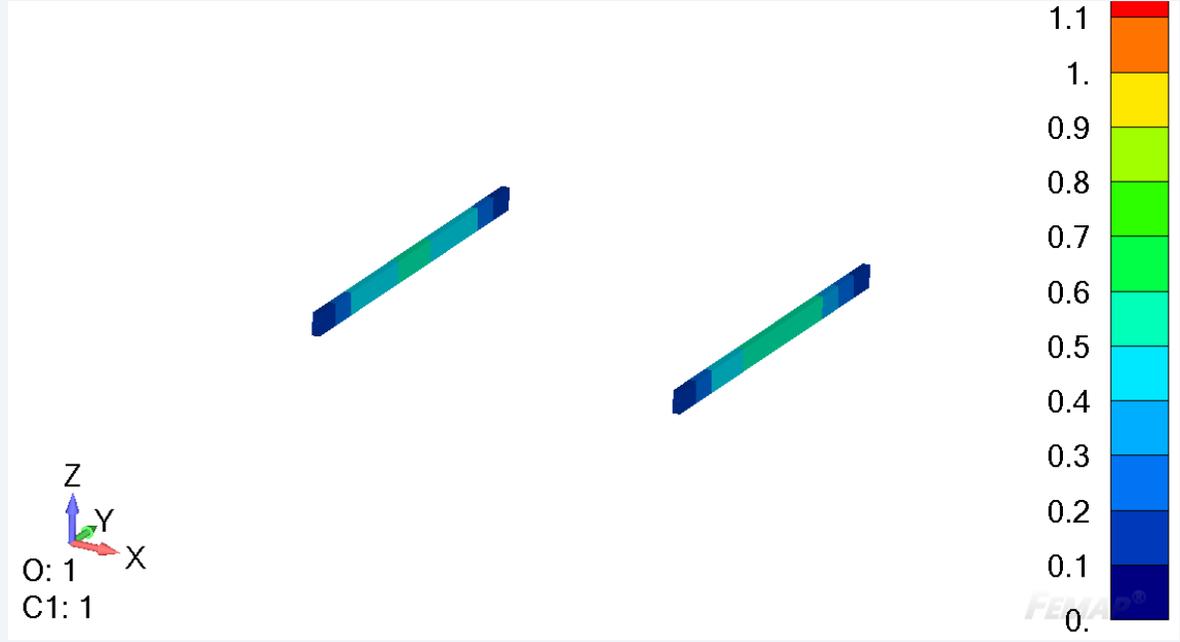
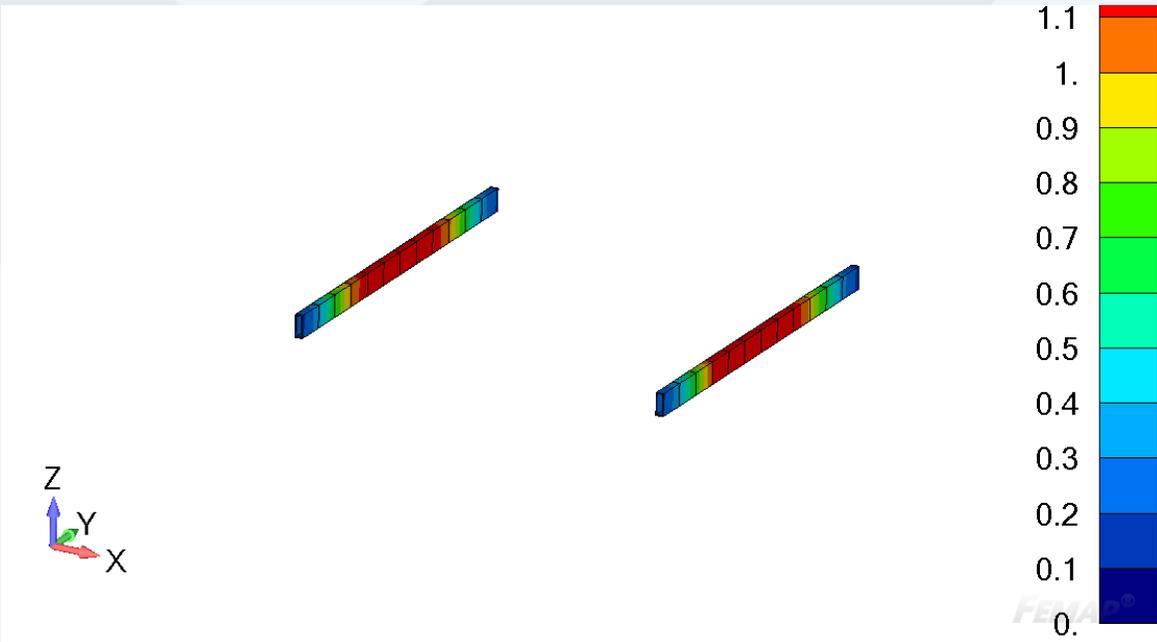
1

Click on *Plot Optimal Result*

Load	Standards - Check - Limit Parameters	Optimize by	Result
LG1..Overall	1..AISC 360-10 Members (14th, 2010) 16..Overall - 8..Uf Overall, Limit: [0;1]	Min Shape Cross Section Area	Calculated

Result Before the Optimization

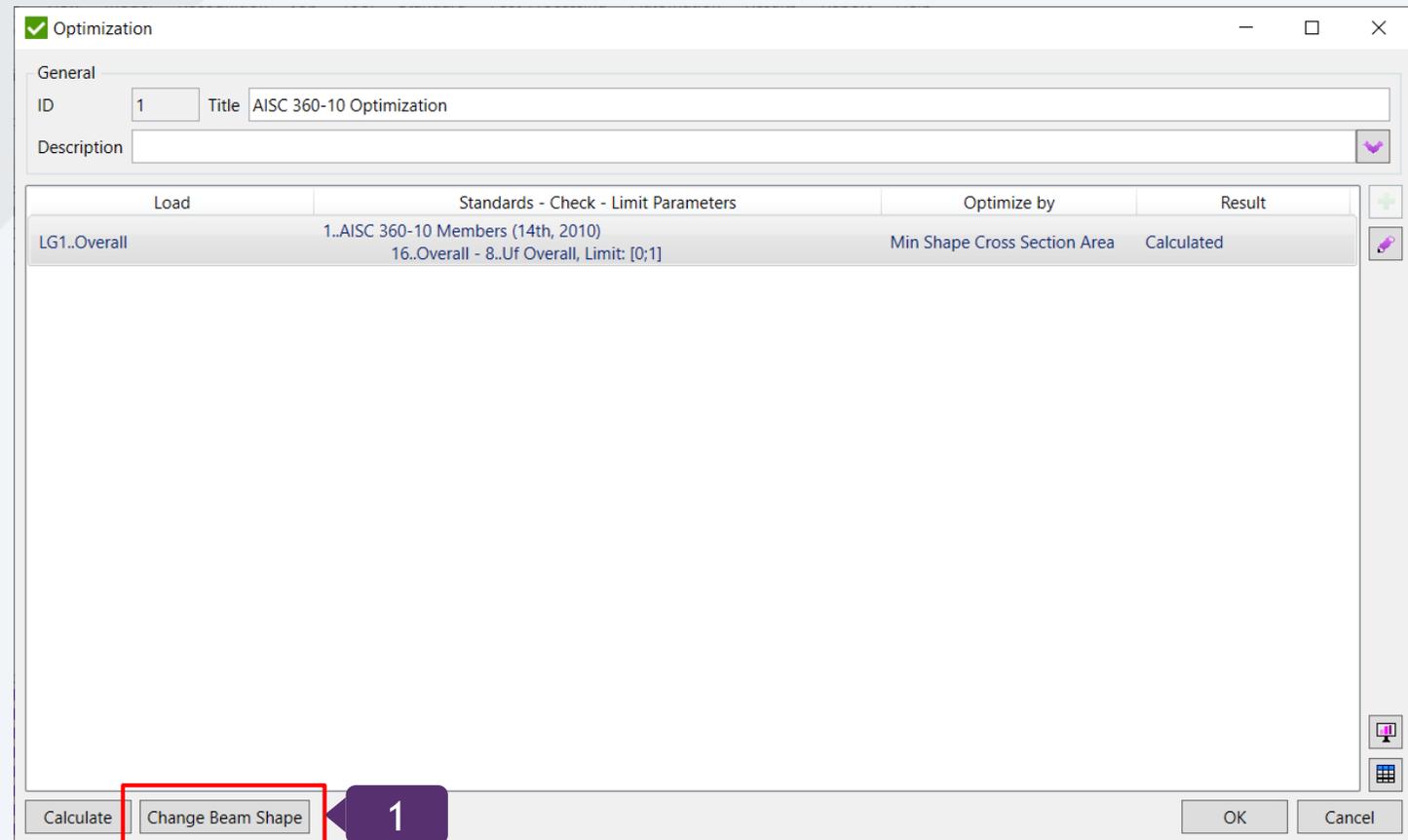
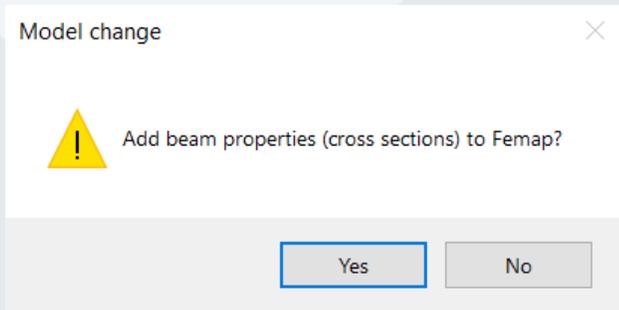
Result After the Optimization



This Tutorial only demonstrates the workflow with Optimization Tool. Optimization rule can be set more precisely. For Example, using the Peak Finder you can group only the overshooting elements into a Component and run the optimization on this Component. Multiple rules with different variables can be set.

1

Click on *Change Beam Shape*



Property 300x10 is automatically replaced by HSS20x8x625(Optimal Result)