



Tutorial  
**API 2A RP/ISO 19902/Norsok N004**

30 Jan 2020  
version 5.3

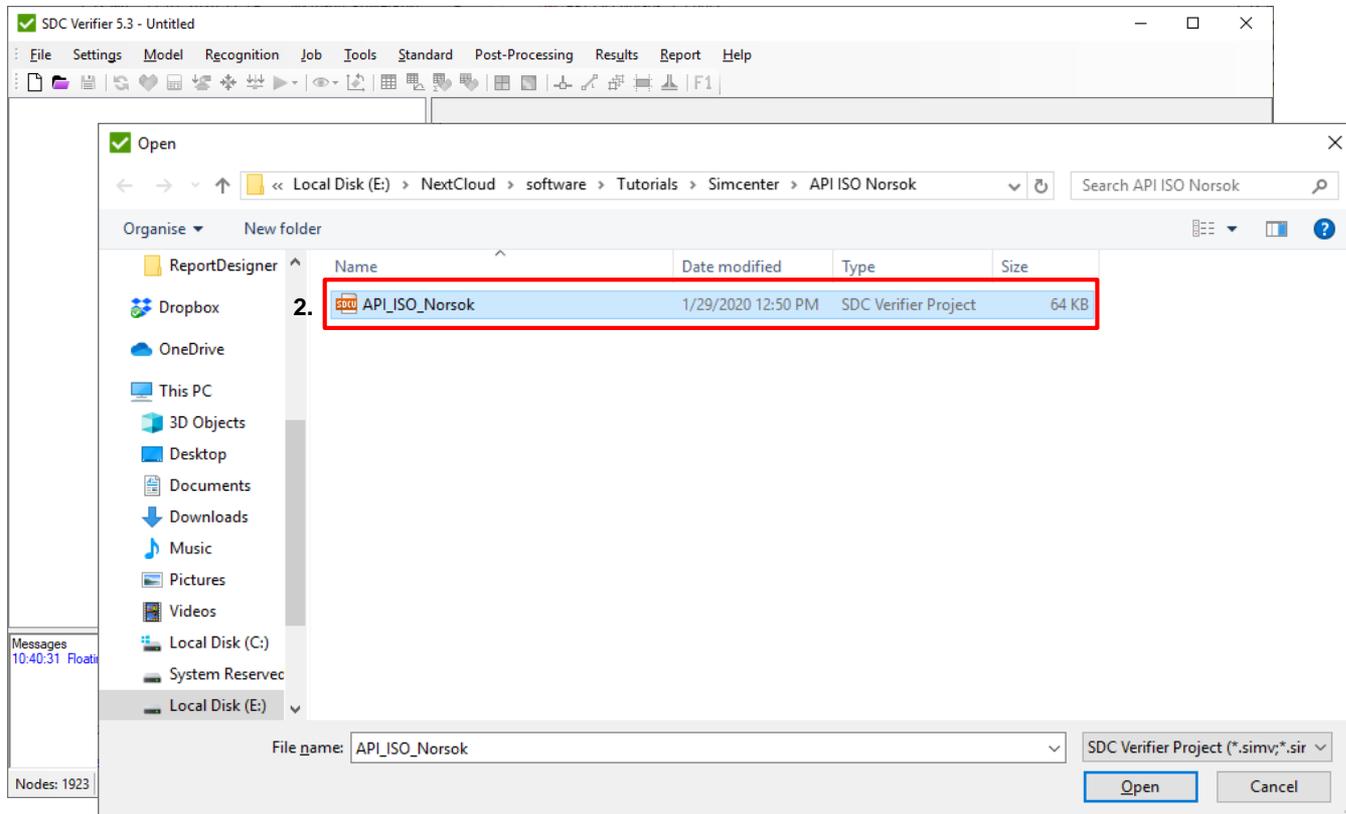
- ▶ In this tutorial, an API 2A RP, ISO 19902 and Norsok N004 Beam Design Checks are reviewed in details.
- ▶ A beam model of a steel frame has been used as a start FEM model.
- ▶ Beam member finder was used to recognize beam member length in 3 directions.
- ▶ The report was generated with the help of report designer.

# Open Project

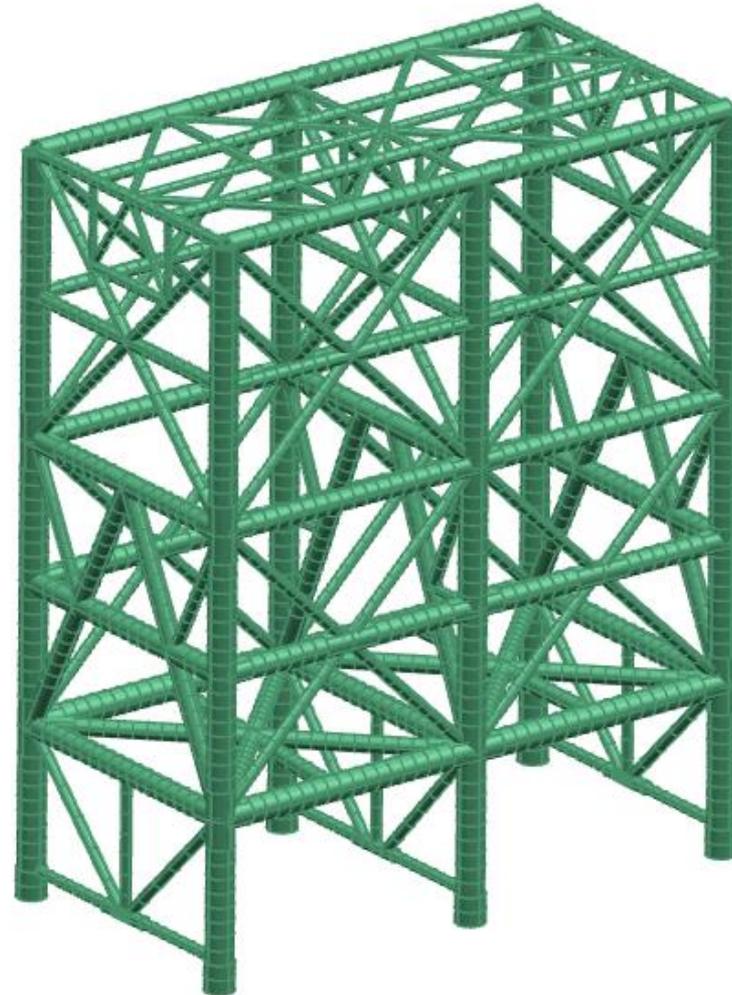
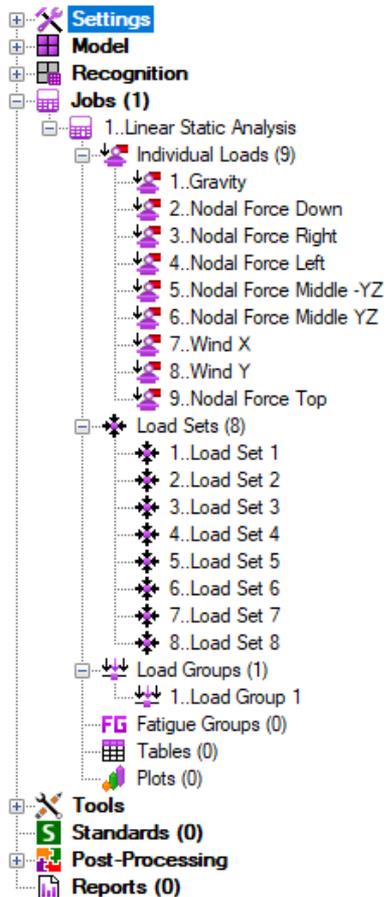
1 Launch **SDC Verifier** 

2 Execute *File - Open Project*.

3 Project: **API RP 2A-LRFD.sdcv**



# Predefined project

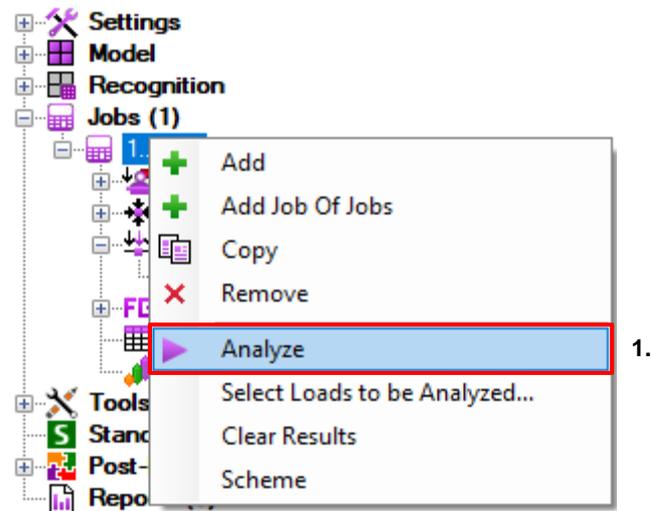


This tutorial uses predefined project with the following created data: individual loads, load sets and load group. The focus of this tutorial is to check the cylindrical members and create the basic report.

# Analyze Job

1

Execute ► **Analyze** from *Linear Static Analysis* context menu



Joint – 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;

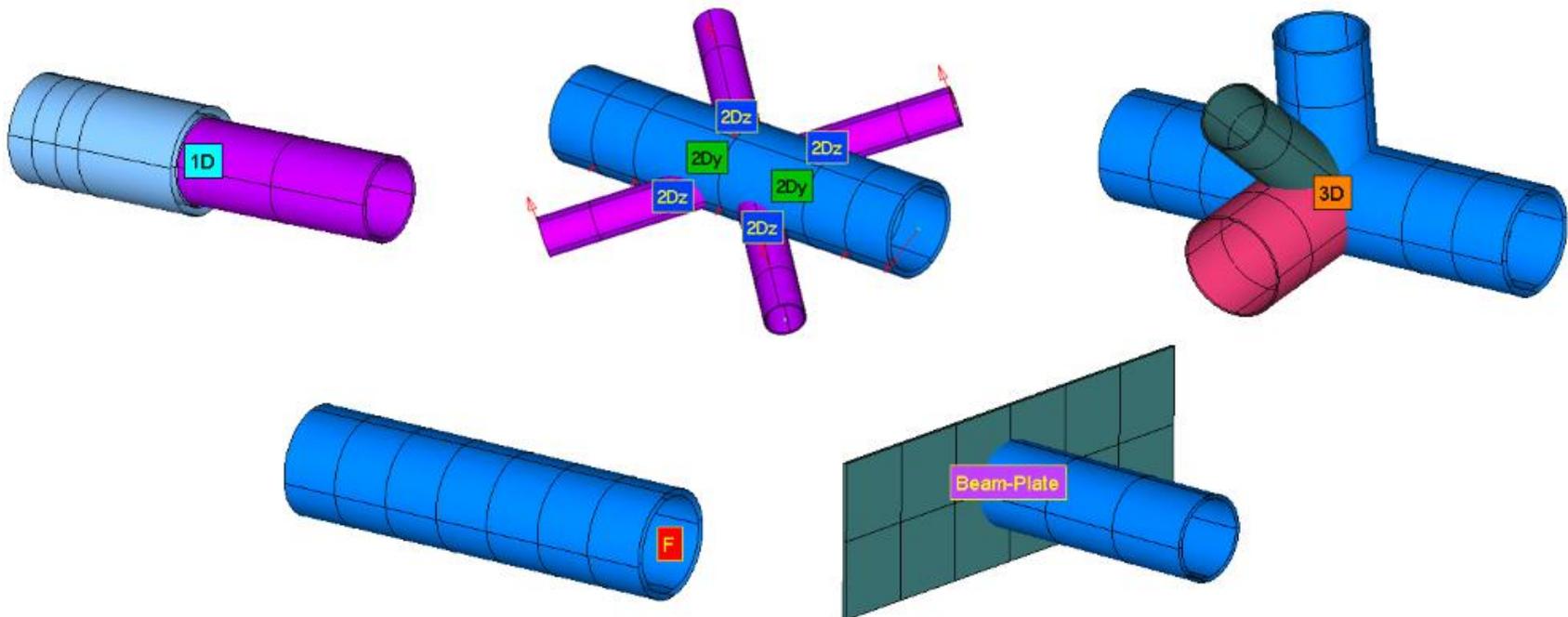
2D Joint – beam members connected in one plane;

3D Joint – beam members connected in space;

Free Joint – node which belongs only to one element (free);

Beam-Plate Joint – beam member connected to plates (perpendicularly);

User Defined;



# Joint Recognition. Settings

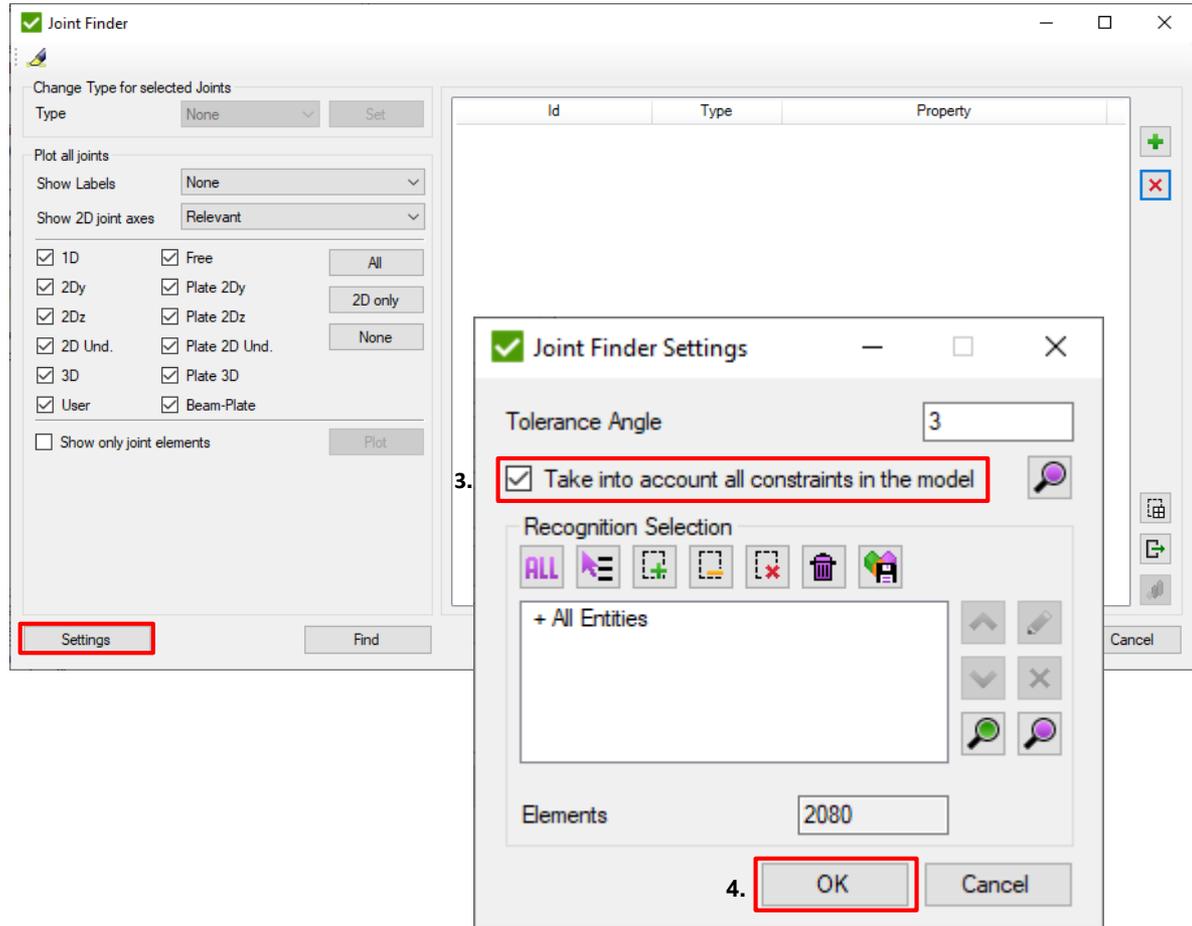
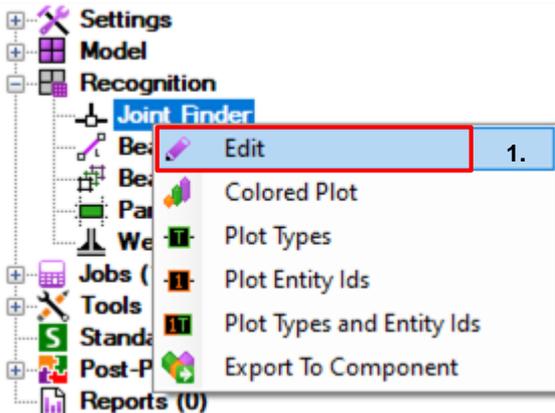
1 Execute *Edit* from *Joints* context menu

2 Press *Settings*.

3 Take into account all constraints in the model: **ON**

4 Press *Ok*.

When performing the joint recognition there are 3 options for existing joints. Default option: Keep only modified– remove all joints except edited by user. Keep all existing options should be used when additional elements were added to the model.

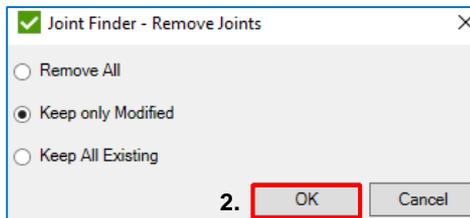
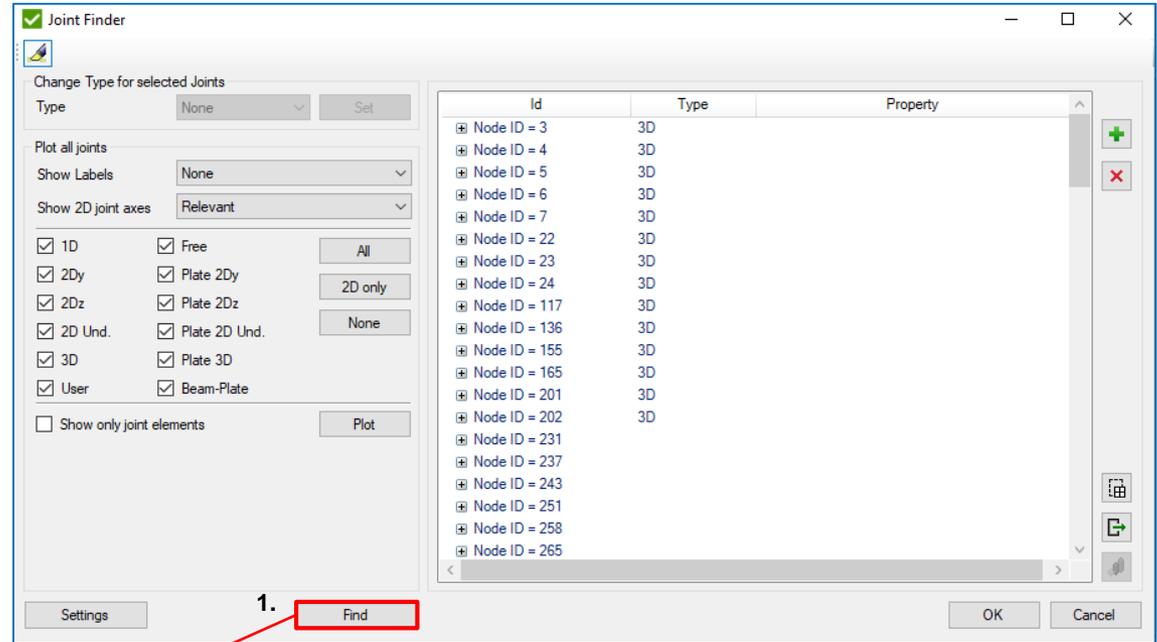
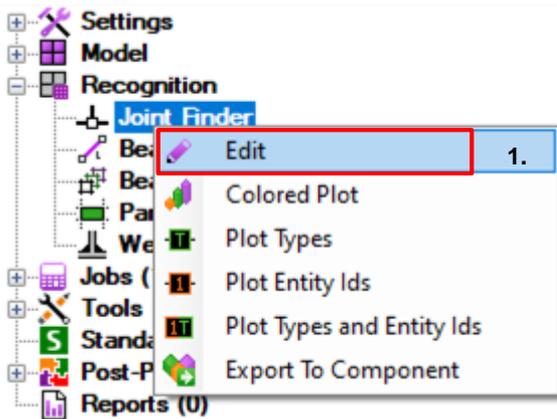


# Joint Recognition. Find

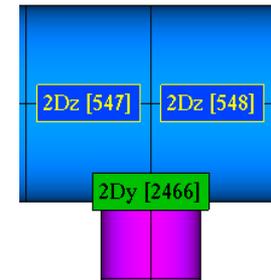
1 Press *Find*.

2 Press *Ok*.

When performing the joint recognition there are 3 options for existing joints. Default option: Keep only modified– remove all joints except edited by user. Keep all existing options should be used when additional elements were added to the model.



Node ID = 719			
Element ID = 547	2Dz	8..400x19	
Element ID = 548	2Dz	8..400x19	
Element ID = 2466	2Dy	14..200x10	



# Joints Plot

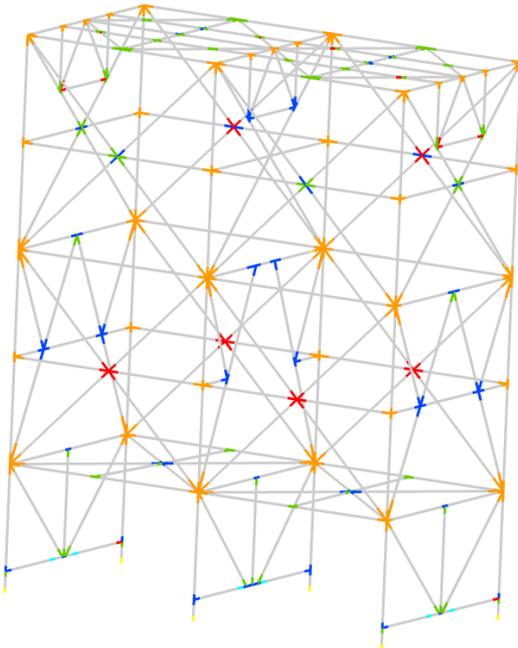
1 Select All Joints (Ctrl+A).

2 Press

3 Press Plot Joint Type in colors

4 Press OK

1D 2Dy 2Dz 2Du 3D F



Id	Type	Property
Node ID = 2323	2Dz	
Node ID = 2318	2Dz	
Node ID = 2315	2Dz	
Node ID = 2314	2Dz	
Node ID = 2236	3D	
Node ID = 2233	2Dz	
Node ID = 2232	2Dz	
Node ID = 2227	3D	
Node ID = 2226	3D	
Node ID = 2225	3D	
Node ID = 2222	3D	
Node ID = 2221	2Dz	
Node ID = 2220	3D	
Node ID = 2219		
Node ID = 2218		
Node ID = 2217	2Dz	
Node ID = 2216	2Dz	
Node ID = 2215	2Dz	
Node ID = 2208	2Dz	
Node ID = 2177		

Plot Joints of specific type:

3. Plot Joint Type Labels

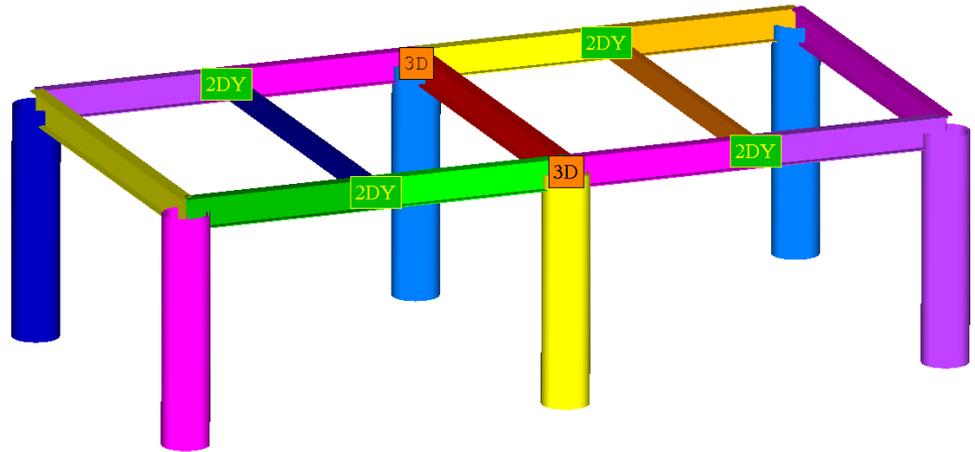
Plot Joint Type in colors

Modify Joint Type:

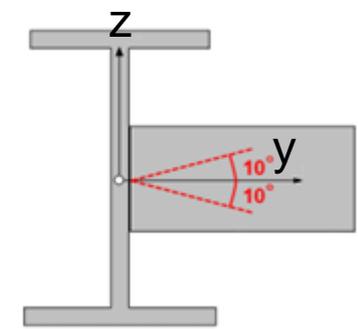
# Beam Member Lengths in 2 directions



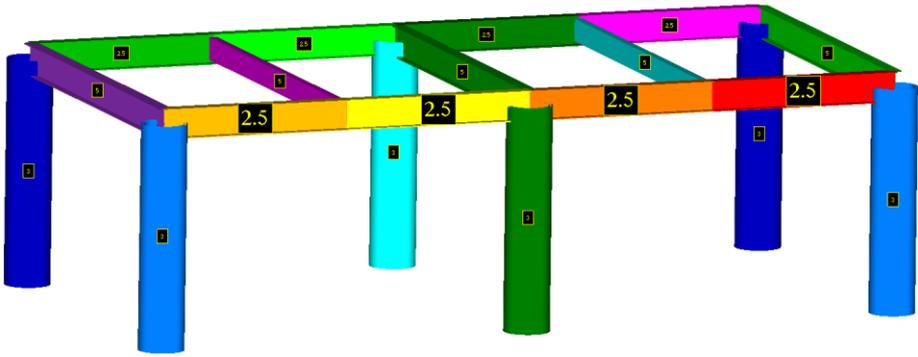
Beam Member Finder recognizes beam members and (buckling) lengths for different directions (Y, Z and Torsional).



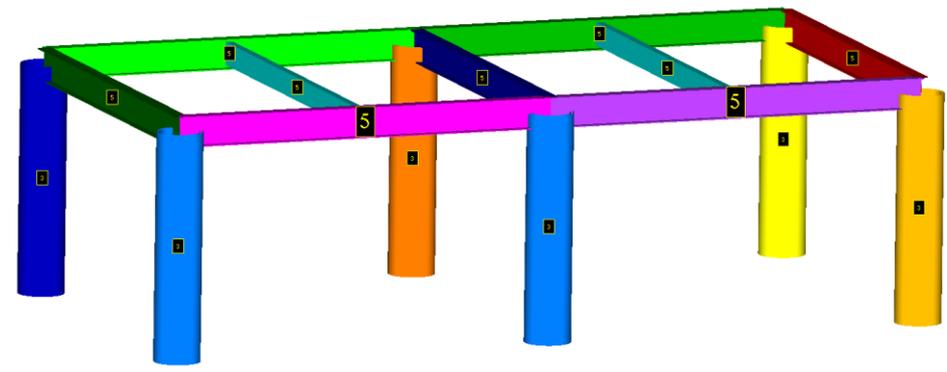
2DY  
Joint



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



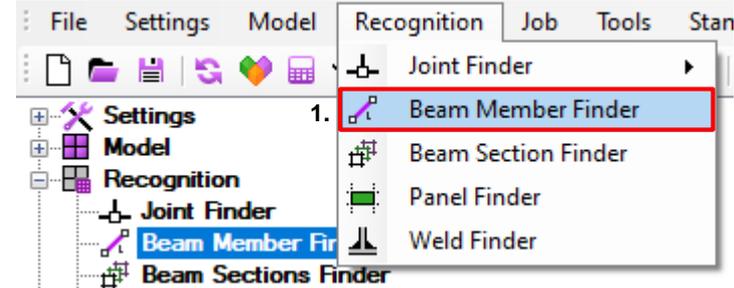
Length Z – 2 Beam Members with  $L = 5$



# Recognize Length

1 Execute *Recognition – Beam Member Finder*

2 Press *Find*.



The 'Beam Member Finder' dialog box is shown with the 'Find' button highlighted. The dialog includes a table of beam members with columns for ID, Title, Elements, Length [m], Length Factor, Cm Type, Modified, and Joint - NodeID [Joint Type].

ID	Title	Elements	Length [m]	Length Factor	Cm Type	Modified	Joint - NodeID [Joint Type]
1	Beam Member 1 (Y)	47	13				923[2Dz] 1107[3D] 155[3D] 1104[3D] 4[3D]
2	Beam Member 2 (Y)	47	13				922[2Dz] 1109[3D] 136[3D] 1108[3D] 117[3D]
3	Beam Member 3 (Y)	32	10				1090[2Dz] 22[3D] 2208[2Dz]
4	Beam Member 4 (Y)	32	10				1100[2Dy] 1117[3D] 2218[2Dy]
5	Beam Member 5 (Y)	18	5				6[3D] 24[3D] 7[3D]
6	Beam Member 6 (Y)	40	10				231[2Dy] 237[2Dy] 243[2Dy] 3[3D] 1361[2Dy] 1...
7	Beam Member 7 (Y)	40	10				251[2Dy] 258[2Dy] 265[2Dy] 5[3D] 1383[2Dy] 1...
8	Beam Member 8 (Y)	18	5	1	A		271[2Dz] 237[2Dz] 258[2Dz]
9	Beam Member 9 (Y)	40	10				271[2Dz] 23[3D] 1389[2Dz]
10	Beam Member 10 (Y)	26	7.072				243[2Dz] 23[3D] 1383[2Dz]
11	Beam Member 11 (Y)	13	3.536	1	A		231[2Dz]
12	Beam Member 12 (Y)	13	3.536	1	A		251[2Dz]
13	Beam Member 13 (Y)	26	7.072				265[2Dz] 23[3D] 1361[2Dz]
14	Beam Member 14 (Y)	45	14.142				1090[2Dz] 1105[3D] 2232[2Dz]
15	Beam Member 15 (Y)	23	7.071	1	A		1090[2Dz]
16	Beam Member 16 (Y)	36	10				1105[3D]
17	Beam Member 17 (Y)	32	10				1114[2Dz] 165[3D] 2232[2Dz]
18	Beam Member 18 (Y)	36	10				381[2Dy] 1106[3D] 1500[2Dy]
19	Beam Member 19 (Y)	22	7.071	1	A		1114[2Dz]
20	Beam Member 20 (Y)	45	14.142				1114[2Dz] 1105[3D] 2208[2Dz]
21	Beam Member 21 (Y)	5	1.5	1	A		
22	Beam Member 22 (Y)	5	1.5	1	A		
23	Beam Member 23 (Y)	5	1.5	1	A		
24	Beam Member 24 (Y)	5	1.5	1	A		
25	Beam Member 25 (Y)	6	1.803	1	A		
26	Beam Member 26 (Y)	6	1.803	1	A		

# Beam Member Finder interface

**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 [mm]	Length Factor	Cm Type	Modified	Joint - NodeID [Joint Type]
1	Beam Member 1 (Y)	47	13000				922 1109[3D] 136[3D] 1108[3D] 117[3D]
2	Beam Member 2 (Y)	47	13000				923 1107[3D] 155[3D] 1104[3D] 4[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)	16	5000	1	A		2211[2Dz]
8	Beam Member 8 (Y)	16	5000	1	A		
9	Beam Member 9 (Y)	24	5000	1	A		2059[2Dz] 2318[2Dz] 2323[2Dz] 2057[1D] 2044[...]
10	Beam Member 10 (Y)	18	5000	1	A		958[2Dz] 942[2Dz] 957[2Dz] 956[1D] 943[1D]
11	Beam Member 11 (Y)	32	10000				2208[2Dy] 22[3D] 1090[2Dy]
11.1	Beam Member 11.1 (Y)	8	2500	1	A		
11.2	Beam Member 11.2 (Y)	8	2500	1	A		
11.3	Beam Member 11.3 (Y)	8	2500	1	A		
11.4	Beam Member 11.4 (Y)	8	2500	1	A		
12	Beam Member 12 (Y)	32	10000				2221[2Dz] 201[3D] 1103[2Dz]
13	Beam Member 13 (Y)	16	5000	1	A		1093[2Dz]
14	Beam Member 14 (Y)	24	5000	1	A		926[1D] 2314[2Dz] 941[2Dz] 2315[2Dz] 939[1D]
15	Beam Member 15 (Y)	32	10000				2218[2Dy] 1117[3D] 1100[2Dy]
16	Beam Member 16 (Y)	32	10000				2219[2Dy] 1116[3D] 1101[2Dy]
17	Beam Member 17 (Y)	18	5000				1142[3D] 1125[3D] 1124[3D]
18	Beam Member 18 (Y)	40	10000				1349[2Dy] 1355[2Dy] 1361[2Dy] 3[3D] 243[2Dy]...
19	Beam Member 19 (Y)	40	10000				1369[2Dy] 1376[2Dy] 1383[2Dy] 5[3D] 265[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				6[3D] 24[3D] 7[3D]

Settings Find OK Cancel

Break Options define what joints are used to split beam members

Change Length/Length Factor for selected beam members

Cm Type is used in API 2A, AISC89, ISO 19902 and Norsok N004 standards

Colored Plot of members with labels (ID, Length, Factor or Cm Type).

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

- Plot selected members
- 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

11	Beam Member 11 (Y)	32	10000			2208[2Dy] 22[3D] 1090[2Dy]
11.1	Beam Member 11.1 (Y)	8	2500	1	A	
11.2	Beam Member 11.2 (Y)	8	2500	1	A	
11.3	Beam Member 11.3 (Y)	8	2500	1	A	
11.4	Beam Member 11.4 (Y)	8	2500	1	A	



# Beam Member's Length Plot

- 1 Select All Beam Members (Ctrl+A)
- 2 Press
- 3 Press Plot Length labels
- 4 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

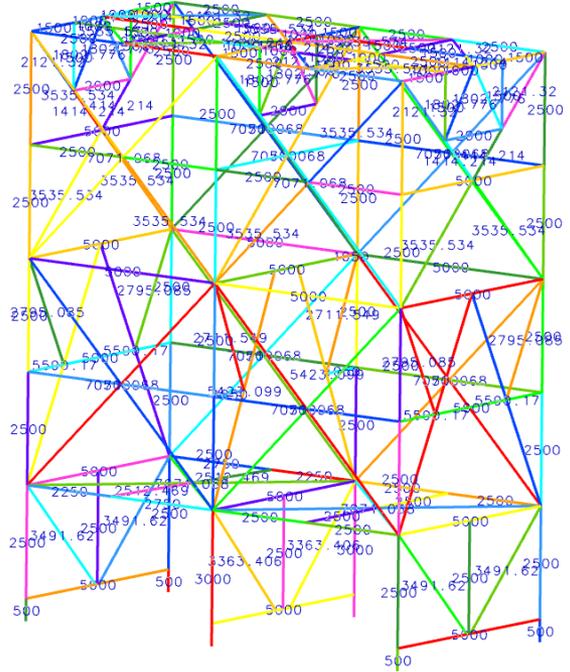
Set to Selected  
 Length [mm]  Set  
 Length Factor  Set  
 Cm Type A  Set

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

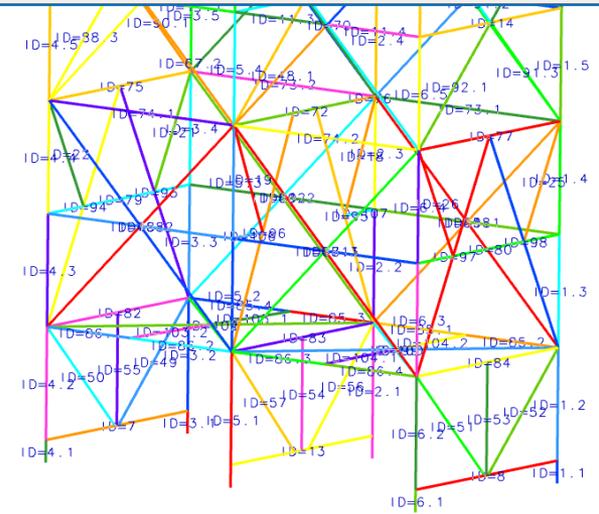
ID	Title	Elements	Length [mm]	Length Factor	Cm Type	Modified	Joint - NodeID [Joint Type]
1	Beam Member 1 (Y)	47	13000				922 1109[3D] 136[3D] 1108[3D] 117[3D]
2	Beam Member 2 (Y)	47	13000				923 1107[3D] 155[3D] 1104[3D] 4[3D]
3	Beam Member 3 (Y)	47	13000				204 2225[3D] 1273[3D] 2222[3D] 1122[3D]
4	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)	16	5000	1	A		2211[2Dz]
8	Beam Member 8 (Y)	16	5000	1	A		
9	Beam Member 9 (Y)	24	5000	1	A		2059[2Dz] 2318[2Dz] 2323[2Dz] 2057[1D] 2044[1D]
10	Beam Member 10 (Y)	18	5000	1	A		958[2Dz] 942[2Dz] 957[2Dz] 956[1D] 943[1D]
11	Beam Member 11 (Y)	32	10000				2208[2Dy] 22[3D] 1090[2Dy]
12	Beam Member 12 (Y)	32	10000				2221[2Dz] 201[3D] 1103[2Dz]
13	Beam Member 13 (Y)	16	5000	1	A		1093[2Dz]
14	Beam Member 14 (Y)	24	5000	1	A		936[1D] 2314[2Dz] 941[2Dz] 2315[2Dz] 939[1D]
15	Beam Member 15 (Y)	32	10000				2218[2Dy] 1117[3D] 1100[2Dy]
16	Beam Member 16 (Y)	32	10000				2219[2Dy] 1116[3D] 1101[2Dy]
17	Beam Member 17 (Y)	18	5000				1142[3D] 1125[3D] 1124[3D]
18	Beam Member 18 (Y)	40	10000				1349[2Dy] 1355[2Dy] 1361[2Dy] 3[3D] 243[2Dy]...
19	Beam Member 19 (Y)	40	10000				1369[2Dy] 1376[2Dy] 1383[2Dy] 5[3D] 265[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				6[3D] 24[3D] 7[3D]
23	Beam Member 23 (Y)	7	2711.549	1	A		
24	Beam Member 24 (Y)	7	2711.549	1	A		
25	Beam Member 25 (Y)	7	2795.085	1	A		

Settings Find

4. **OK** Cancel



Also it is possible to display beam members IDs by pressing Plot Members ID labels



- Plot selected members
- 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

# Cm – reduction factors

Cmy and Cmz reduction factors are used in combined axial and bending check:

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

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

By default **Cm Type** 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 = Calculate  
used in API 2A, AISC89, ISO19902  
and Norsok N004 standards

A

B

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

Notes to Table D.3-1:

(1) Use whichever is more applicable to a specific situation. Values of the reduction factor  $C_m$  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

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

Situation	Effective Length Factor K	Reduction Factor $C_m^{(1)}$
<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)

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 0507613 T48 ■

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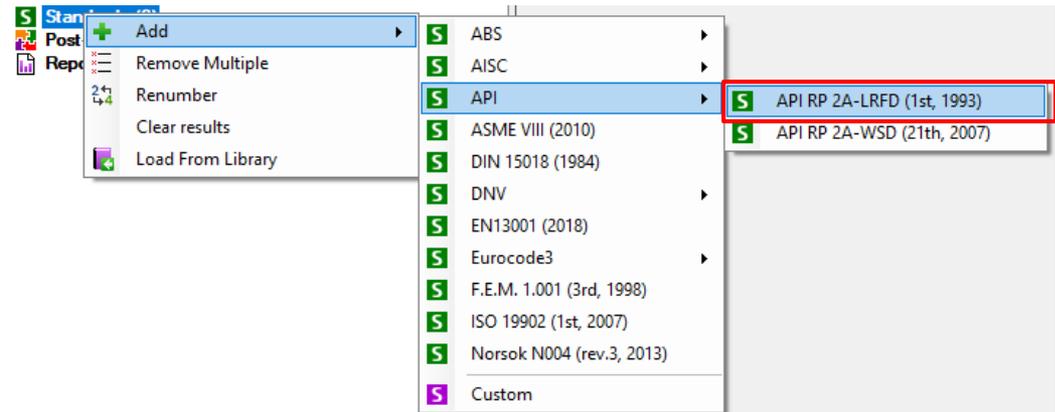
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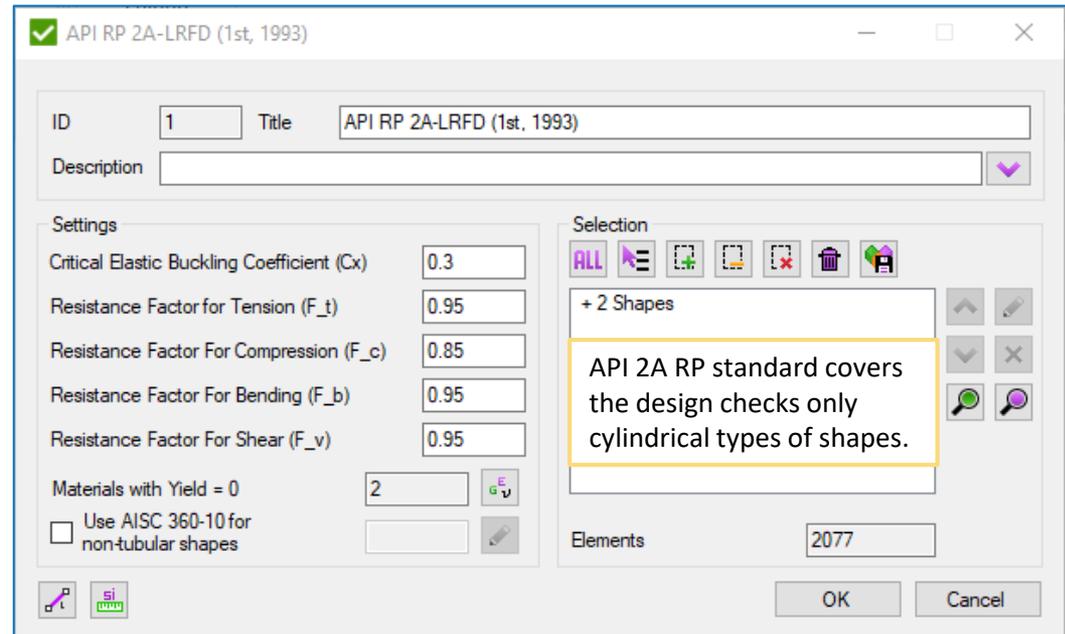
# Add API RP 2A-LRFD standard

1

Execute *Standards* => *Add* => *API*  
=> *API RP 2A-LRFD (1<sup>st</sup>, Jul 1993)*.



1.



## 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

# Define Material Characteristics

1

Press  to set the material yield stress and tensile strength

2

Select All Materials (Ctrl+A)

3

Tensile Strength: **360e+3 [kPa]**

4

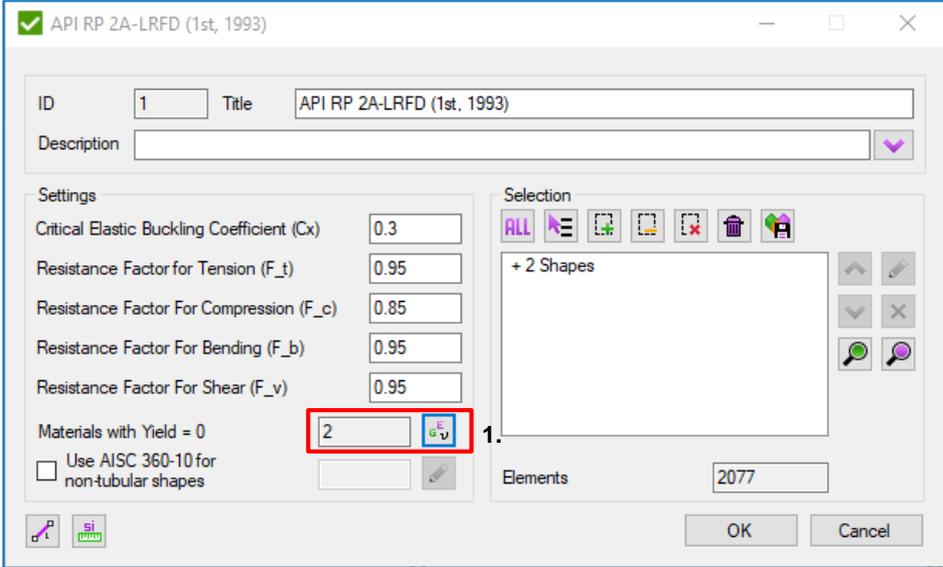
Yield Stress: **240e+3 [kPa]**

5

Press *Set*

6

Press *OK*



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

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

Description: [Empty]

Settings

Critical Elastic Buckling Coefficient (Cx): 0.3

Resistance Factor for Tension (F<sub>t</sub>): 0.95

Resistance Factor For Compression (F<sub>c</sub>): 0.85

Resistance Factor For Bending (F<sub>b</sub>): 0.95

Resistance Factor For Shear (F<sub>v</sub>): 0.95

Materials with Yield = 0: 2  1.

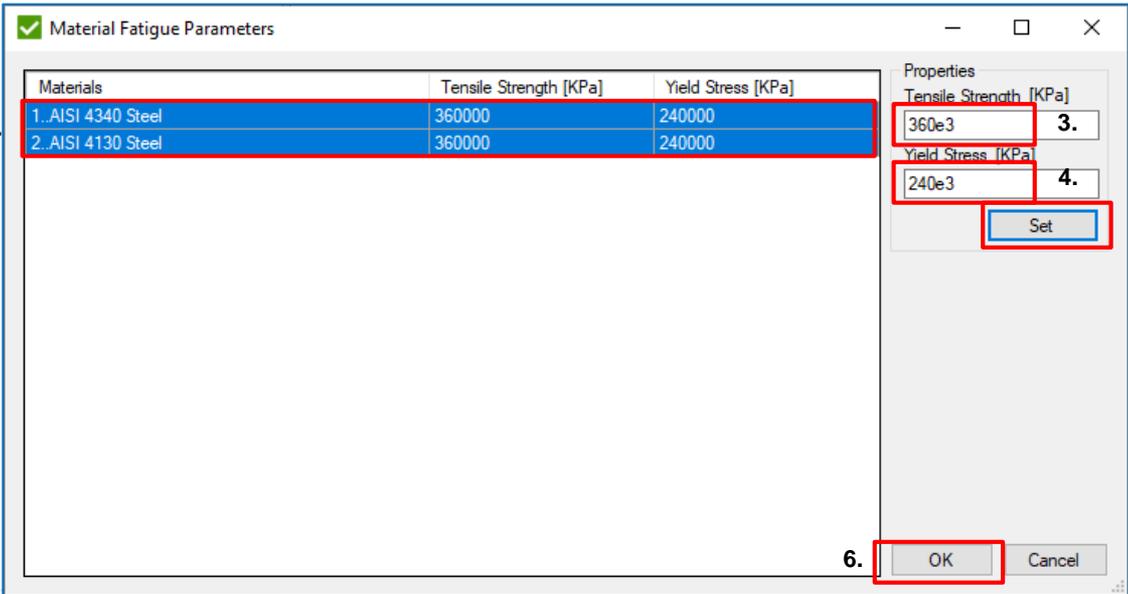
Use AISC 360-10 for non-tubular shapes

Selection

+ 2 Shapes

Elements: 2077

OK Cancel



Material Fatigue Parameters

Materials	Tensile Strength [KPa]	Yield Stress [KPa]
1..AISI 4340 Steel	360000	240000
2..AISI 4130 Steel	360000	240000

Properties

Tensile Strength [KPa]: 360e3 3.

Yield Stress [KPa]: 240e3 4.

Set 5.

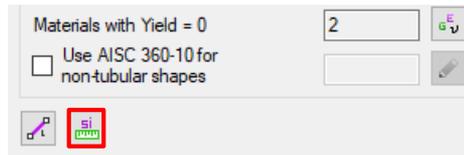
OK 6. Cancel

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 unit system used in the model should be specified in SDC Verifier.

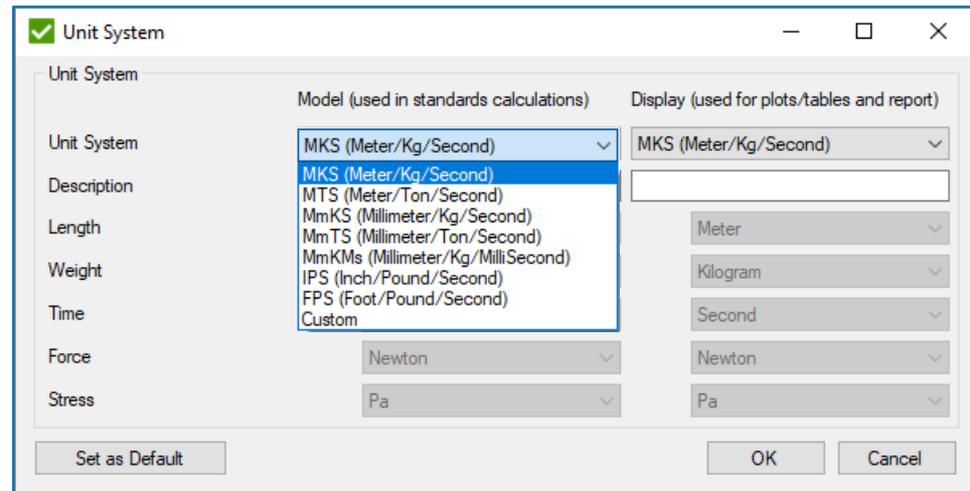
Parameter = RequirementsValid (Requirements Valid)

All: `if((Units.GetInMillimeters(Thickness) >= 6) and (Units.GetInMPa(Yield) < 414) and (D / Thickness < 300), yes, no)`

By default MKS (Meter/Kg/Second) unit system is used. To change unit system press



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.



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

### All (All Entities)

Standard	1..API 2A RP	Check Selection	7..Overall Check
Individual Load	1..Gravity -9.81.Legs.Fixed		All Entities
<b>Extreme</b>	<b>Absolute Axial Uf</b>	<b>Absolute Bending Uf</b>	<b>Absolute Shear Uf</b>
			<b>Absolute Axial and Bending Uf</b>
			<b>Overall Utilization Factor</b>
Minimum	12345678.00	12345678.00	12345678.00
Maximum	12345678.00	12345678.00	12345678.00
Absolute	12345678.00	12345678.00	12345678.00

# Extreme table for bending check

1 Execute *Table* from the **Bending Stress Check** context menu

2 Press  to select load

3 Load Type: **Load Group**

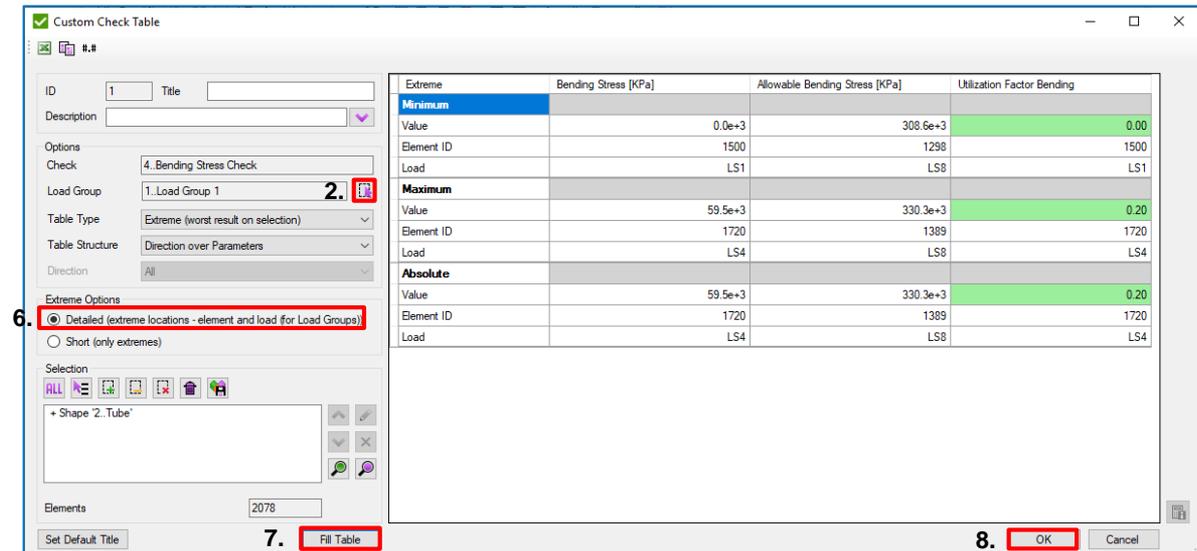
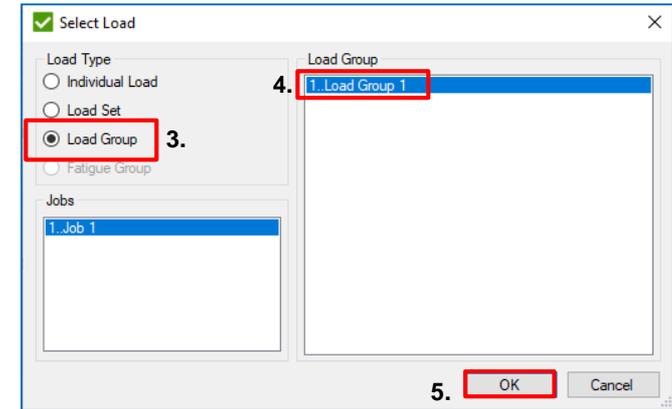
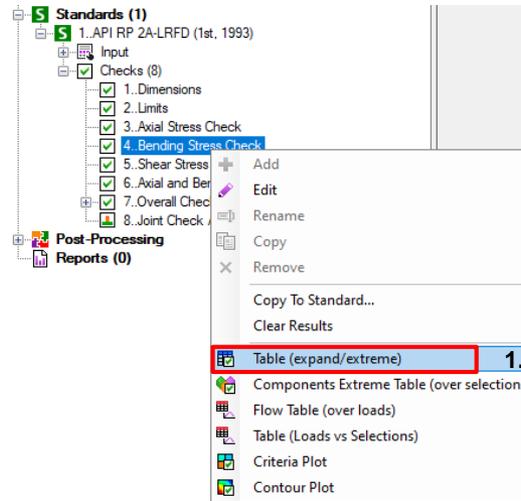
4 Load: **1..Load Group 1**

5 Press *OK*

6 Extreme Options: **Detailed**

7 Press *Fill Table*

8 Press *OK*



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 = worst Uf among all checks.

# Criteria Plot for Bending Stress Check

1 Execute *Criteria Plot* from **Bending Stress Check** context menu

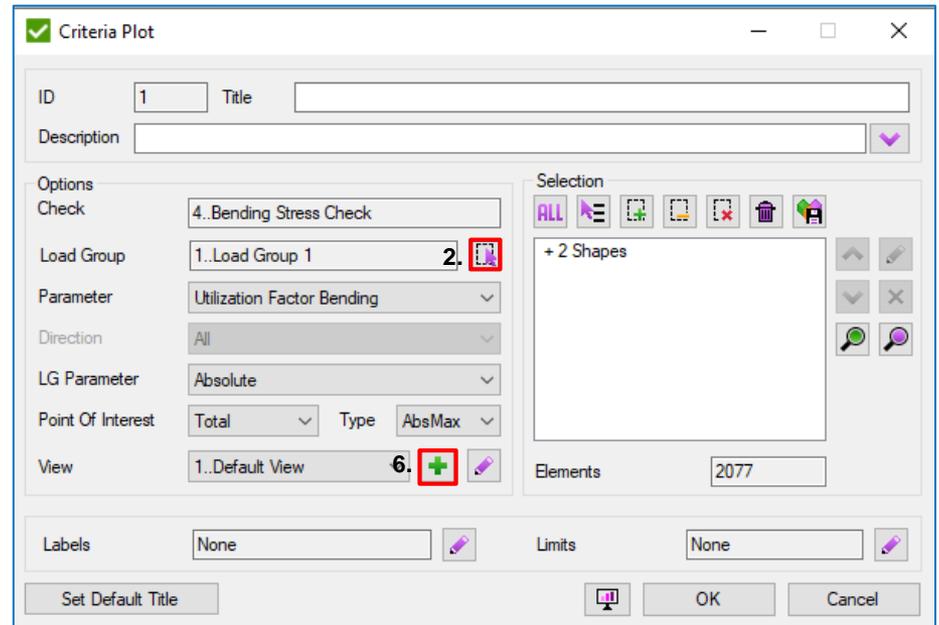
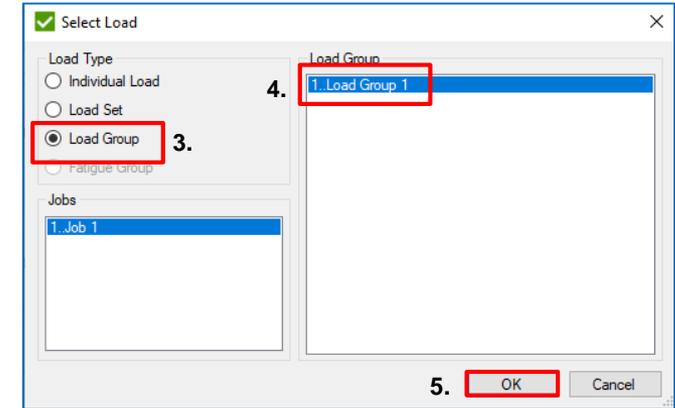
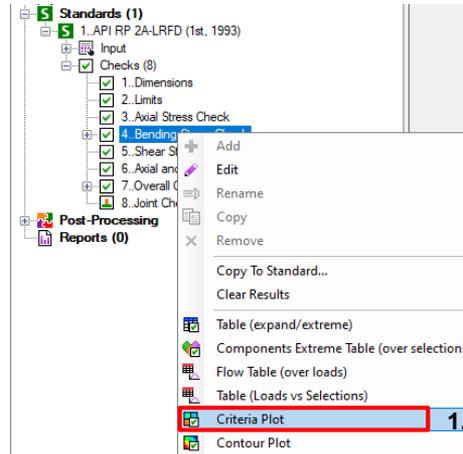
2 Press  to select load

3 Load Type: **Load Group**

4 Load: **1..Load Group 1**

5 Press *OK*

6 Press to add view



# Plot. Create View

1 Title: **Isometric**

2 Orient model in Simcenter as shown on the picture

3 Press *Get*

4 Color Display: **Banded**

5 Select: **Use local limits. Max: 0.48**

6 Press *OK*

**1.**

ID 2 Title **Isometric**

Description

Location

Origin X 2445.65 Origin Y 6933.56 Origin Z 1400.26

Rotation Matrix

XX	-0.77	XY	-0.64	XZ	-0.05
YX	0.29	YY	-0.42	YZ	0.86
ZX	-0.57	ZY	0.65	ZZ	0.50

Scale 1.18E-002 **3.** Get Show

**2.**

**5.**

Settings

Rendering Style Shaded with Edge

Edges External

Edges Color Silver Gray

Lighted

Color Display **4.** Banded

Show Cross Section and Plate Thickness

Show Deformation

Show undeformed model

Legend Text Color Deep Steel

Automatic Font Scaling

Text Scale Factor

Legend Header Customized

Legend Position Right

Get Show

Legend Limits

Use limits from legend settings

**Use local limits**

Mode Min Max

Min 0

Max 0.48

Number of levels 12

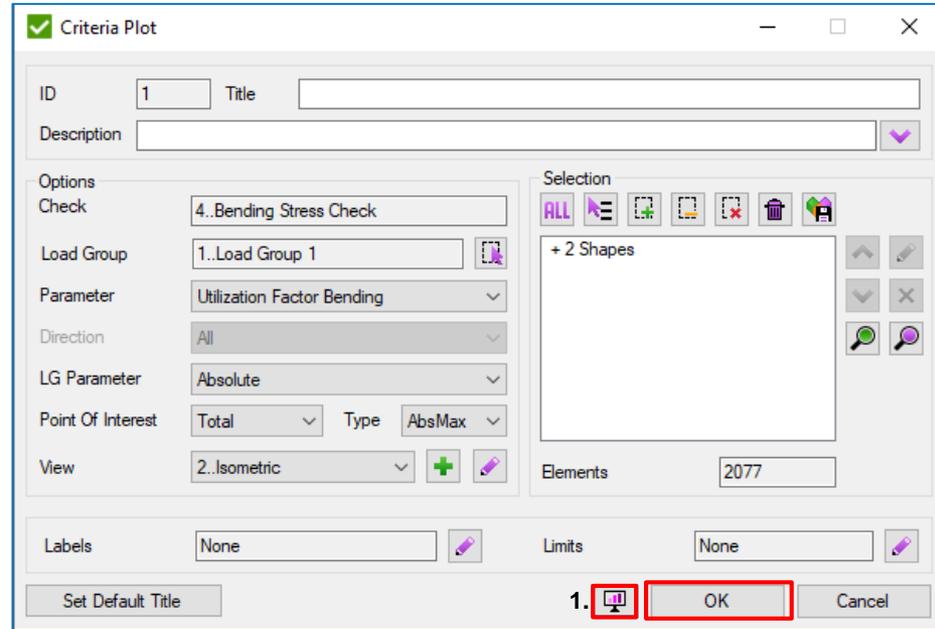
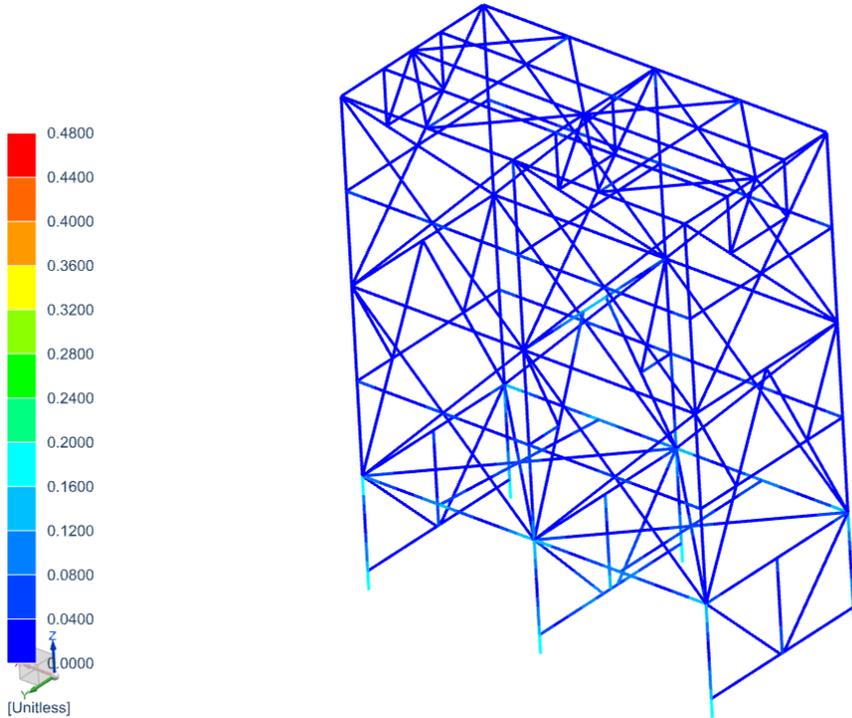
Format General

**6.** OK Cancel

# Display Plot

1 Press  to display plot

2 Press *OK*

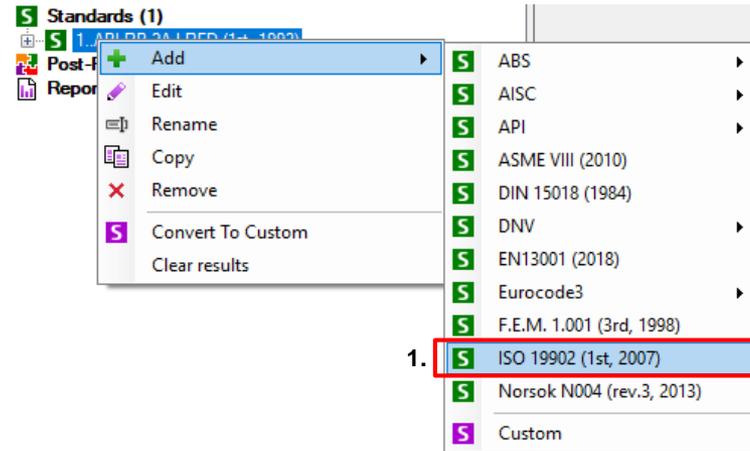


2.

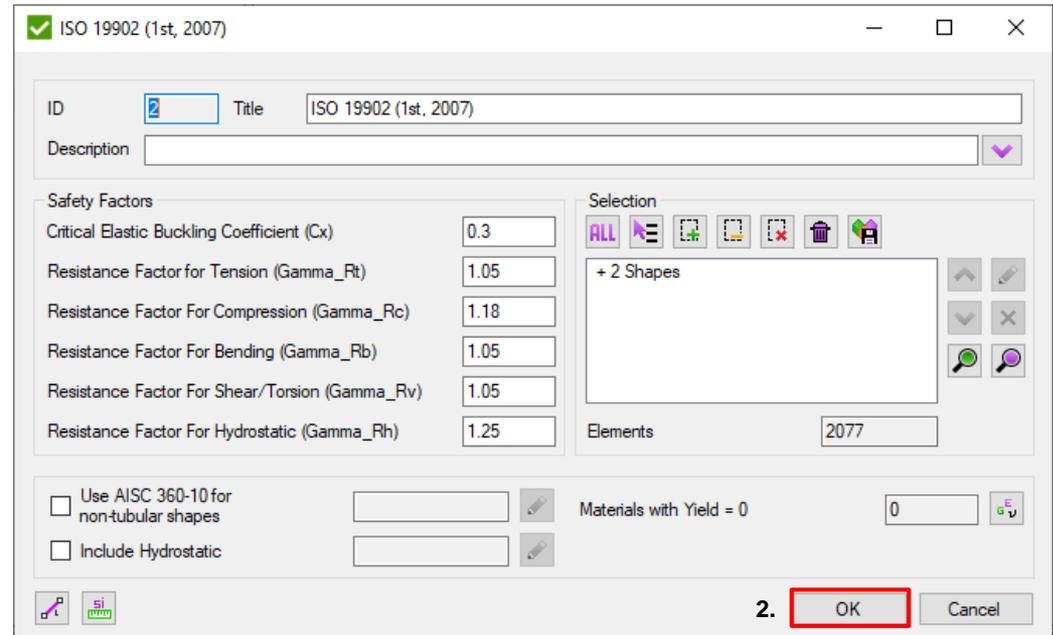
# Add ISO 19902 standard

1 Execute *Standards* => *Add* => *ISO 19902* (1<sup>st</sup>, Dec 2007).

2 Press *OK*



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 = worst  $U_f$  among all checks  $< 1$ .



$C_x$  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,  $\gamma_{R,b} = 1,05$ ;

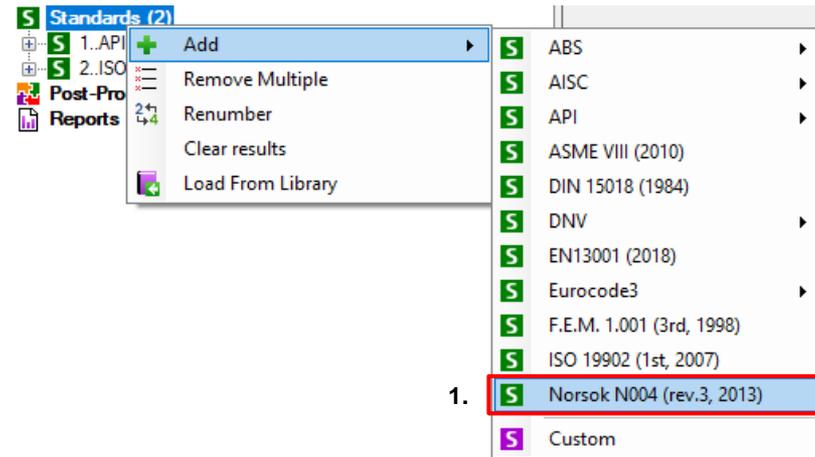
$\gamma_{R,v}$  is the partial resistance factor for shear strength,  $\gamma_{R,v} = 1,05$ ;

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

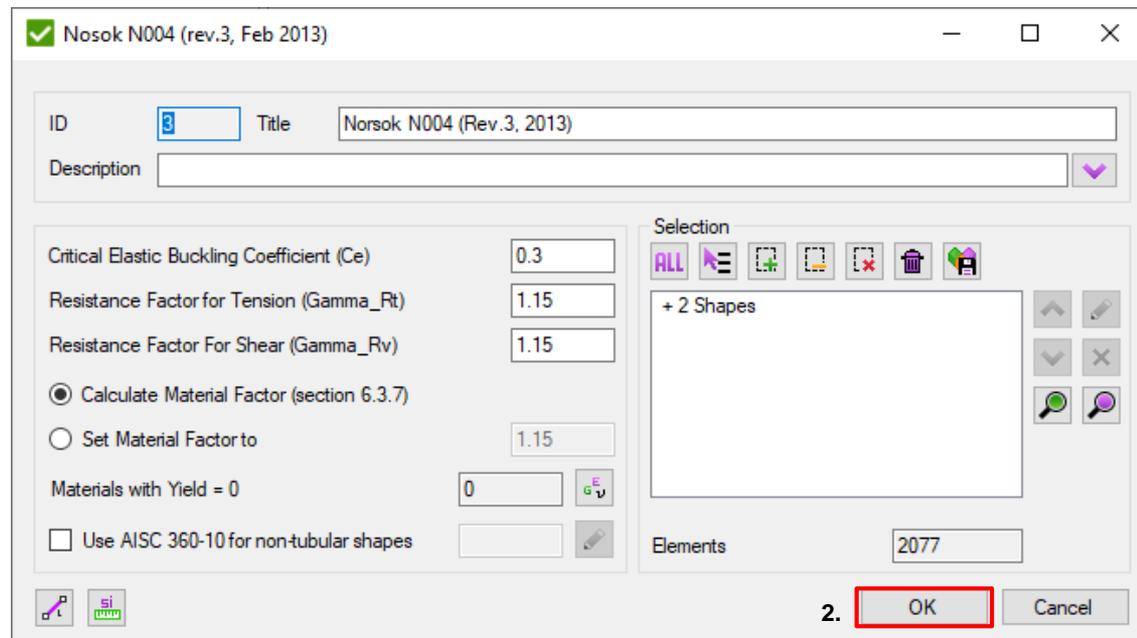
# Add Norsok N004 standard

1 Execute *Standards* => *Add* => *Norsok N004 (rev.3, Feb 2013)*.

2 Press *OK* twice



Norsok N004 procedure is similar to API 2A RP. In overall check it is possible to verify if the structure passes all checks : Overall Utilization Factor = worst  $U_f$  among all checks < 1.



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

where

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

where  $f_{ct}$  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

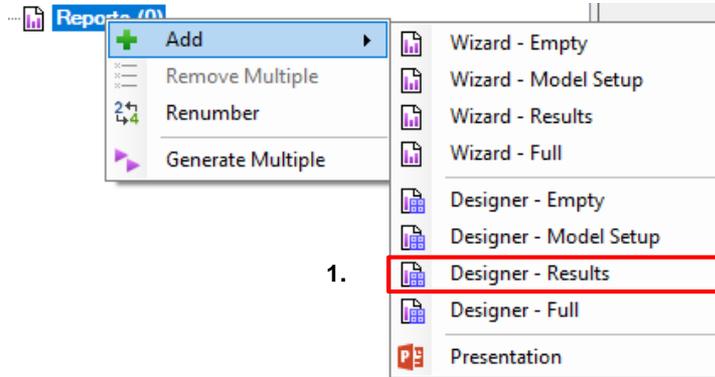
$$\sigma_{c,Sd} = \frac{N_{Sd}}{A} + \frac{\sqrt{M_{y,Sd}^2 + M_{z,Sd}^2}}{W} \tag{6.25}$$

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

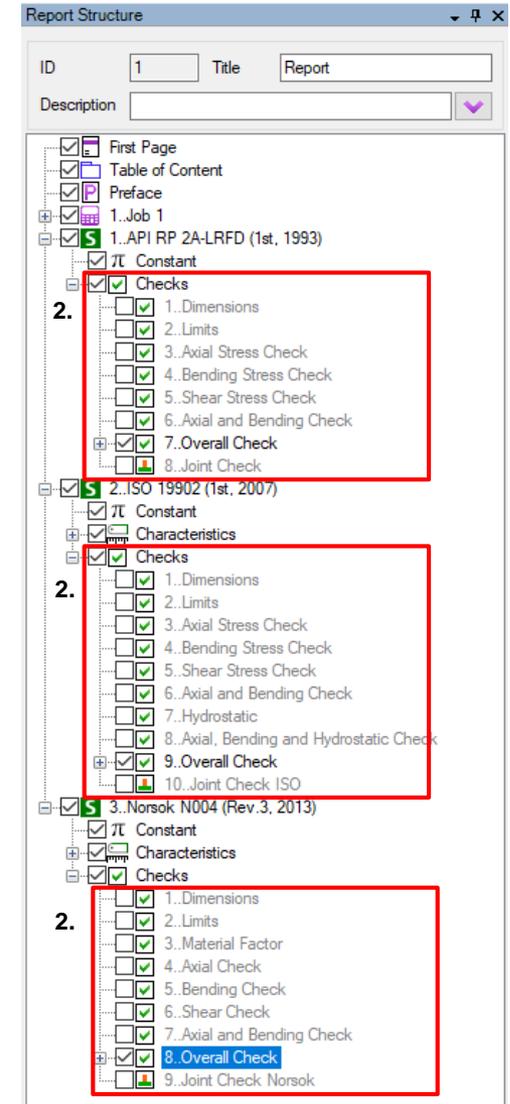
# Report

1. Execute *Add - Designer - Results* from *Reports* context menu.

2. Exclude all checks except the **Overall check** in each standard.



There are 4 templates of the reports:  
*Empty* – only first page and preface items are included;  
*Model Setup* – description of the model data (materials, properties, components, boundary conditions) is included;  
*Results* – for each load extreme displacement tables, stress and displacement plots are included. Predefined tables: sum of reaction forces, stresses/displacements summary tables;  
*Full* – Model Setup + Results + all tables created in Job.



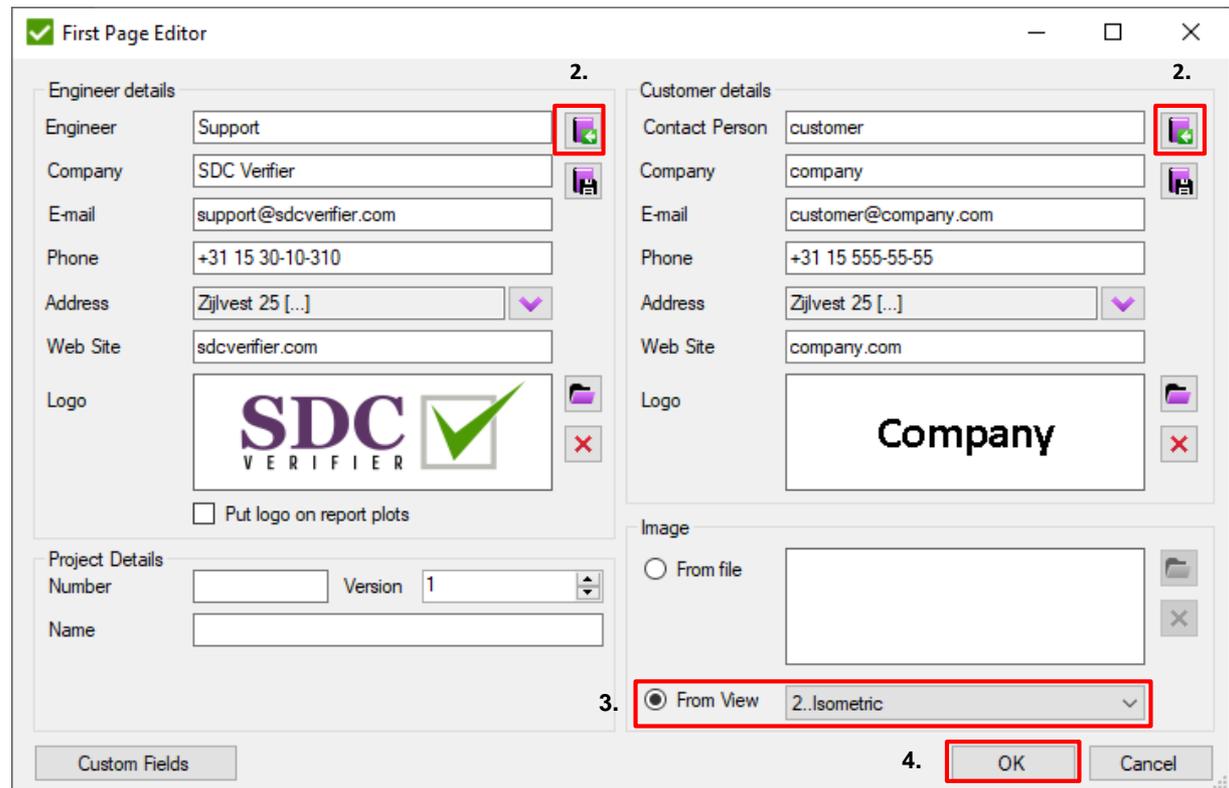
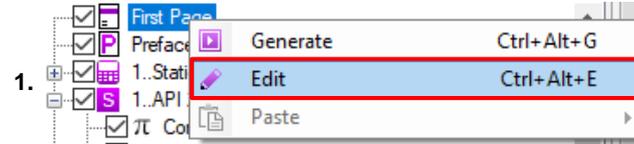
# Report. First Page

1 Right click on *First Page* => *Edit*.

2 Press  to load engineer and customer info from library

3 Select Image *From View* and pick '*2..Isometric*'.

4 Press *OK*.



**First Page Editor**

**Engineer details**

Engineer: Support 

Company: SDC Verifier 

E-mail: support@sdcverifier.com

Phone: +31 15 30-10-310

Address: Zijlvest 25 [...] 

Web Site: sdcverifier.com

Logo:   

Put logo on report plots

**Customer details**

Contact Person: customer 

Company: company 

E-mail: customer@company.com

Phone: +31 15 555-55-55

Address: Zijlvest 25 [...] 

Web Site: company.com

Logo:   

**Image**

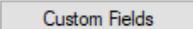
From file  

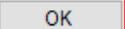
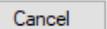
From View **2..Isometric** 

**Project Details**

Number:  Version: 1 

Name:

Custom Fields 

**OK**  Cancel 

# Report exported to Microsoft Word

Press to generate complete report.



Press to export to Word.

First page



## Report



Prepared by:  
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Engineer:  
customer  
Support  
customer  
Project Number:  
1  
Version:  
2 Nov 2017  
Date:

### 7..Overall Check

API 2A RP

Property	Value			
Elemental Custom Check Shape '2_Tube'	5			
17..Overall Check				
Load Group	LG1..Load Group 1			
Shape '2_Tube'				
Absolute Axial UF	Absolute Bending UF	Absolute Shear UF	Absolute Axial and Bending UF	Overall Utilization Factor
0.21	0.20	0.12	0.30	0.33
Factor (LG1, Shape '2_Tube', v1)				
17..Overall Check				
Absolute Overall Utilization Factor	Load Group Selection	LG1..Load Group 1 Shape '2_Tube'	Data Conversion Average	
Default View				

### 9..Overall Check

ISO 19902

Check	Absolute Bending Um	Absolute Shear Um	Absolute Shear Torsional Um	Absolute Axial and Bending Um	Overall Utilization Factor
0.22	0.19	0.12	0.09	0.31	0.90
Factor (LG1, Shape '2_Tube', v1)					
Check					
all Utilization Factor	Load Group Selection	LG1..Load Group 1 Shape '2_Tube'	Data Conversion Average		

### 8..Overall Check

Norsok N004

Check	Absolute Bending UF	Absolute Shear UF	Absolute Shear Torsional UF	Absolute Axial and Bending UF	Overall Utilization Factor
0.22	0.21	0.13	1.00	0.22	1.08
Factor (LG1, Shape '2_Tube', v1)					
Check					
Utilization Factor	Load Group Selection	LG1..Load Group 1 Shape '2_Tube'	Data Conversion Average		