



Tutorial

# API 2A RP/ISO 19902/Norsok N004

Updated on: January 25th 2024

Tested with: SDC Verifier 2023 R2

Simcenter3D 2306

SDC Verifier is a powerful Simcenter add-on that helps verify structures according to standards and generates full calculations reports.

- In this tutorial, API 2A RP/ISO 19902/Norsok N004 Beam Design Checks are reviewed.
- Beam Design Checks are reviewed in details;
- A beam model of a steel frame has been used as a start FEM model.
- Beam member finder was used to recognize beam member length in 3 directions.
- The functionality of SDC Verifier Report Designer can be checked via the link to a separate tutorial (Slide 27).

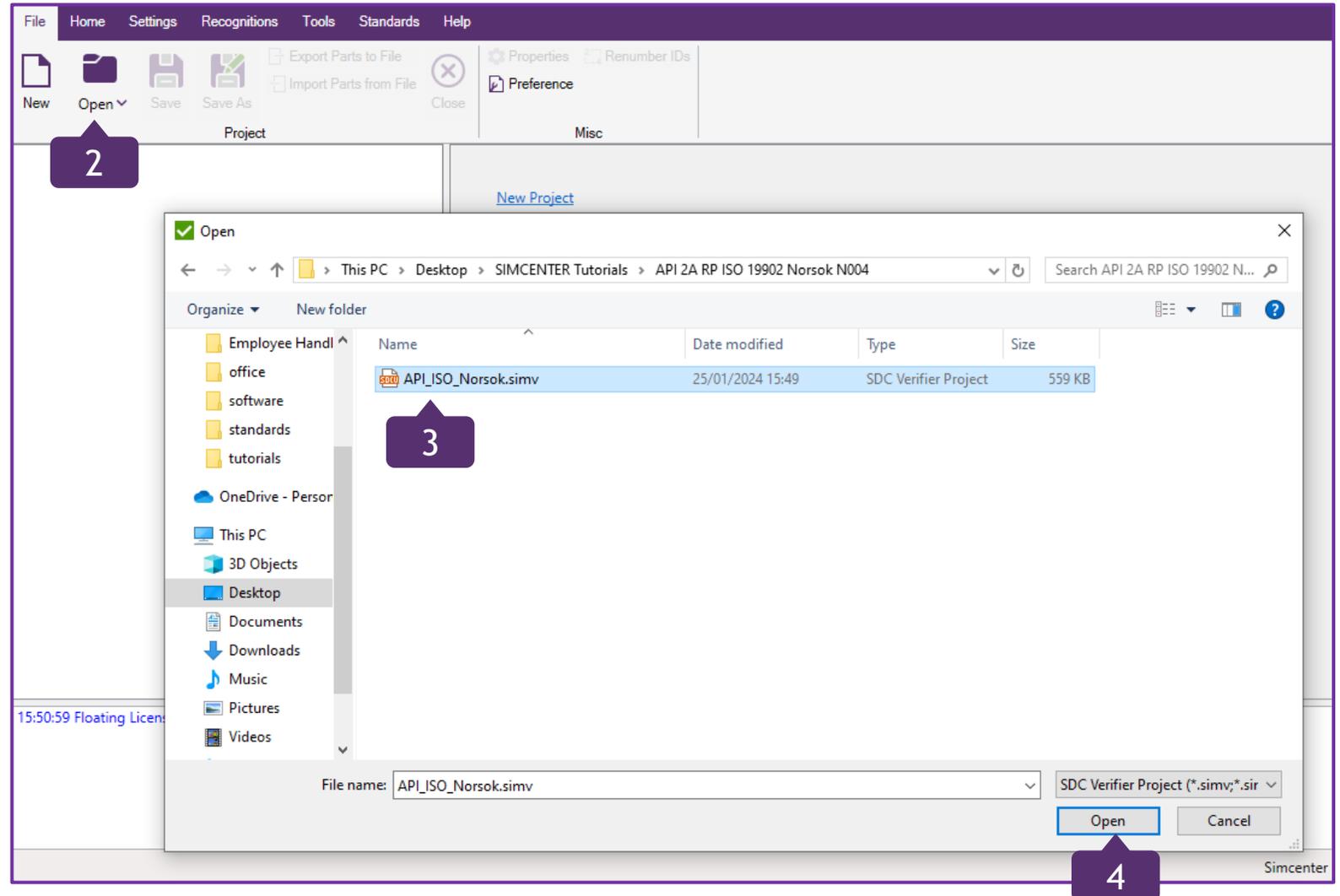
# Open the Starter Model

1 Launch SDC Verifier for Simcenter 3D

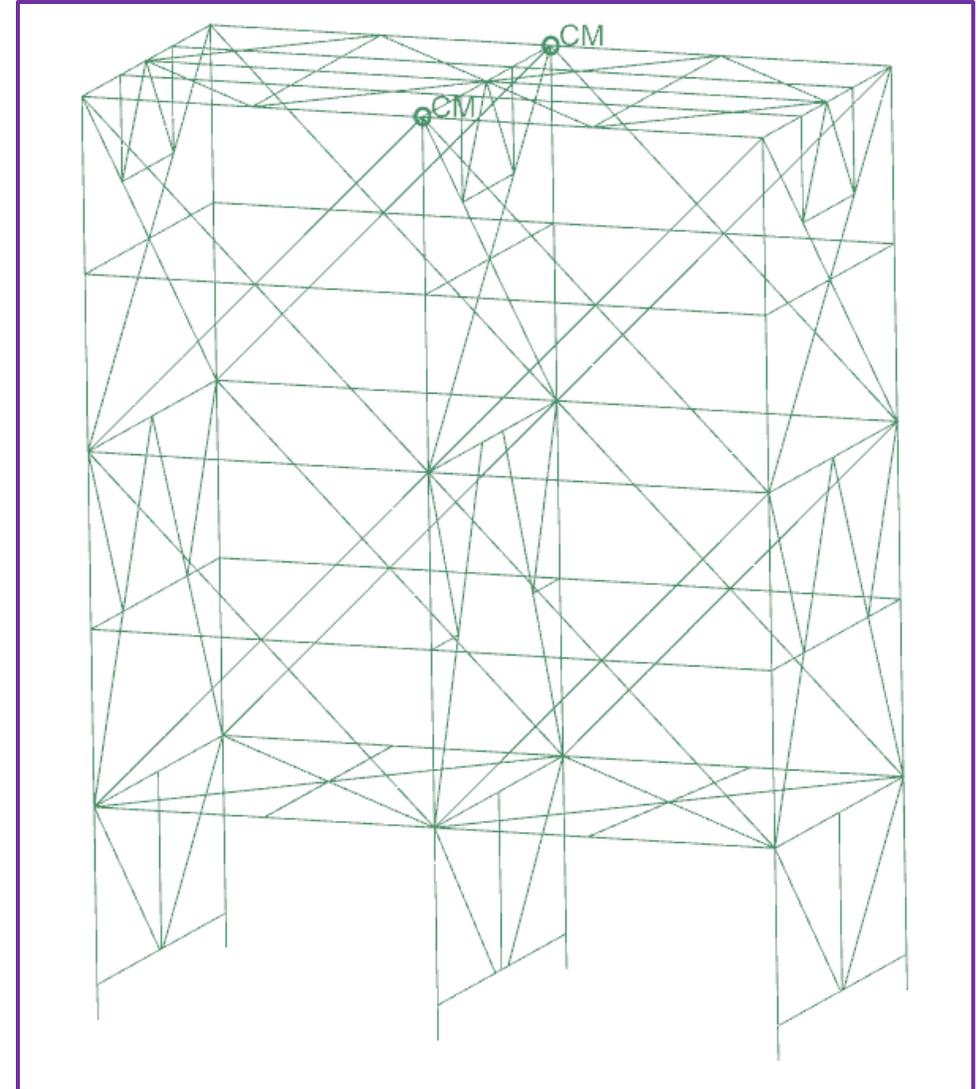
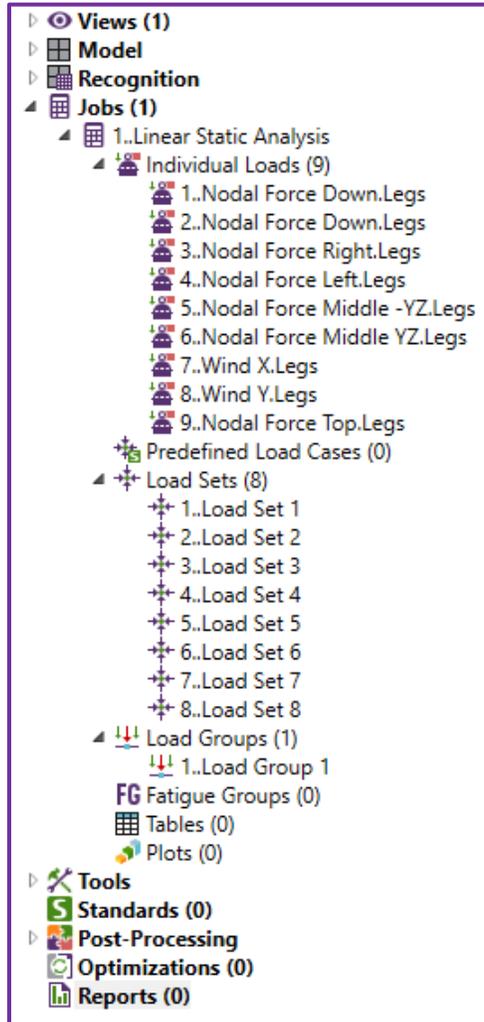
2 In *File* section, press *Open*

3 Select a project *API\_ISO\_Norsok.simv*

4 Press *Open*



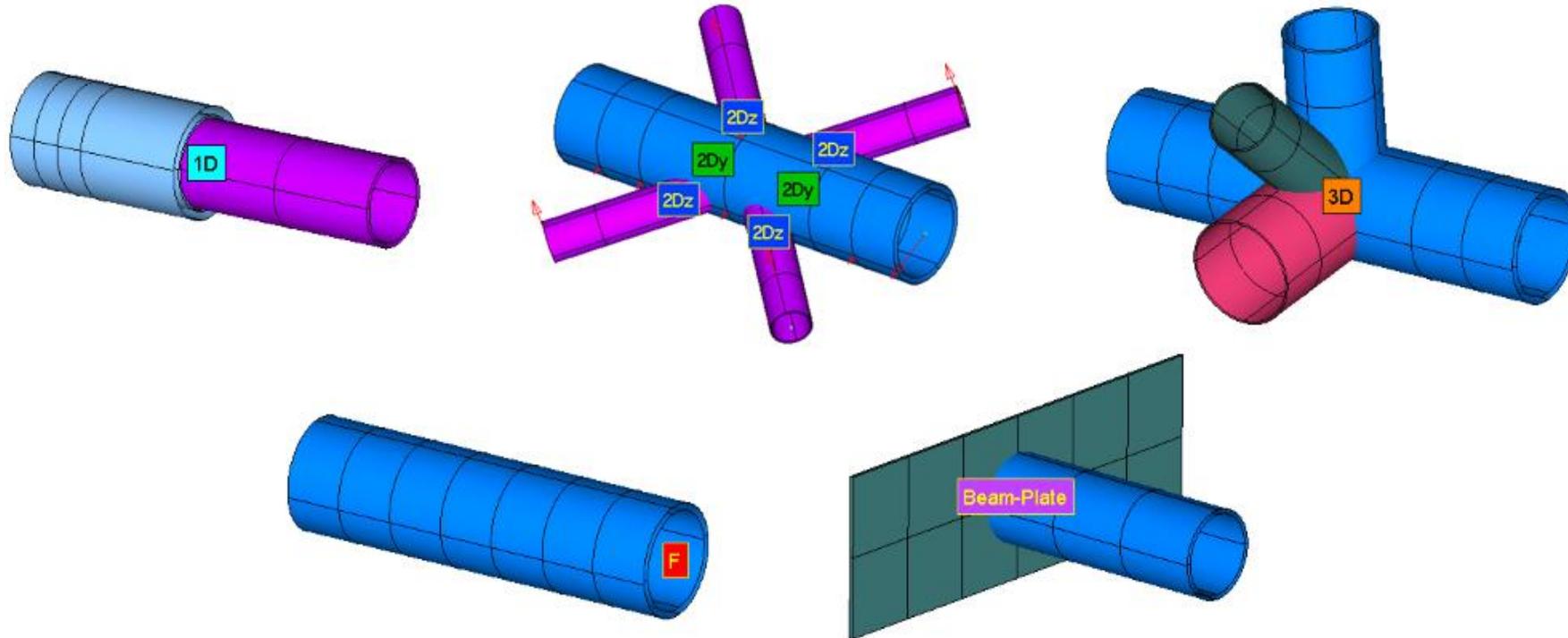
This tutorial presents a predefined project with the following created data: Individual Loads, Load Sets and a Load Group. The focus of this tutorial is to check the cylindrical members and create the basic report.



Joint is a location where different Beam Members connect.  
They are used to recognize beam member length by Beam Member Finder Tool.

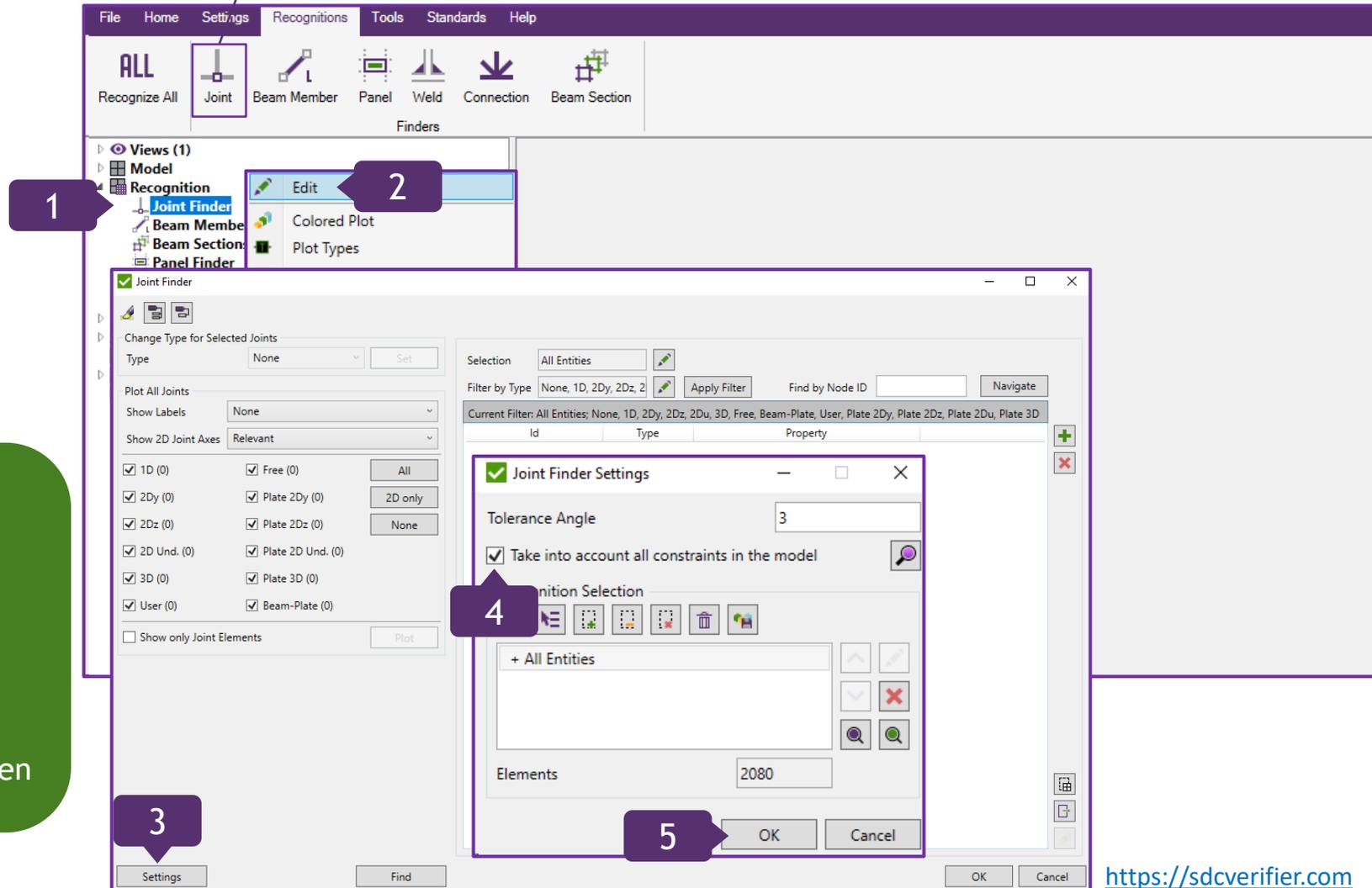
There are 6 types of Joints:

- 1D Joint - 2 beam members that lie on the curve, but with different properties;
- 2D Joint - beam members connected in one plane;
- 3D Joint - beam members connected in space;
- Free Joint - a node which belongs only to one element (free);
- Beam-Plate Joint - a beam member connected to plates (perpendicularly);
- User Defined;



- 1 In the *Model Tree*, expand *Recognition* and select *Joint Finder*
- 2 Execute right click on *Joint Finder* and select *Edit*
- 3 Press *Settings*
- 4 Take into account all constraints in the model is *ON*
- 5 Press *OK*

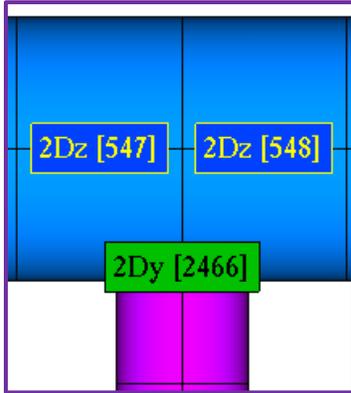
An alternative method of using a Joint Finder Tool is to press Joint in the Recognition section of the Toolbar.



When performing Joint Recognition, there are 3 options for existing joints:  
Default option - Keep only modified;  
Remove All joints (except for those, edited by a user);  
Keep All Existing options - it should be used, when additional elements were added to the model.

1 Press Find

2 Press OK



Joint Finder

Change Type for Selected Joints  
Type: None

Plot All Joints  
Show Labels: None  
Show 2D Joint Axes: Relevant

1D (6)     Free (1)    All  
 2Dy (50)     Plate 2Dy (0)    2D only  
 2Dz (42)     Plate 2Dz (0)    None  
 2D Und. (16)     Plate 2D Und. (0)  
 3D (39)     Plate 3D (0)  
 User (0)     Beam-Plate (0)

Show only Joint Elements    Plot

Selection: All Entities  
Filter by Type: None, 1D, 2Dy, 2Dz, 2Du, 3D, Free, Beam-Plate, User, Plate 2Dy, Plate 2Dz, Plate 2Du, Plate 3D

Id	Type	Property
Node ID = 3	3D	
Node ID = 4	3D	
Node ID = 5	3D	
Node ID = 6	3D	
Node ID = 7	3D	
Node ID = 22	3D	
Node ID = 23	3D	
Node ID = 24	3D	
Node ID = 117	3D	
Node ID = 136	3D	
Node ID = 155	3D	
Node ID = 165	3D	
Node ID = 201	3D	
Node ID = 202	3D	
Node ID = 231	3D	
Node ID = 237	2Dy	
Node ID = 243	2Dy	
Node ID = 251	2Dy	
Node ID = 258	2Dy	
Node ID = 265	2Dy	
Node ID = 271	2Dy	

SDC Verifier  
114 Joints were recognized  
OK

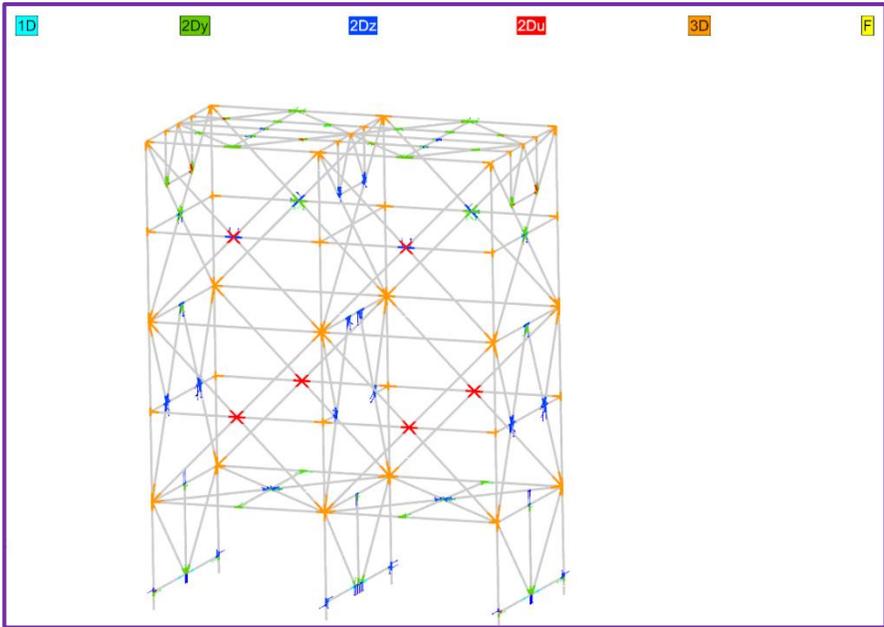
Find    OK    Cancel

Node ID = 719
Element ID = 2466    2Dy    14.200x10
Element ID = 547    2Dz    8.400x19
Element ID = 548    2Dz    8.400x19

1 Select all Joints (*Ctrl+A*)

2 Press  and select *Plot Joint Type in Colors*

3 Press *OK*



**Modify Joint Type.**

Change Type for Selected Joints  
Type: None Set

Plot All Joints  
Show Labels: None  
Show 2D Joint Axes: Relevant

<input checked="" type="checkbox"/> 1D (6)	<input checked="" type="checkbox"/> Free (1)	All
<input checked="" type="checkbox"/> 2Dy (50)	<input checked="" type="checkbox"/> Plate 2Dy (0)	2D only
<input checked="" type="checkbox"/> 2Dz (42)	<input checked="" type="checkbox"/> Plate 2Dz (0)	None
<input checked="" type="checkbox"/> 2D Und. (16)	<input checked="" type="checkbox"/> Plate 2D Und. (0)	
<input checked="" type="checkbox"/> 3D (39)	<input checked="" type="checkbox"/> Plate 3D (0)	
<input checked="" type="checkbox"/> User (0)	<input checked="" type="checkbox"/> Beam-Plate (0)	

Show only Joint Elements Plot

**Plot Joints of specific Type.**

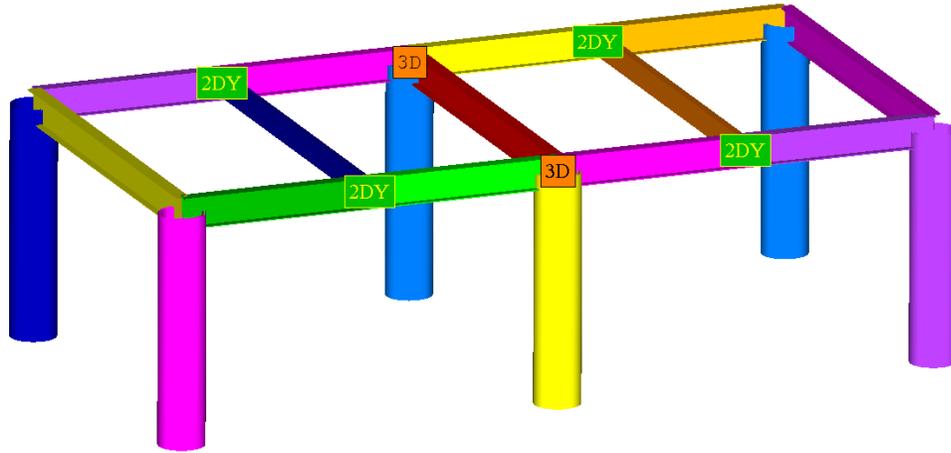
Selection: All Entities  
Filter by Type: None, 1D, 2Dy, 2Dz, 2Du, 3D, Free, Beam-Plate, User, Plate 2Dy, Plate 2Dz, Plate 2Du, Plate 3D  
Find by Node ID: [ ] Navigate

Id	Type	Property
Node ID = 3	3D	
Node ID = 4	3D	
Node ID = 5	3D	
Node ID = 6	3D	
Node ID = 7	3D	
Node ID = 22	3D	
Node ID = 23	3D	
Node ID = 24	3D	
Node ID = 117	3D	
Node ID = 136	3D	
Node ID = 155	3D	
Node ID = 165	3D	
Node ID = 201	3D	
Node ID = 202	3D	
Node ID = 231	3D	
Node ID = 237	2Dy	
Node ID = 243	2Dy	
Node ID = 251	2Dy	
Node ID = 258		
Node ID = 265		
Node ID = 271		

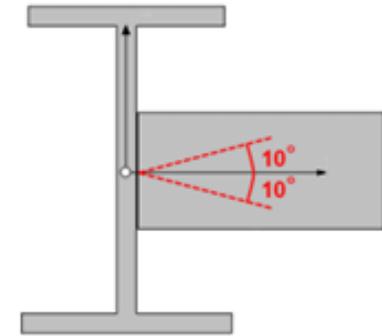
Plot Joint Type Labels  
Plot Joint Type in Colors

OK Cancel

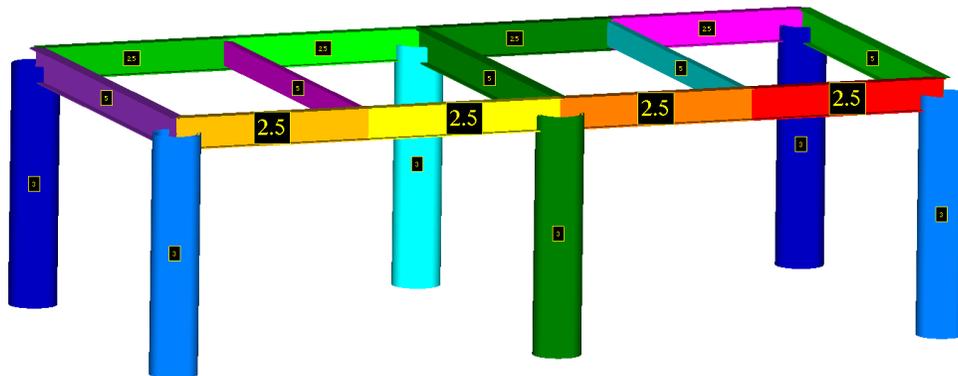
Beam Member Finder recognizes Beam members and (buckling) Lengths for different directions (Y, Z and Torsional).



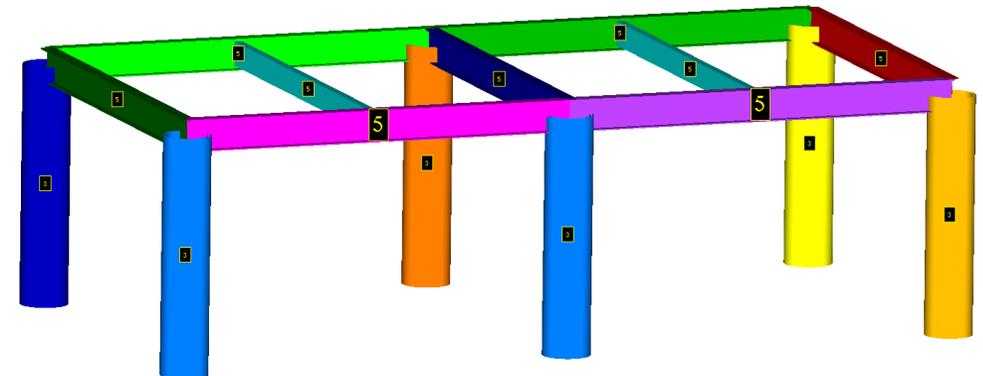
2DY  
Joint



Length Y – 4 Beam Members with  $L = 2.5$



Length Z – 2 Beam Members with  $L = 5$



# Recognize Length Y

1

In *Recognition* section of the *Model Tree*, execute right click on *Beam Member Finder* and press *Edit*

2

*Length Y* - 2Dy, 3D, Plate 2Dy, Plate 3D  
*Length Z* - 2Dz, 3D, Plate 2Dz, Plate 3D  
*Torsion (Lb)* - 2Dy, 2Dz, 2D Und., 3D

3

Press *Find*

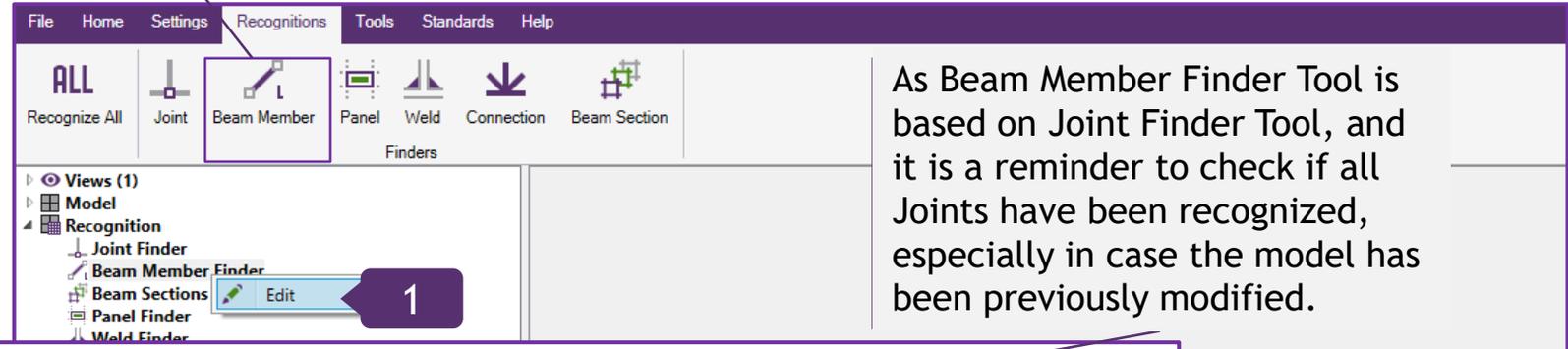
4

Press *No*

5

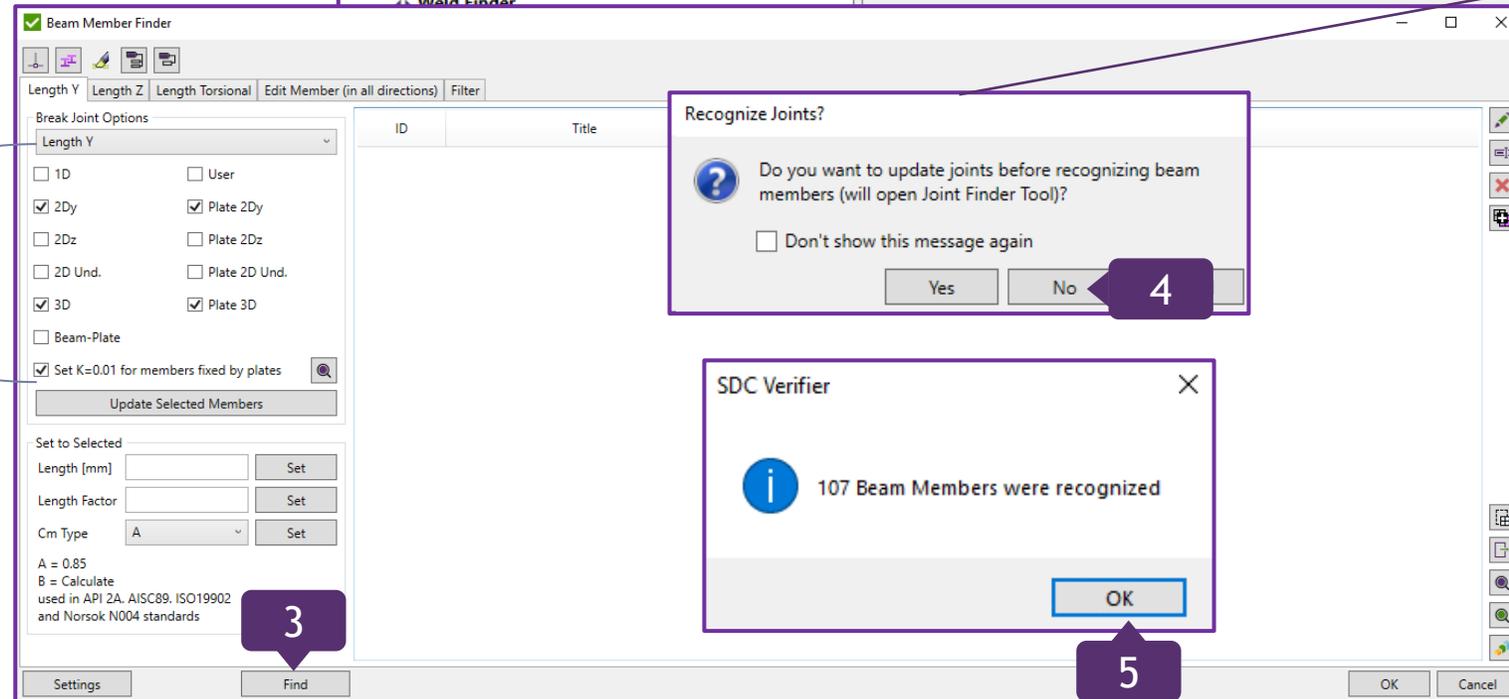
Press *OK*

An alternative method of using a Beam Member Finder Tool is to press Beam Member in the Recognition section of the Toolbar.



As Beam Member Finder Tool is based on Joint Finder Tool, and it is a reminder to check if all Joints have been recognized, especially in case the model has been previously modified.

2



3

5

# Beam Member Finder Interface Explanation

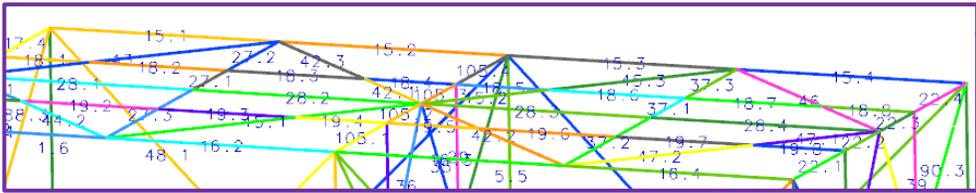
Beam Member is a straight line. If it contains joints, it is split on sub members.

Break Joint Options define what joints are used to split Beam Members.

Change Length/Factor for selected beam members.

Cm Type is used in API 2A, ISO 19902 and Norsok N004 standards.

Select all Beam Members and press Select Plot Members ID Labels.



- Plot selected members
- Plot Length Criteria
- Plot Members ID Labels
- Plot Full Members ID Labels
- Plot Length Labels
- Plot Cm Type Labels
- Plot Length Factor Labels
- Plot Joints for Selected Members
- Plot Members Y and Z axes
- Plot Length Labels in Y and Z axes

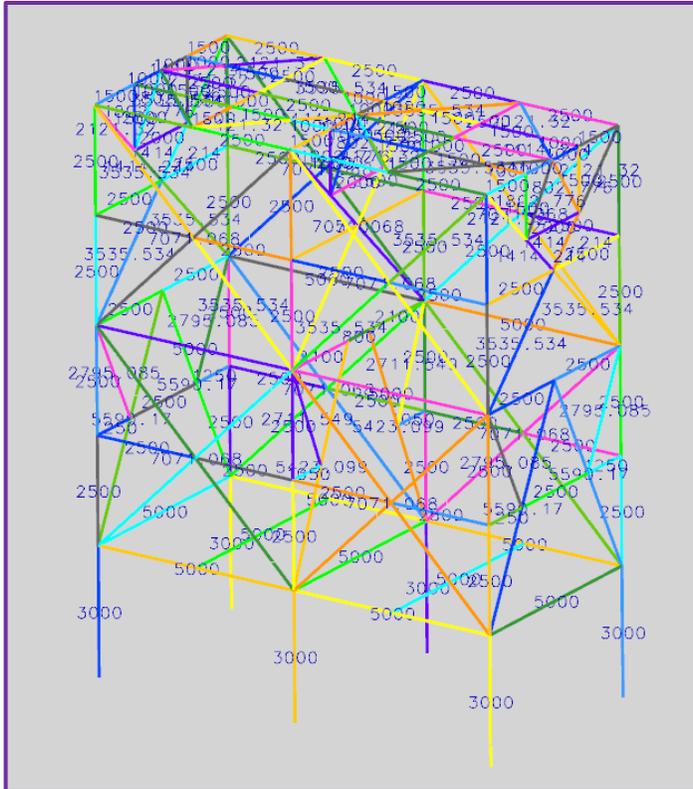
15	Beam Member 15 (Y)	32	10000				1100[2Dy] 1117[3D] 2218[2Dy]
15.1	Beam Member 15.1 (Y)	8	2500	1	A		
15.2	Beam Member 15.2 (Y)	8	2500	1	A		
15.3	Beam Member 15.3 (Y)	8	2500	1	A		
15.4	Beam Member 15.4 (Y)	8	2500	1	A		

# Beam Member's Length Plot

1 Select all Beam Members (*Ctrl+A*)

2 Press  and select *Plot Length Labels*

3 Press *OK*



**Beam Member Finder**

Length Y Length Z Length Torsional Edit Member (in all directions) Filter

Break Joint Options  
Length Y

1D  User  
 2Dy  Plate 2Dy  
 2Dz  Plate 2Dz  
 2D Und.  Plate 2D Und.  
 3D  Plate 3D  
 Beam-Plate  
 Set K=0.01 for members fixed by plates

Update Selected Members

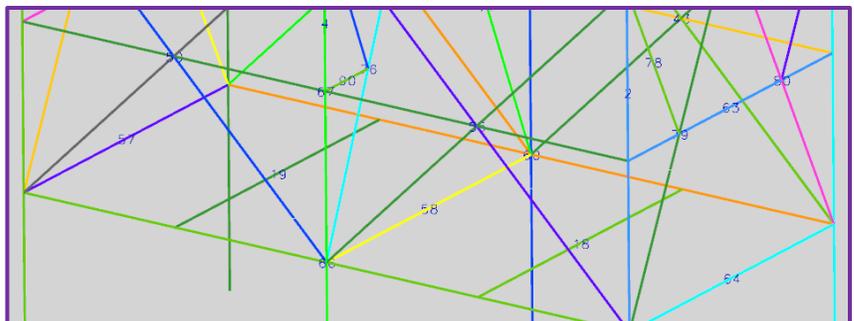
Set to Selected  
Length [mm]  Set  
Length Factor  Set  
Cm Type A Set

A = 0.85  
B = Calculate  
used in API 2A, AISC89, ISO19902  
and Norsok N004 standards

ID	Title	Elements	Length	Length Factor	Cm Type	Modified	Joint - NodeID [Joint Type]
1	Beam Member 1 (Y)	47	13000				923 1107[3D] 155[3D] 1104[3D] 4[3D]
2	Beam Member 2 (Y)	47	13000				922 1109[3D] 136[3D] 1108[3D] 117[3D]
3	Beam Member 3 (Y)	47	13000				2041 2225[3D] 1273[3D] 2222[3D] 1122[3D]
4	Beam Member 4 (Y)	47	13000				2040 2227[3D] 1254[3D] 2226[3D] 1235[3D]
5	Beam Member 5 (Y)	47	13000				924[2Dz] 1106[3D] 165[3D] 1105[3D] 22[3D]
6	Beam Member 6 (Y)	47	13000				921[2Dz] 1111[3D] 202[3D] 1110[3D] 201[3D]
7	Beam Member 7 (Y)	32	10000				1090[2Dy] 22[3D] 2208[2Dy]
8	Beam Member 8 (Y)	16	5000	1	A		1093[2Dz]
9	Beam Member 9 (Y)	24	5000	1	A		926[1D] 2314[2Dz] 941[2Dz] 2315[2Dz] 939[1D]
10	Beam Member 10 (Y)	32	10000				1103[2Dz] 201[3D] 2221[2Dz]
11	Beam Member 11 (Y)	16	5000	1	A		2211[2Dz]
12	Beam Member 12 (Y)	16	5000	1	A		
13	Beam Member 13 (Y)	24	5000	1	A		2059[2Dz] 2318[2Dz] 2323[2Dz] 2057[1D] 2044[1D]
14	Beam Member 14 (Y)	18	5000	1	A		958[2Dz] 942[2Dz] 957[2Dz] 956[1D] 943[1D]
15	Beam Member 15 (Y)	32	10000				1100[2Dy] 1117[3D] 2218[2Dy]
16	Beam Member 16 (Y)	32	10000				1101[2Dy] 1116[3D] 2219[2Dy]
17	Beam Member 17 (Y)	18	5000				6[3D] 24[3D] 7[3D]
18	Beam Member 18 (Y)	40	10000				231[2Dy] 237[2Dy] 243[2Dy] 3[3D] 1361[2Dy] 1355[2Dy] 1349[2Dy]
19	Beam Member 19 (Y)	40	10000				251[2Dy] 258[2Dy] 265[2Dy] 5[3D] 1383[2Dy] 1376[2Dy] 1369[2Dy]
20	Beam Member 20 (Y)	7	2795.085	1	A		
21	Beam Member 21 (Y)	7	2795.085	1	A		
22	Beam Member 22 (Y)	18	5000				1124[3D] 1142[3D] 1125[3D]

Settings Find OK Cancel

Also, it is possible to display Beam Members IDs by pressing 



- Plot selected members
- Plot Length Criteria
- Plot Members ID Labels
- Plot Full Members ID Labels
- Plot Length Labels
- Plot Cm Type Labels
- Plot Length Factor Labels
- Plot Joints for Selected Members
- Plot Members Y and Z axes
- Plot Length Labels in Y and Z axes

1

In *Home* section, press *Analyze*

The screenshot shows the SDC Verifier software interface. The 'Home' ribbon is active, and the 'Analyze' button is highlighted with a purple callout box containing the number '1'. The left-hand tree view shows a project structure with 'Jobs (1)' expanded to show '1..Linear Static Analysis'. The console window at the bottom displays the following text:

```
10:53:33 Linear Static Analysis analysis started  
10:53:34 Analysis options:  
Simple analysis loads: 9  
Inertia relief analysis loads: 0  
Not included loads: 0  
Skipped loads: 8  
10:53:55 Linear Static Analysis analysis finished
```

At the bottom of the console, it shows: Nodes: 1923 Elements: 2080 C:\Users\user\Desktop\SIMCENTER Tutorials\API 2A RP ISO 19902 Norsok N004\scaffold\_tutorial\_s.sim MmKS (Millimeter/Kg/Second) Simcenter

Linear Static Analysis started and finished.

Cmy and Cmz reduction factors are used in combined axial and bending check. API RP 2A description:

$$\frac{f_c}{\phi_c F_{cn}} + \frac{1}{\phi_b F_{bn}} \left\{ \left[ \left( 1 - \frac{f_e}{\phi_c F_{ey}} \right) \left[ \frac{C_{my} f_{by}}{f_e} \right]^2 \right] + \left[ \left( 1 - \frac{f_e}{\phi_c F_{ez}} \right) \left[ \frac{C_{mz} f_{bz}}{f_e} \right]^2 \right] \right\}^{0.5} \leq 1.0$$

..... (D.3.2-1)

**TABLE D.3-1  
EFFECTIVE LENGTH AND BENDING  
REDUCTION FACTORS FOR  
MEMBER STRENGTH CHECKING**

Situation	Effective Length Factor K	Reduction Factor Cm <sup>(1)</sup>
<b>Superstructure Legs</b>		
Braced	1.0	(a)
Portal (unbraced)	K <sup>(2)</sup>	(a)
<b>Jacket Legs &amp; Piling</b>		
Grouted Composite Section	1.0	(c)
Ungouted Jacket Legs	1.0	(c)
Ungouted Piling Between Shim Points	1.0	(b)
<b>Jacket Braces</b>		
Face-to-face Length of Main Diagonals	0.8	(b) or (c)
Face of Leg to Centerline of Joint Length of K-Braces <sup>(3)</sup>	0.8	(c)
Longer Segment Length of X-Braces <sup>(3)</sup>	0.9	(c)
Secondary Horizontals	0.7	(c)
Deck Truss Chord members	1.0	(a),(b) or (c)
<b>Deck Truss Web Members</b>		
In-Plane Action	0.8	(b)
Out-of-Plane Action	1.0	(a) or (b)

Notes to Table D.3-1:

(1) Use whichever is more applicable to a specific situation. Values of the reduction factor Cm referred to in the above table are as follows:

(a) 0.85

(b)  $0.6 - 0.4 \frac{M_1}{M_2}$ , no more than 0.85, or less than

0.40, where  $M_1/M_2$  is the ratio of smaller to larger moments at the ends of that portion of the member unbraced in the plane of bending under consideration.  $M_1/M_2$  is positive when the number is bent in reverse curvature, negative when bent in single curvature.

(c)  $1.0 - 0.4 \frac{f_c}{\phi_c F_e}$ , or 0.85, whichever is less

By default, Cm Type is equal to A = 0.85 for all members. It is possible to modify Cm Type for selected members:

Cm Type A Set

A = 0.85  
 B = Maximum (0.6 - 0.4 \* (M1/M2), 1 - 0.4 \* (fc / (PhiC \* Fe)))

In SDC Verifier, B = minimum from (b) and (c)

API RP\*2A-LRFD 93 ■ 0732290 0507612 001 ■

## Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms — Load and Resistance Factor Design

API RECOMMENDED PRACTICE 2A-LRFD (RP 2A-LRFD)  
FIRST EDITION, JULY 1, 1993

American Petroleum Institute  
1220 L Street, Northwest  
Washington, DC 20005



This “Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms — Load and Resistance Factor Design” (LRFD) contains the engineering design principles and good practices that have been the basis of the API RP2A working strength design (WSD) recommended practice, now in its 20th Edition. The LRFD provisions have been developed from the WSD provisions using reliability based calibration.

API RP\*2A-LRFD 93 ■ 0732290 0507612 T48 ■

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and content. This publication is intended to supplement rather  
than replace individual engineering judgment.

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1

Execute right click on *Standards* and select *Add* => *API* => *API RP 2A-LRFD (1st, 1993)*

API 2A RP Standard covers the design checks only cylindrical types of shapes.

## SECTION D CYLINDRICAL MEMBER DESIGN

$C_x$  = critical elastic buckling coefficient

The theoretical value of  $C_x$  is 0.6. However, a reduced value of  $C_x = 0.3$  is recommended for use in Equation D.2.2-3 to account for the effect of initial geometric imperfections within API Spec 2B tolerance limits, Reference D2.

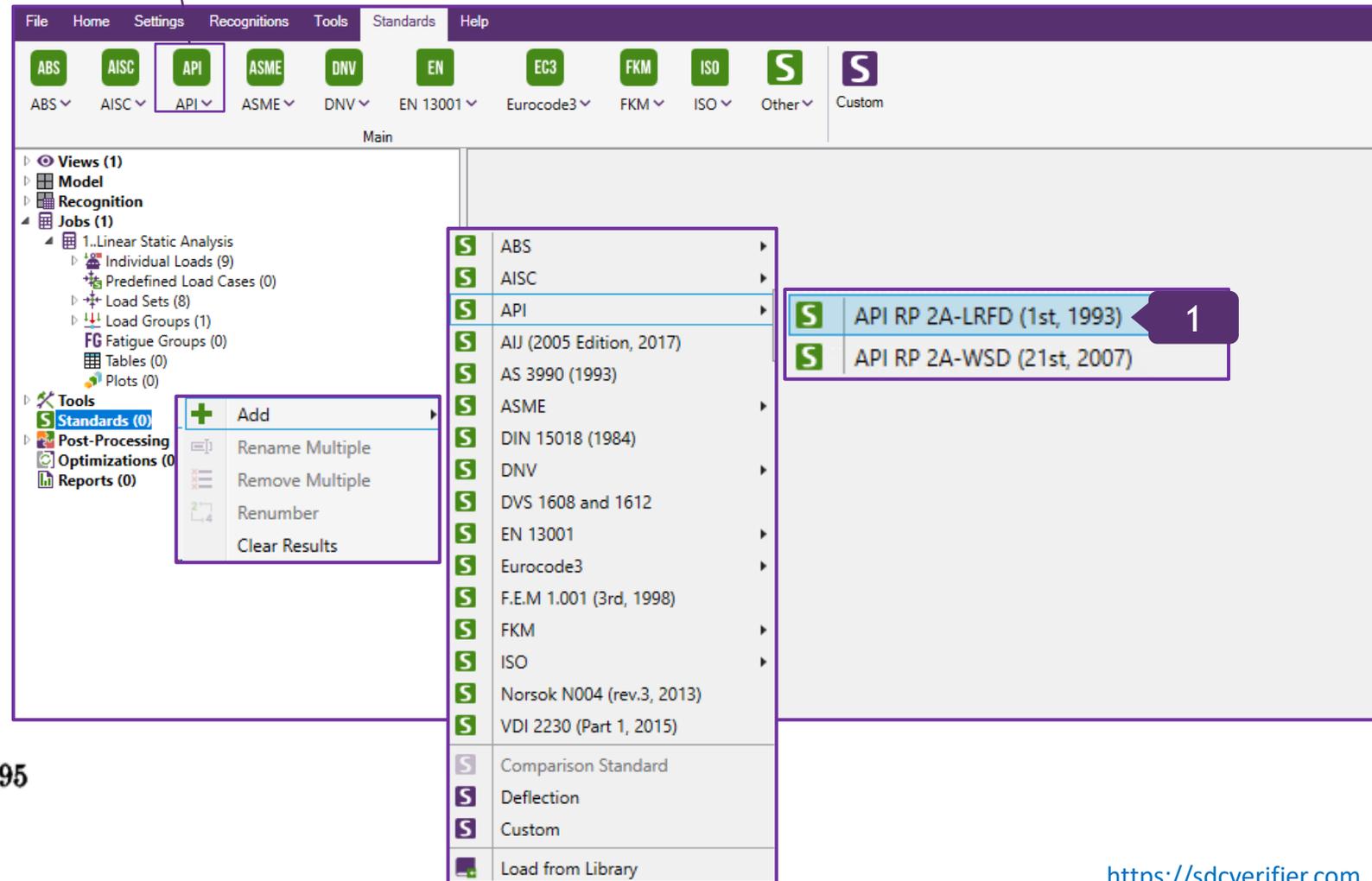
$\phi_t$  = resistance factor for axial tensile strength, 0.95

$\phi_c$  = resistance factor for axial compressive strength, 0.85

$\phi_b$  = resistance factor for bending strength, 0.95.

$\phi_v$  = resistance factor for beam shear strength, 0.95

An alternative method of adding Standards is to select API (in this case) in the Standards section of the Toolbar.



1

Press *OK*

- Standards (1)
  - 1..API RP 2A-LRFD (1st, 1993)
    - Input
      - Constants (5)
      - Types (1)
      - Characteristic (0)
      - Classifications (0)
      - Standard Tables (0)
    - Checks (8)
      - 1..Dimensions
      - 2..Limits
      - 3..Axial Stress Check
      - 4..Bending Stress Check
      - 5..Shear Stress Check
      - 6..Axial and Bending Check
      - 7..Overall Check
      - 8..Joint Check API LRFD

8 Checks have been created.

API RP 2A-LRFD (1st, 1993)

ID: 1 Title: API RP 2A-LRFD (1st, 1993)

Alias: Standard1

Description: [Empty]

Safety Factors

Critical Elastic Buckling Coefficient (Cx)	0.3
Resistance Factor for Tension (Ft)	0.95
Resistance Factor For Compression (Fc)	0.85
Resistance Factor For Bending (Fb)	0.95
Resistance Factor For Shear (Fv)	0.95

Selection

+ Shape '2..Tube'

Elements: 2078

Use AISC 360-10 for non-tubular shapes

Materials with Yield = 0

OK Cancel

1

# Preview Table Results for Overall Check

1

In Checks section, select 7..Overall Check and execute right click

2

Select Table (expand/extreme)

3

In Load Group, press

4

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

5

Detailed (extreme locations - element and loads (for Loads Groups)) is ON

6

Press Fill Table

7

Press OK

Extreme	Absolute Axial Uf	Absolute Bending Uf	Absolute Shear Uf	Absolute Shear Uf To	Absolute Axial and Br	Overall Utilization Fac
<b>Minimum</b>						
Value	0.00	0.00	0.00	0.00	0.00	0.00
Element ID	1269	1269	1269	1269	1269	1269
Load	LS8	LS1	LS8	LS8	LS1	LS8
<b>Maximum</b>						
Value	0.20	0.20	0.12	0.98	0.26	0.98
Element ID	2048	1720	1496	2453	980	2453
Load	LS4	LS4	LS7	LS7	LS1	LS7
<b>Absolute</b>						
Value	0.20	0.20	0.12	0.98	0.26	0.98
Element ID	2048	1720	1496	2453	980	2453
Load	LS4	LS4	LS7	LS7	LS1	LS7

- 1..API RP 2A-LRFD (1st, 1993)
  - Input
  - Checks (8)
    - 1..Dimensions
    - 2..Limits
    - 3..Axial Stress Check
    - 4..Bending Stress Check
    - 5..Shear Stress Check
    - 6..Axial and Bending Check
    - 7..Overall Check
    - 8..Joint Check API LRFD

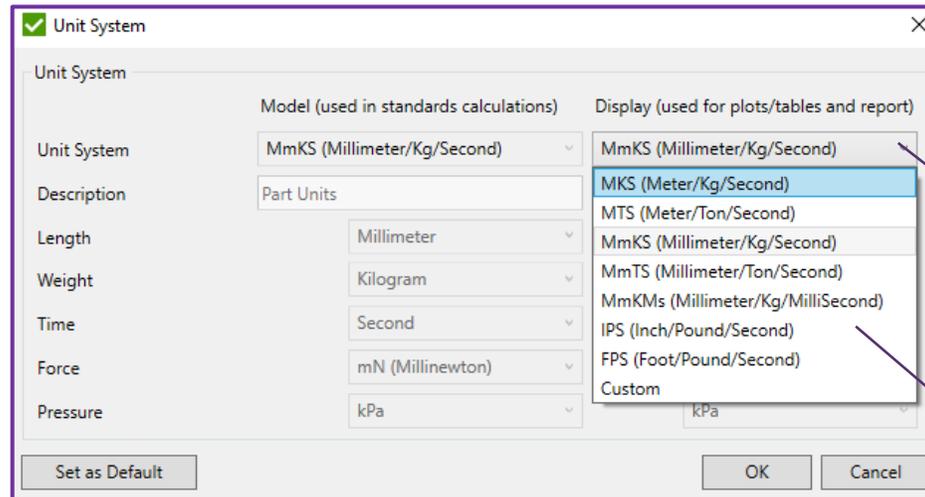
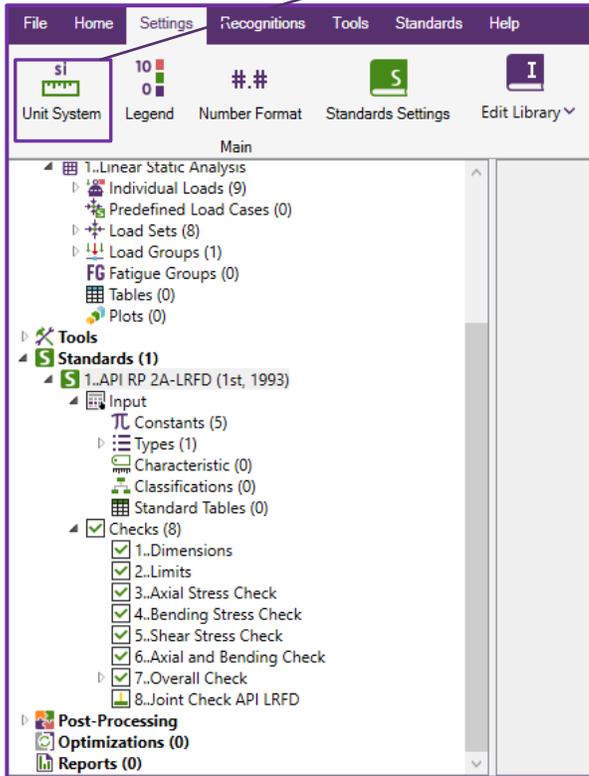
- Add
- Edit
- Rename
- Copy
- Remove
- Copy To Standard...
- Move
- Clear Results
- Table (expand/extreme)**
- Components Extreme Table (over selections)
- Flow Table (over loads)
- Criteria Plot
- Contour Plot
- Beam Member Diagram

Overall Check contains results from all Checks. With the help of one table/plot, it is possible to verify if the model passes the checks ( $< 1$ ).  
Overall Utilization Factor = the worst Uf among all checks.

API RP 2A Standard is applicable to stiffened and unstiffened cylinders having  $t \geq 6\text{mm}$ ,  $D / t < 120$  and Yield Stress  $< 414\text{ MPa}$ . To validate this condition, the Unit System, which is used in the model, should be specified in SDC Verifier.

```
Parameter = RequirementsValid (Requirements Valid)
if((Units.GetInMillimeters(Thickness) >= 6) and (Units.GetInMPa(Yield) < 414) and (D / Thickness < 300), yes, no)
```

Unit System can be found in Settings section of the Ribbon.



By default, MKS (Meter/Kg/Second) unit system is used. To change unit system, expand this section.

There are 7 predefined Unit Systems: MKS, MTS, MmKS, MmTS, MmKMs, IPS and FPS. Custom Unit System can be used in specific cases as well.

Results on 7..Overall Check

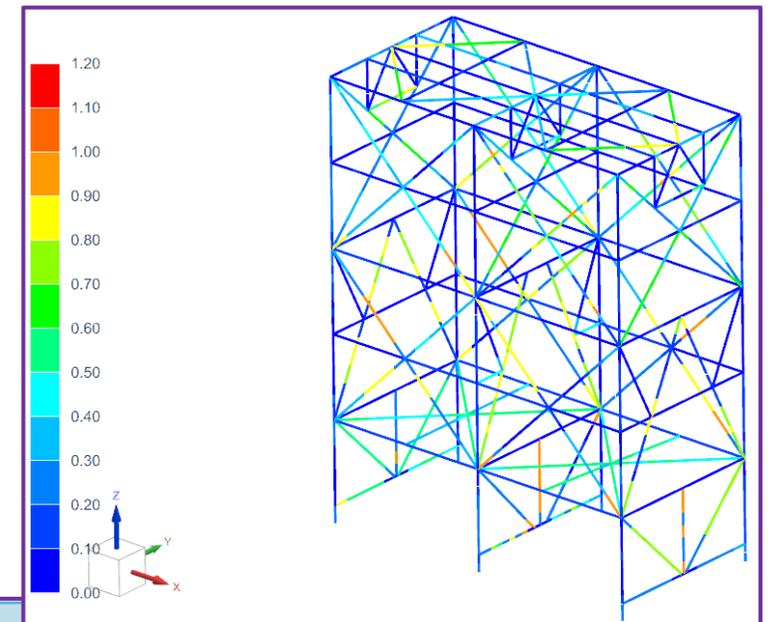
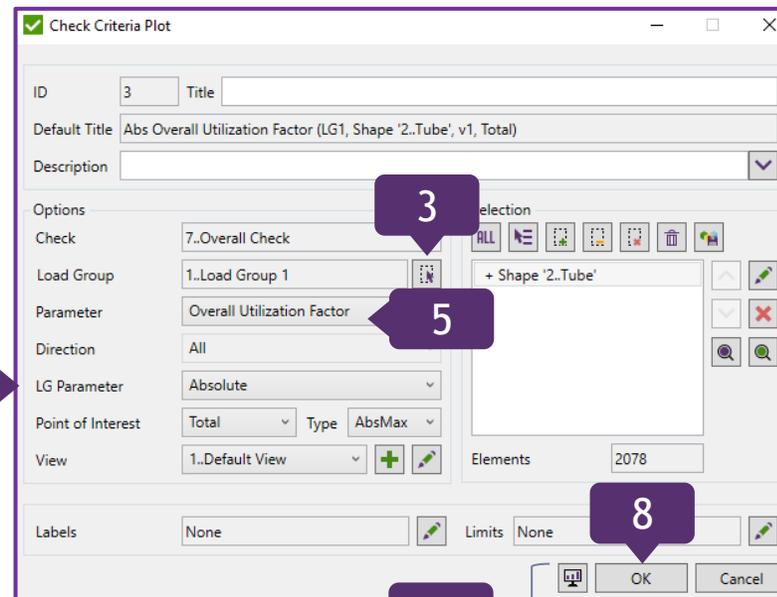
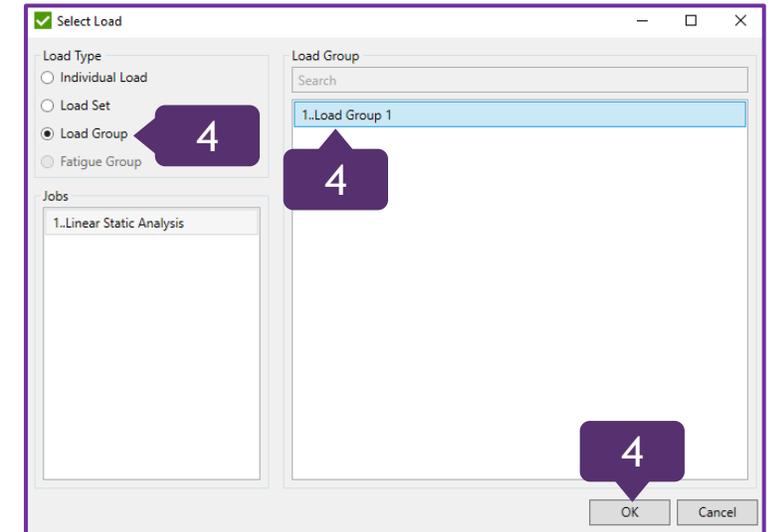
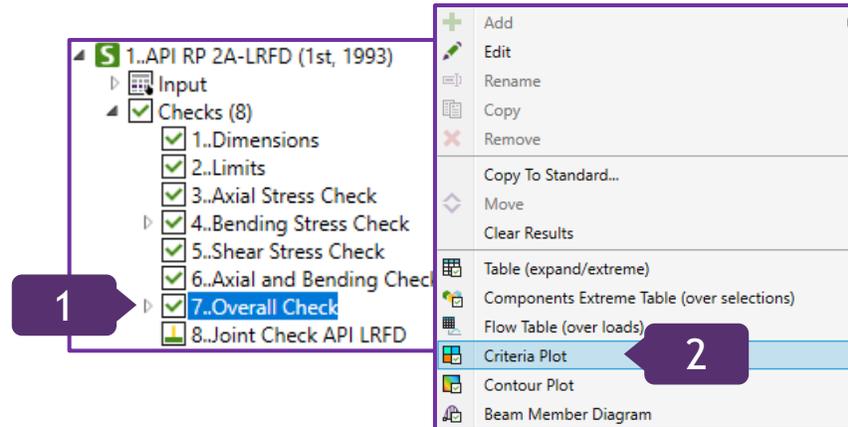
Table Info: Shape '2..Tube', LG1..Load Group 1, Direction: All, Short, Extreme.

Extreme	Absolute Axial Uf	Absolute Bending Uf	Absolute Shear Uf	Absolute Shear Uf To	Absolute Axial and Br	Overall Utilization Fa
<b>Minimum</b>	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00
<b>Maximum</b>	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00
<b>Absolute</b>	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00	12345678.00

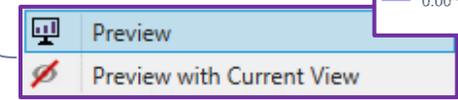
In case the standard cannot perform verification of the model, the results will display the value = 12345678.

# Criteria Plot for OverallCheck

- 1 In Checks section, select 7..Overall Check and execute right click
- 2 Select *Criteria Plot*
- 3 In Load Group, press
- 4 Select *Load Group* => 1..Load Group 1 and press *OK*
- 5 Parameter: *Overall Utilization Factor*
- 6 LG Parameter: *Absolute*
- 7 Press , and then *Preview*
- 8 Press *OK*



SDC Verifier uses Legend from 0.00 to 1.20 for Utilization Factor. Elements in orange and red do not pass the check.



$C_x$  is the elastic critical buckling coefficient, see below;

The theoretical value of  $C_x$  for an ideal tubular is 0,6. However, a reduced value of  $C_x = 0,3$  should be used in Equation (13.2-10) to account for the effect of initial geometric imperfections within the tolerance limits given in Clause 21. A reduced value of  $C_x = 0,3$  is implicit in the value of  $f_{xe}$  used in Equations (13.2-8) and (13.2-9).

$\gamma_{R,t}$  is the partial resistance factor for axial tensile strength,  $\gamma_{R,t} = 1,05$ .

$\gamma_{R,c}$  is the partial resistance factor for axial compressive strength,  $\gamma_{R,c} = 1,18$ .

$\gamma_{R,b}$  is the partial resistance factor for bending strength,  $\gamma_{R,b} = 1,05$ ;

$\gamma_{R,v}$  is the partial resistance factor for shear strength,  $\gamma_{R,v} = 1,05$ ;

$\gamma_{R,h}$  is the partial resistance factor for hoop buckling strength,  $\gamma_{R,h} = 1,25$ .

# Add ISO 19902 (1st, 2007) Standard

1 Execute right click on *Standards* and select *Add => ISO => ISO 19902 (1st, 2007)*

2 Press *OK*

An alternative method of adding Standards is to select ISO (in this case) in the Standards section of the Toolbar.

ISO 19902 procedure is similar to API 2A RP. In overall check, it is possible to verify if the structure passes all checks: Overall Utilization Factor = the worst  $U_f$  among all checks < 1.

- 2..ISO 19902 (1st, 2007)
  - Input
  - Checks (10)
    - 1..Dimensions
    - 2..Limits
    - 3..Axial Stress Check
    - 4..Bending Stress Check
    - 5..Shear Stress Check
    - 6..Axial and Bending Check
    - 7..Hydrostatic
    - 8..Axial, Bending and Hydrostatic Check
    - 9..Overall Check
    - 10..Joint Check ISO
  - Post-Processing
  - Optimizations
  - Reports (0)

10 Checks have been created.

ISO 19902 (1st, 2007)

ID: 2 Title: ISO 19902 (1st, 2007)

Alias: Standard2

Description: [dropdown]

Safety Factors

Critical Elastic Buckling Coefficient	0.3
Resistance Factor for Tension (Gamma_Rt)	1.05
Resistance Factor for Compression (Gamma_Rc)	1.18
Resistance Factor for Bending (Gamma_Rb)	1.05
Resistance Factor for Shear/Torsion (Gamma_Rv)	1.05
Resistance Factor for Hoop Buckling (Gamma_Rh)	1.25

Selection

+ Shape '2..Tube'

Elements: 2078

Use AISC 360-10 for Non-tubular Shapes

Include Hydrostatic

Materials with Yield / Tensile = 0 0

OK Cancel

It is also possible to preview Table Results and Criteria Plot from Overall Check by following the steps from slides 18 and 20.

$$\begin{aligned}
 C_e &= \text{critical elastic buckling coefficient} = 0.3 \\
 \gamma_{R,t} &= \text{material factor for tension} = 1.15 \\
 \gamma_{R,v} &= \text{material factor for shear} = 1.15 \\
 \gamma_M &= \text{see section 6.3.7} \\
 \gamma_M &= 1.15 \quad \text{for } \bar{\lambda}_s < 0.5 \\
 \gamma_M &= 0.85 + 0.60\bar{\lambda}_s \quad \text{for } 0.5 \leq \bar{\lambda}_s \leq 1.0 \\
 \gamma_M &= 1.45 \quad \text{for } \bar{\lambda}_s > 1.0
 \end{aligned} \tag{6.22}$$

where

$$\bar{\lambda}_s = \frac{|\sigma_{c,Sd}|}{f_{cl}} \cdot \lambda_c + \left( \frac{\sigma_{p,Sd}}{f_h} \right)^2 \cdot \lambda_h \tag{6.23}$$

where  $f_{cl}$  is calculated from Equation (6.6) or Equation (6.7) whichever is appropriate and  $f_h$  from Equation (6.17), Equation (6.18), or Equation (6.19) whichever is appropriate.

$$\lambda_c = \sqrt{\frac{f_y}{f_{cle}}}, \text{ and } \lambda_h = \sqrt{\frac{f_y}{f_{he}}} \tag{6.24}$$

$f_{cle}$  and  $f_{he}$  is obtained from Equation (6.8), and Equation (6.20) respectively.

$\sigma_{p,Sd}$  is obtained from Equation (6.16) and

$$\sigma_{c,Sd} = \frac{N_{Sd}}{A} + \frac{\sqrt{M_{y,Sd}^2 + M_{z,Sd}^2}}{W} \tag{6.25}$$

$N_{Sd}$  is negative if in tension.

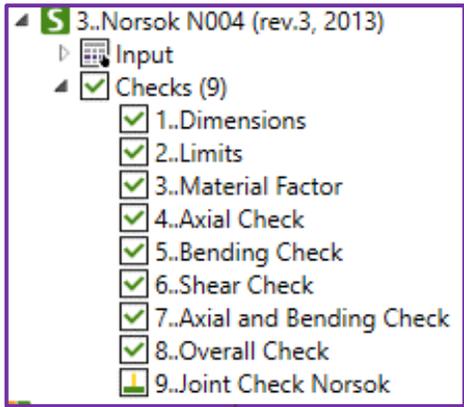
# Add Norsok N004 (rev.3, 2013) Standard

1 Execute right click on *Standards* and select *Add => Norsok N004 (rev.3, 2013)*

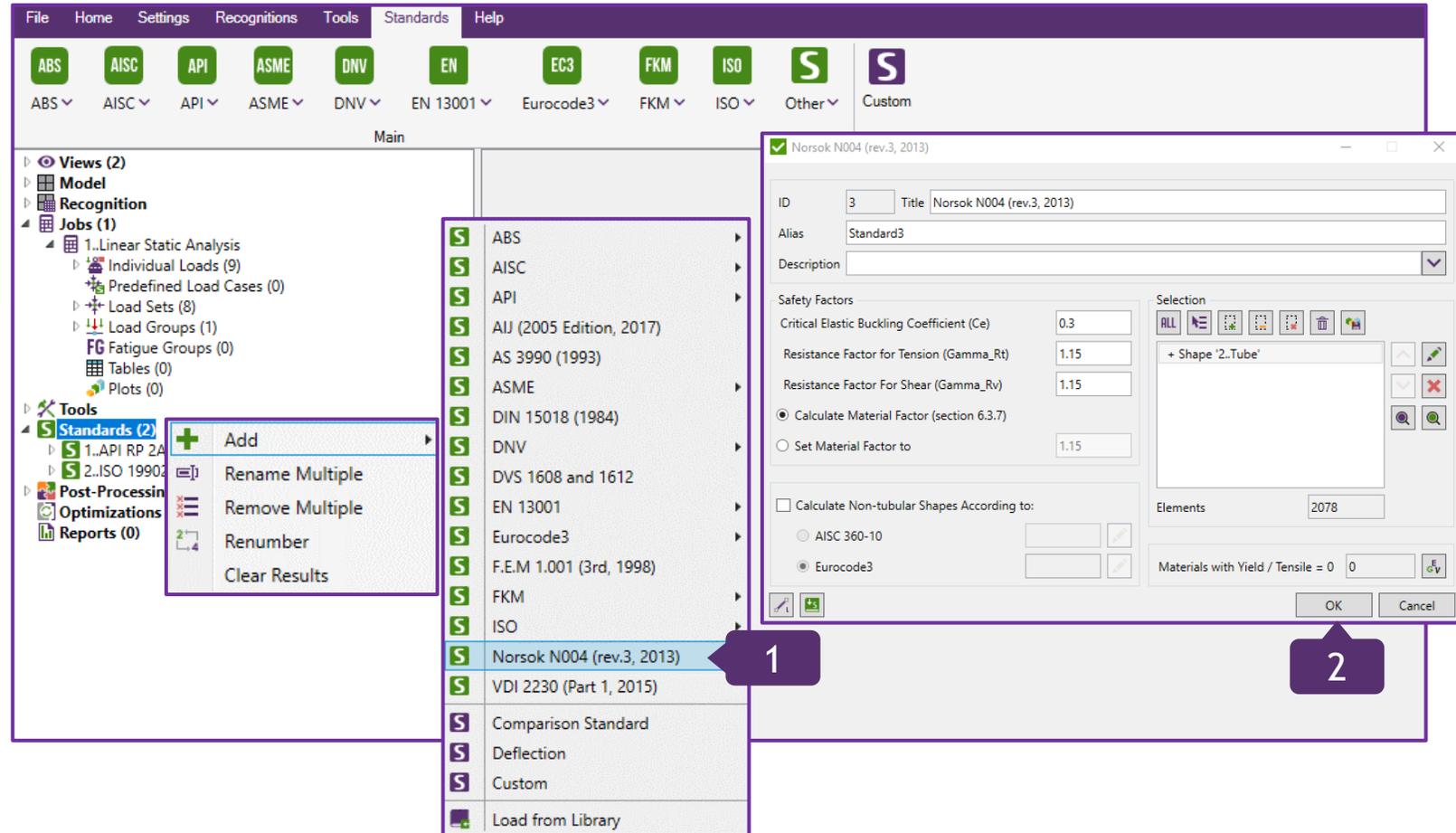
2 Press *OK*

It is also possible to preview Table Results and Criteria Plot from Overall Check by following the steps from slides 18 and 20.

ISO 19902 procedure is similar to API 2A RP. In overall check, it is possible to verify if the structure passes all checks: Overall Utilization Factor = the worst  $U_f$  among all checks < 1.



9 Checks have been created.



## API RP 2A-LRFD (1st, 1993) Standard

Table Info: Shape '2..Tube', LG1..Load Group 1, Direction: All, Detailed, Extreme.

Extreme	Absolute Axial Uf	Absolute Bending Uf	Absolute Shear Uf	Absolute Shear Uf To	Absolute Axial and Br	Overall Utilization Fac
<b>Minimum</b>						
Value	0.00	0.00	0.00	0.00	0.00	0.00
Element ID	1500	1500	1500	1500	1500	1500
Load	LS8	LS1	LS8	LS8	LS1	LS8
<b>Maximum</b>						
Value	0.20	0.20	0.12	0.98	0.26	0.98
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7
<b>Absolute</b>						
Value	0.20	0.20	0.12	0.98	0.26	0.98
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7

## ISO 19902 (1st, 2007) Standard

Table Info: Shape '2..Tube', LG1..Load Group 1, Direction: All, Detailed, Extreme.

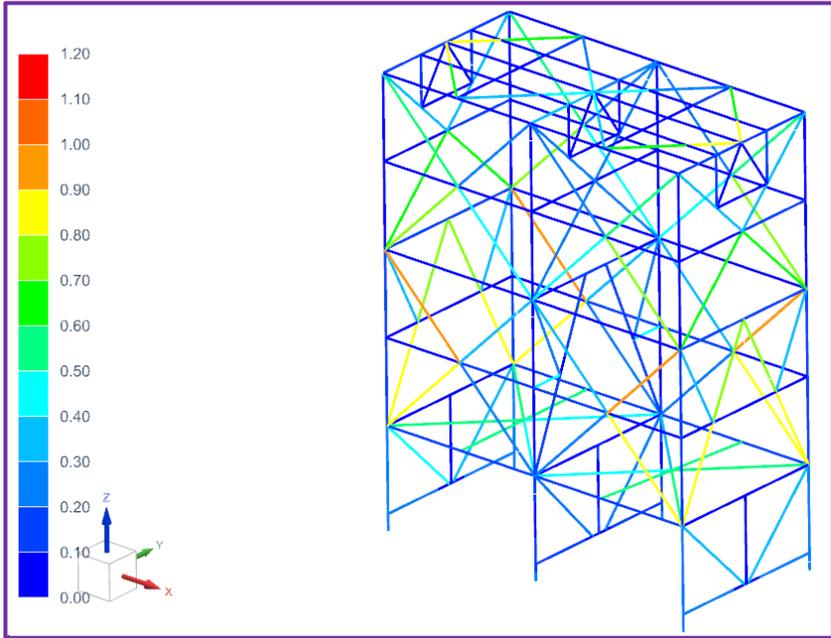
Extreme	Axial Um	Bending Um	Shear Um	Shear Torsional Um	Axial and Bending Ur	Overall Utilization Fac
<b>Minimum</b>						
Value	0.00	0.00	0.00	0.00	0.00	0.00
Element ID	1500	1500	1500	1500	1500	1500
Load	LS8	LS1	LS8	LS8	LS1	LS8
<b>Maximum</b>						
Value	0.21	0.19	0.12	0.98	0.29	0.98
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7
<b>Absolute</b>						
Value	0.21	0.19	0.12	0.98	0.29	0.98
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7

## Norsok N004 (rev.3, 2013) Standard

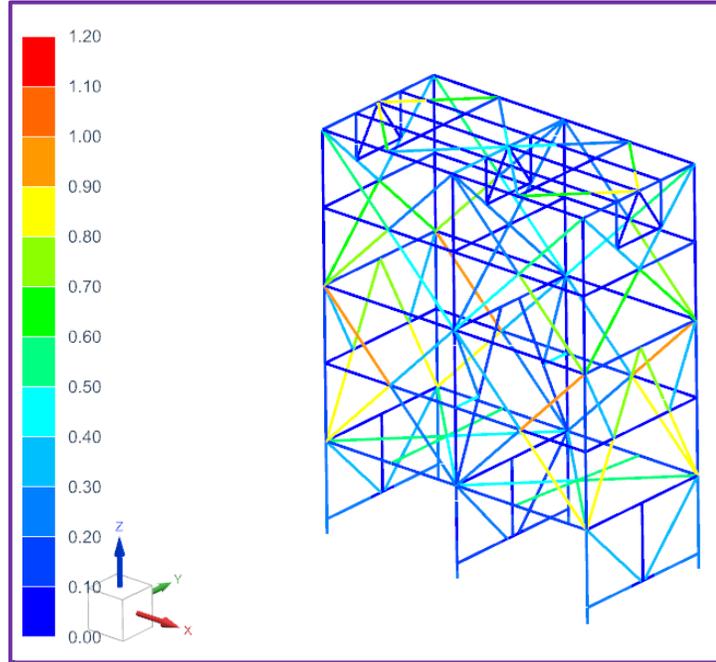
Table Info: Shape '2..Tube', LG1..Load Group 1, Direction: All, Detailed, Extreme.

Extreme	Absolute Axial Uf	Absolute Bending Uf	Absolute Shear Uf	Absolute Shear Torsic	Absolute Axial and Br	Overall Utilization Fac
<b>Minimum</b>						
Value	0.00	0.00	0.00	0.00	0.00	0.00
Element ID	1500	1500	1500	1500	1500	1500
Load	LS8	LS1	LS8	LS8	LS1	LS8
<b>Maximum</b>						
Value	0.21	0.21	0.13	1.07	0.31	1.07
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7
<b>Absolute</b>						
Value	0.21	0.21	0.13	1.07	0.31	1.07
Element ID	1874	1720	1850	2157	980	2157
Load	LS4	LS4	LS7	LS7	LS1	LS7

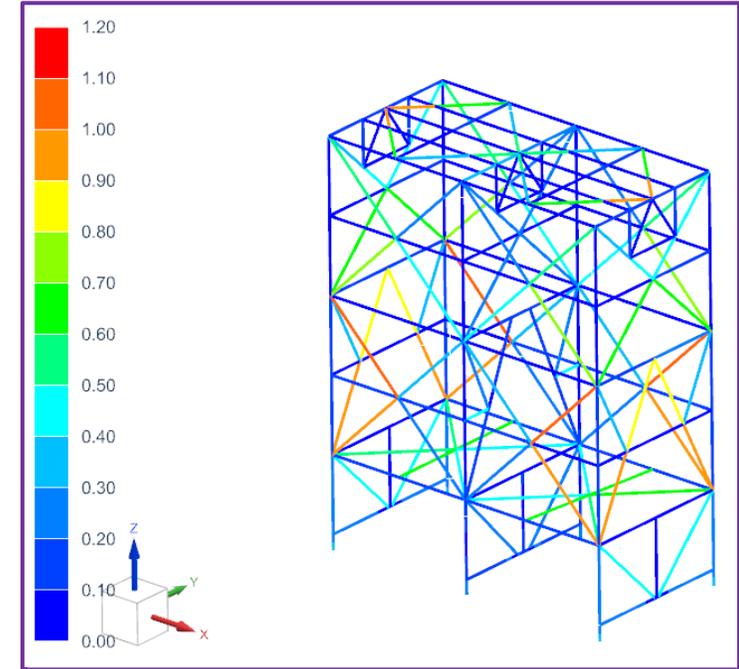
API RP 2A-LRFD (1st, 1993) Standard



ISO 19902 (1st, 2007) Standard



Norsok N004 (rev.3, 2013) Standard



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

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