



Tutorial

# **Eurocode3 Bolts (EN 1993-1-8, 2005)**

Updated on: November 2nd 2023

Tested with: SDC Verifier 2023 R2

Simcenter Femap with Nastran 2022.2 MP2

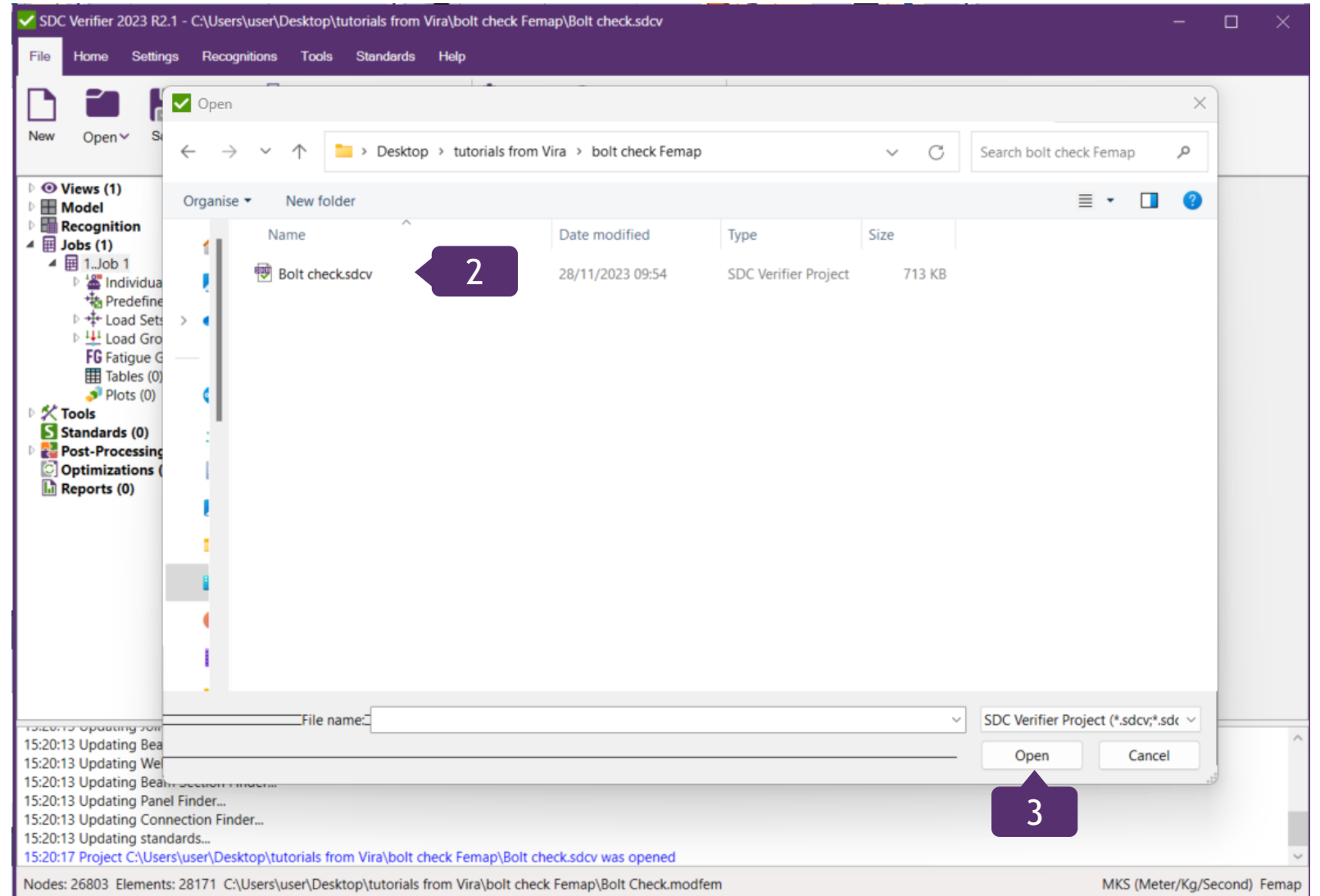
- In this tutorial, Eurocode3 Bolts Check is reviewed in details;
- A plate model (bolts modeled as beams) structure has been used as a start FEM model;
- An Extreme table, showing the worst result on selection, has been created;
- Criteria Plot with Utilization factor overall has been previewed

# Open the Starter Model

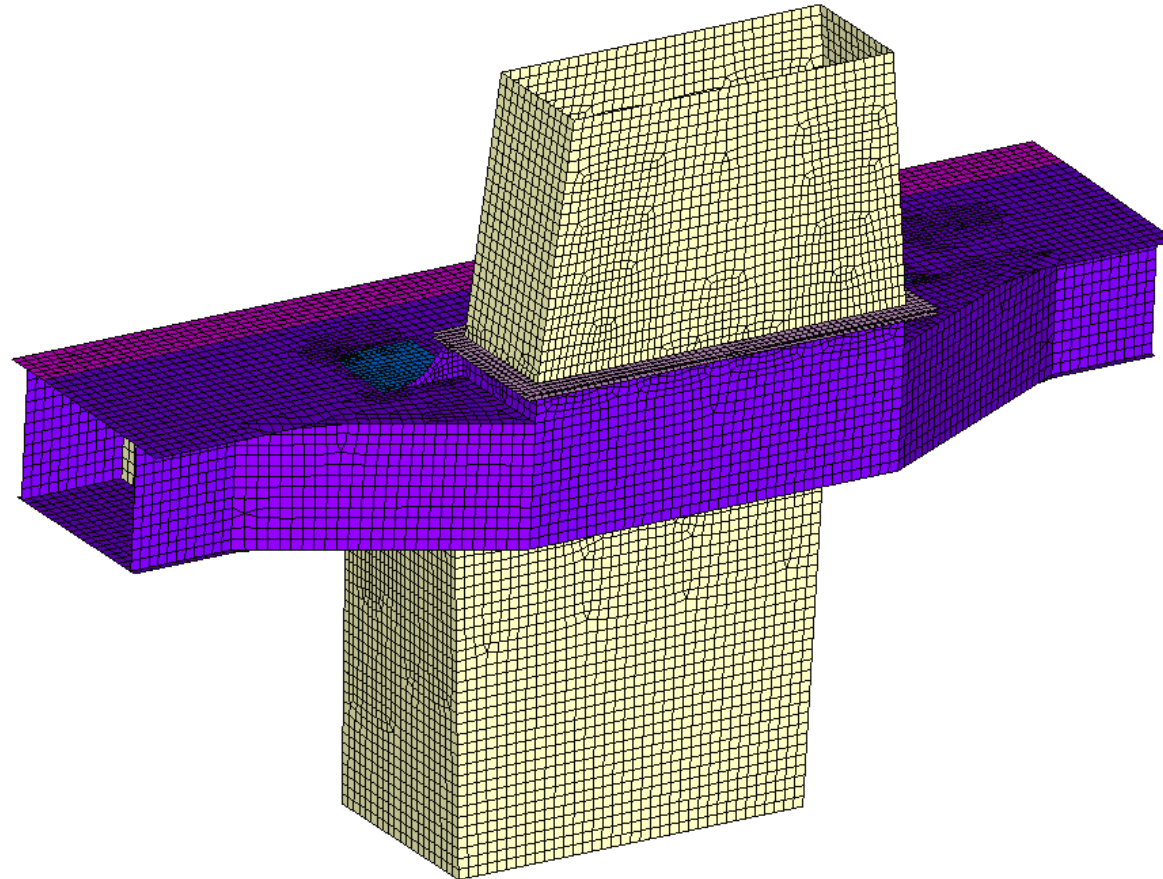
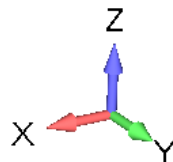
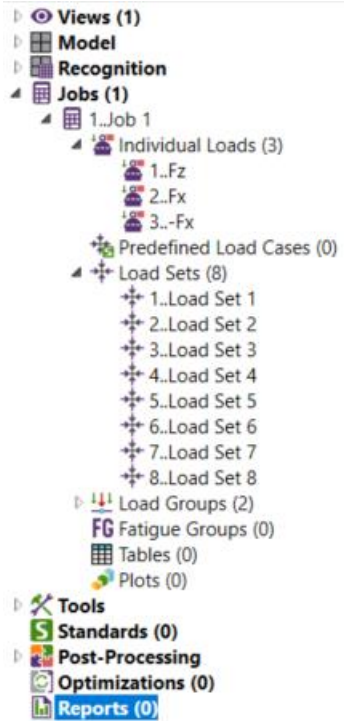
1 Launch SDC Verifier for FEMAP ✓

2 Open project *Bolt Check*


3 Press *Open*

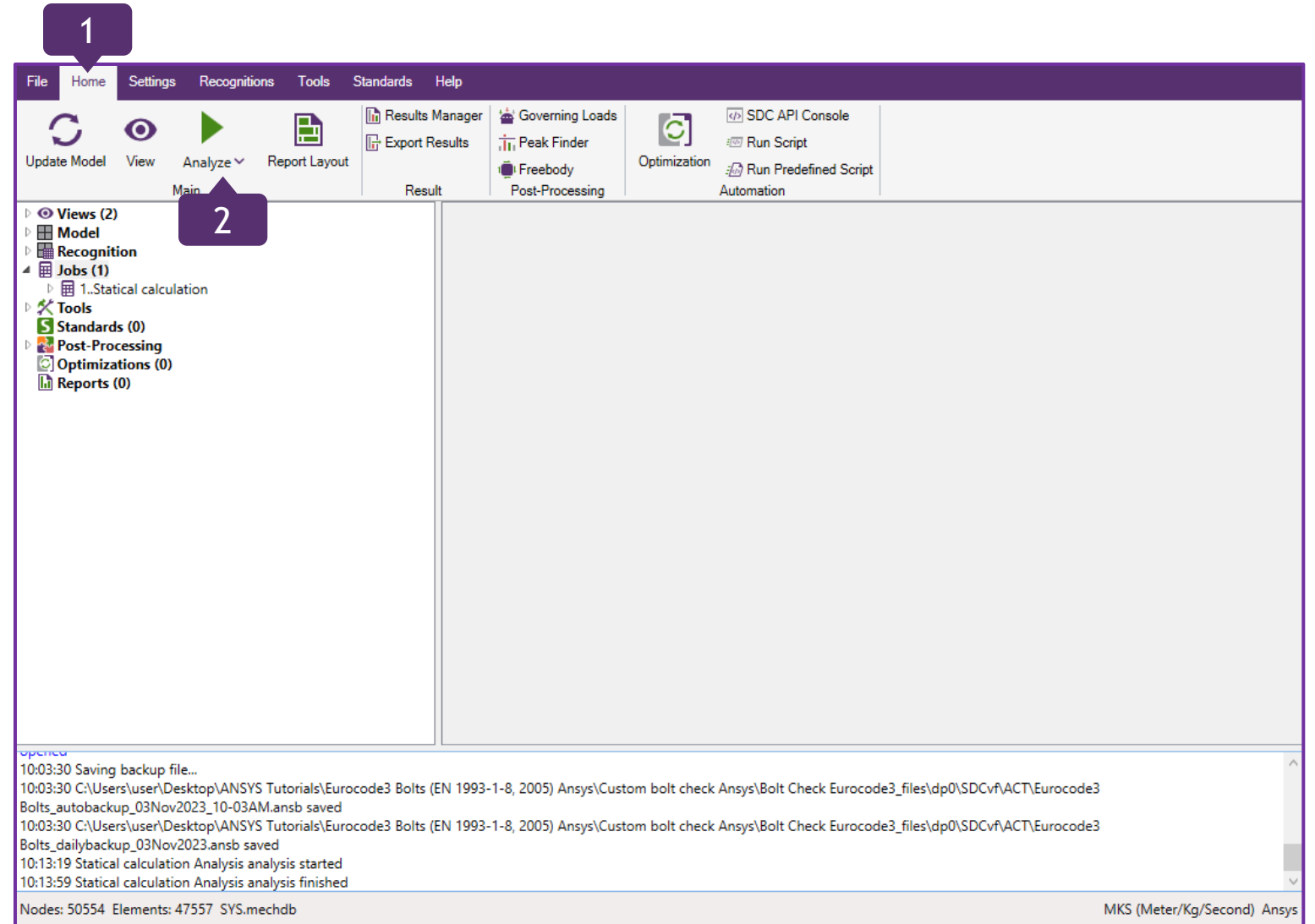


The project in this tutorial has predefined boundary conditions, load combinations and load groups. The model contains plate and beam elements. Bolts are modeled as beam elements.



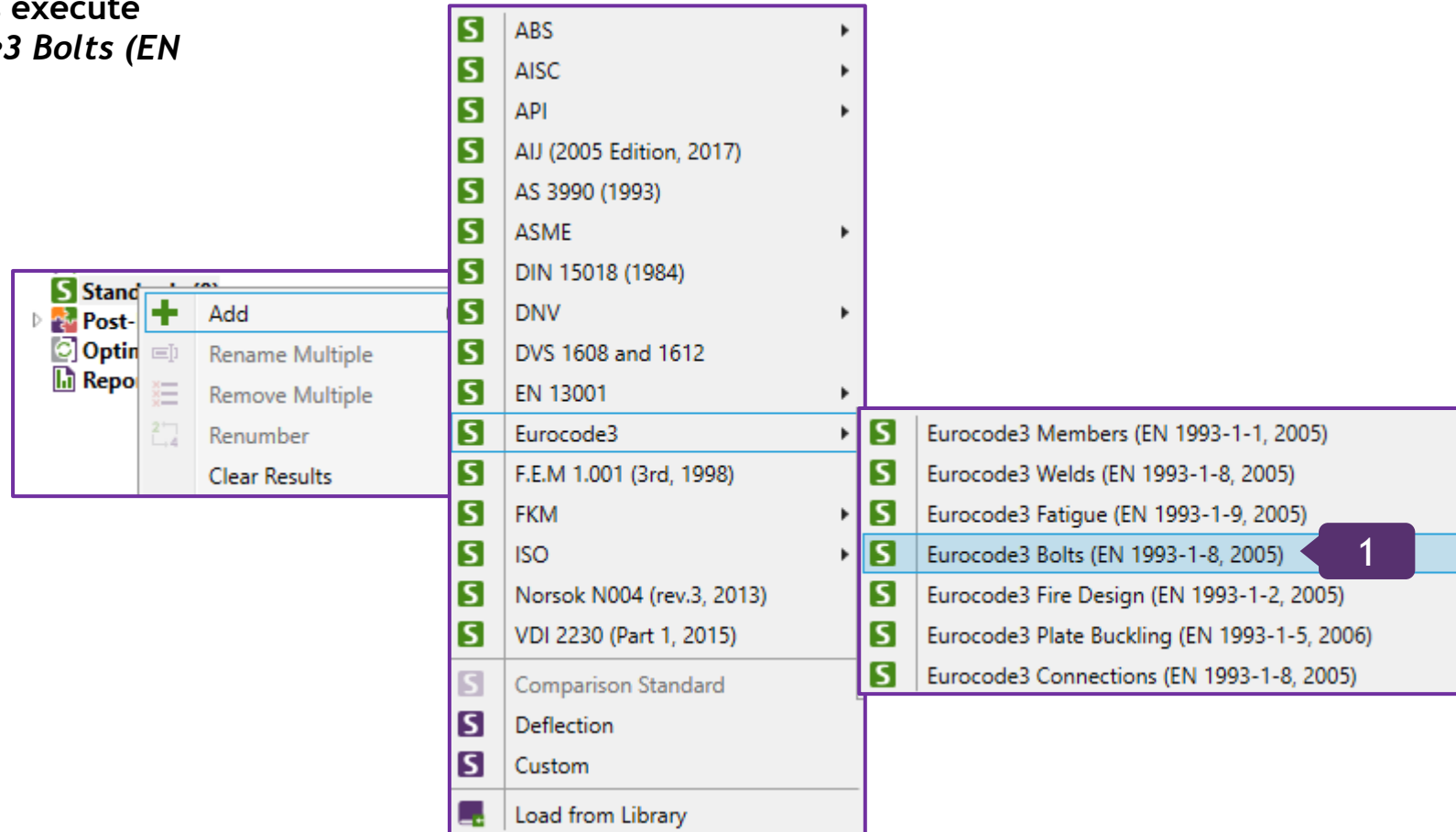
# Run Analysis

- 1 Go to *Home* section on the Ribbon.
- 2 Press  on the toolbar to analyze job.



1

In the *Model tree*, in Standards execute  
*Add => Eurocode3 => Eurocode3 Bolts (EN 1993-1-8, 2005)*



# Define Position Of The Bolt In The Direction Of Load

1

Press  in Position Of The Bolt In The Direction Of Load

2

Elemental Selections Id: *End bolts*

3

Press **OK**

Position of the bolt in the direction of load - bolts need to be defined as end bolts or inner bolts in connection.

**Add Element Characteristic**

ID: 5 Title: Position of the bolt in the direction of load

Alias: Position\_in\_the\_direction\_of\_load

Description:

Elemental Selections Id: **2** End bolts

Selection	Value
Full Model	End bolts

**3** OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Value
Position Of The Bolt In The Direction Of Load	<b>1</b> Bolt Perpendicular To The Direction Of Load
Bolt Threat Pitch	
Shear Plane Position	
Countersunk Bolt	
Class Of Friction Surfaces	
Thickness Of Countersinking	
Connection In Tension	
End Distance (Figure 3.1)	
Edge Distance (Figure 3.1)	
Structure Made From Steel Conforming To	

Constant

Constant	Value
Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel

# Define Bolt Thread Pitch

1 Press  in Bolt Thread Pitch

2 10..Bolt M24 (154 bodies): 0.003

3 Press **OK**

**Properties Characteristics**

ID: 1 Title: Bolt thread pitch

Alias: P

Description: In model units

Properties

Property	Value
1..T = 0.01 (39 bodies, matld 26)	0
2..T = 0.008 (10 bodies, matld 26)	0
3..T = 0.025 (4 bodies, matld 26)	0
4..T = 0.018 (matld 26)	0
5..T = 0.015 (2 bodies, matld 26)	0
6..L100x50x6_bridge (3 bodies)	0
7..T = 0.005 (matld 26)	0
8..L100x50x6_bracing columns (6 bodies)	0
9..L100x50x6_WS (8 bodies)	0
10..Bolt M24 (154 bodies)	0.003
11..Connections (3 bodies)	0

OK Cancel

Bolt thread pitch is the distance between threads expressed that has to be defined.



**Eurocode3 Bolts (EN 1993-1-8, 2005)**


ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)



Alias: Standard1



Description:



Option



Position Of The Bolt In The Direction Of Load: Defined  Position Of The Bolt Perpendicular To The Direction Of Load: 



Bolt Thread Pitch:  1



Shear Plane Position:  Hole Diameter: 



Countersunk Bolt:  Hole Type: 


Class Of Friction Surfaces:  Thickness Of The Connected Plates: 

Thickness Of Countersinking:  Number Of The Friction Planes: 

Connection In Tension:  Net Area: 

End Distance (Figure 3.1):  Spacing P1 (Figure 3.1): 

Edge Distance (Figure 3.1):  Spacing P2 (Figure 3.1): 

Structure Made From Steel Conforming To: 

Constant

Gamma M0 (Table 2.1): 1.1

Gamma M2 (Table 2.1): 1.25

Gamma M3 (Table 2.1): 1.25

Gamma M3 Ser (Table 2.1): 1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel



# Define Shear Plane Position

1

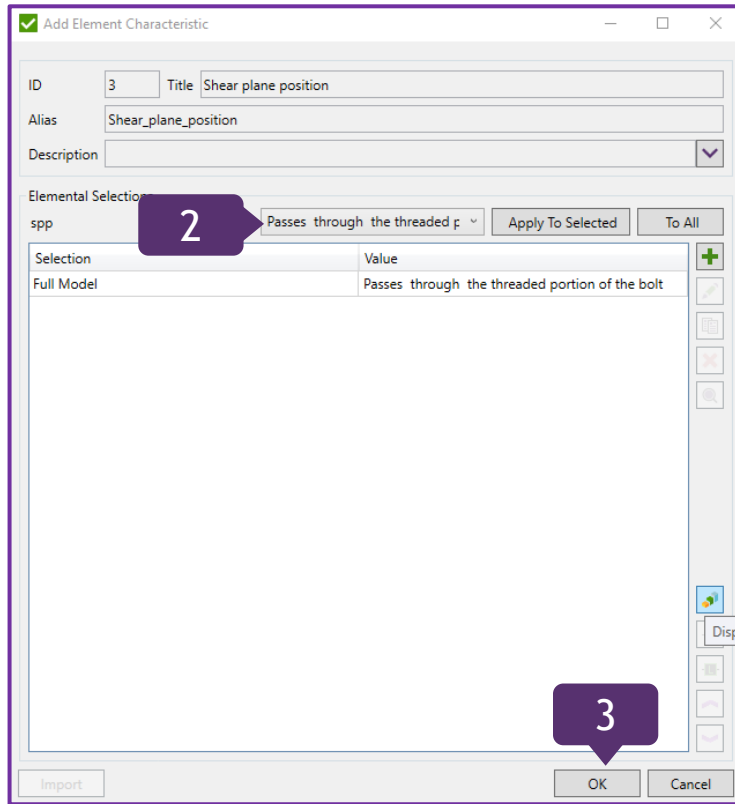
Press  in Shear Plane Position

2

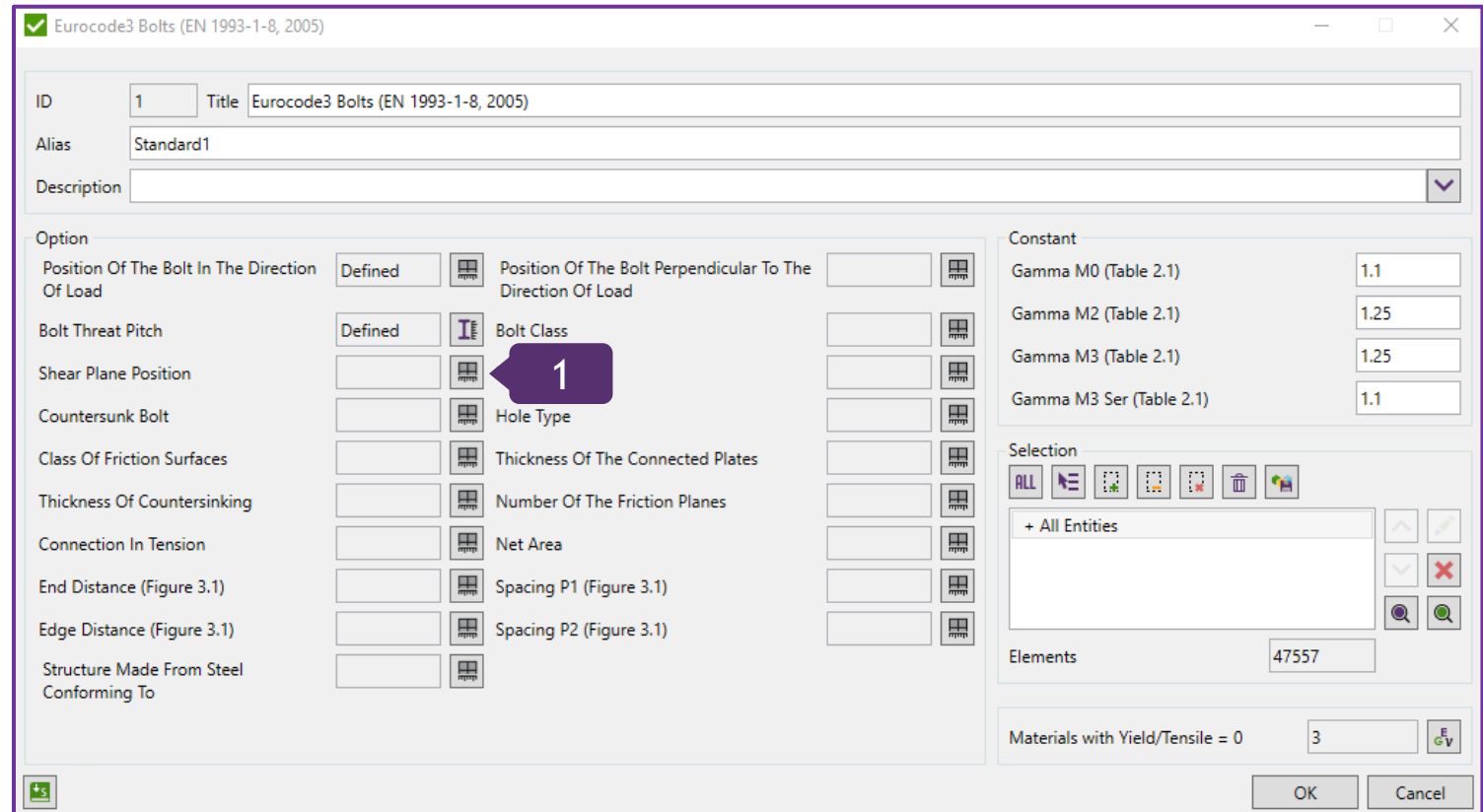
Elemental Selections spp: *Passes through the threaded portion of the bolt*

3

Press **OK**



Shear plane position - select if plane passes through the unthreaded or the threaded portion of the bolt.



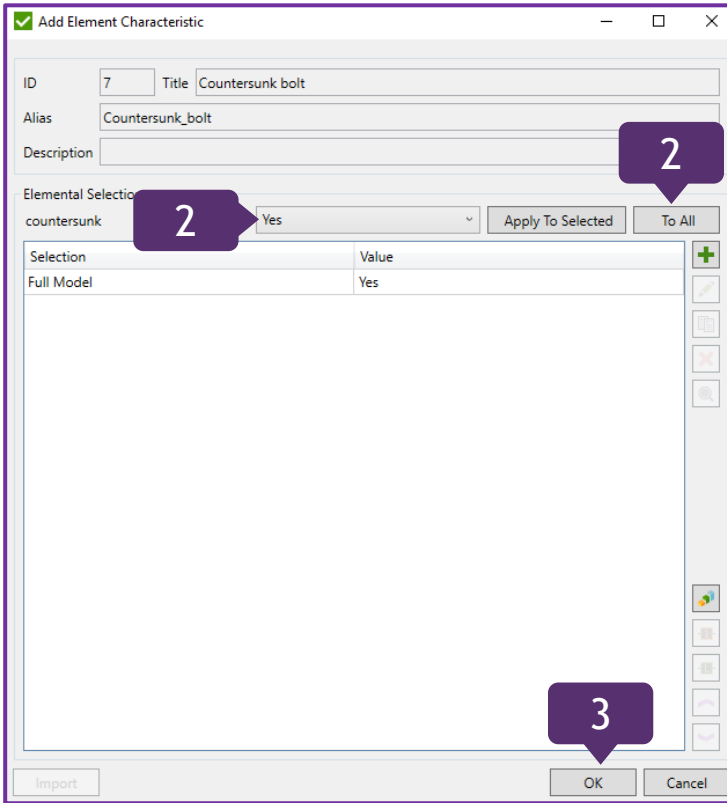
# Define Countersunk Bolt

1 Press  in Countersunk Bolt

2 Elemental Selections countersunk: Yes and press *To All*

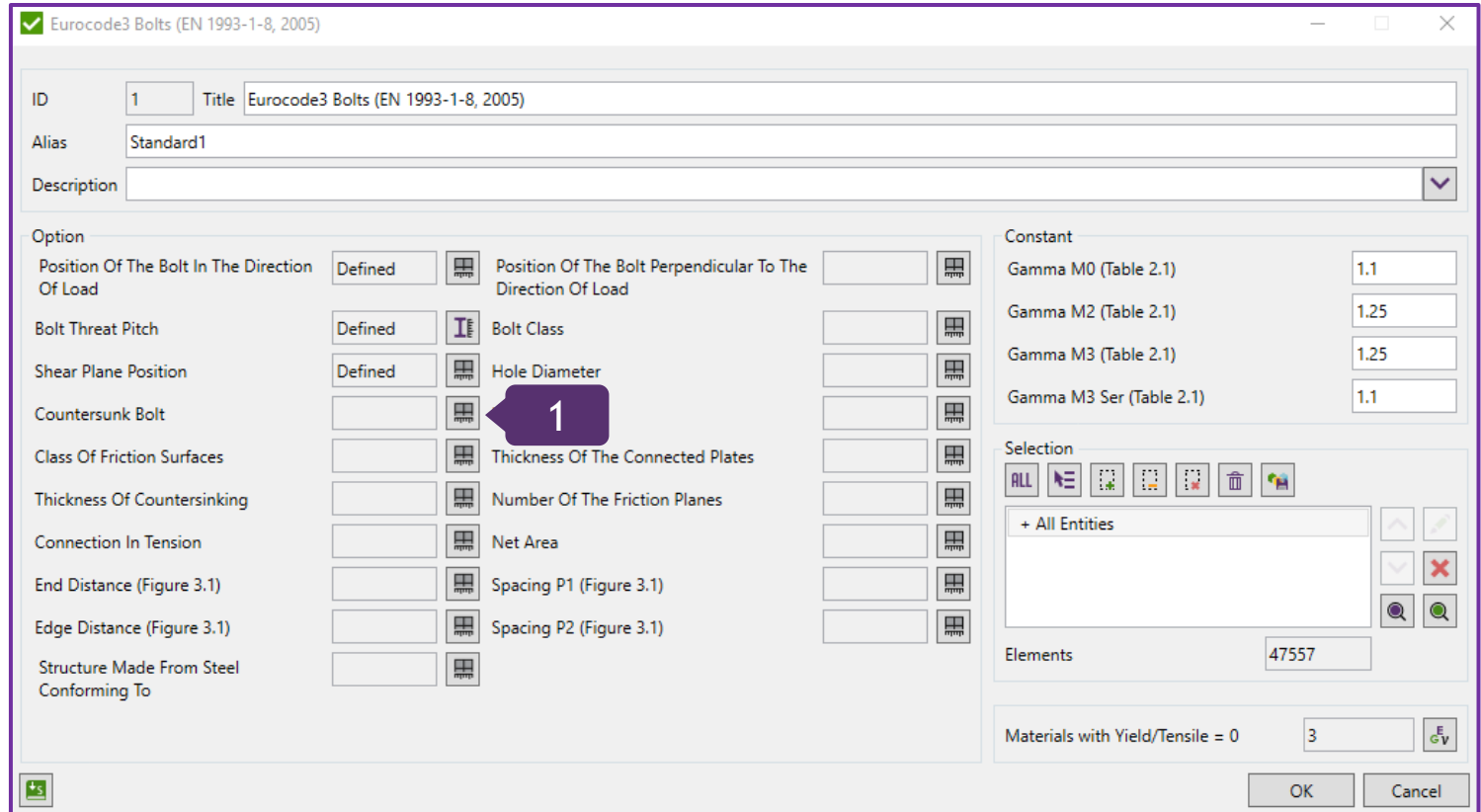
3 Press *OK*

Countersunk bolt - type of bolt has to be defined.



2

3



1

# Define Class Of Friction Surfaces

1 Press  in Class Of Friction Surfaces

2 Elemental Selections cfs: A

3 Press OK

Class of friction surfaces - select A, B, C or D class (Table 3.7)

**Add Element Characteristic**

ID: 9 Title: Class of friction surfaces

Alias: Class\_of\_friction\_surfaces

Description: Used in Table 3.7 to take slip factor for pre-loaded bolts

Elemental Selections

cfs: A

Selection Value

Selection	Value
Full Model	A

OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Defined	Value
Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load
Bolt Thread Pitch	Defined	Bolt Class
Shear Plane Position	Defined	Hole Diameter
Countersunk Bolt	Defined	Hole Type
Class Of Friction Surfaces		1
Thickness Of Countersinking		Number Of The Friction Planes
Connection In Tension		Net Area
End Distance (Figure 3.1)		Spacing P1 (Figure 3.1)
Edge Distance (Figure 3.1)		Spacing P2 (Figure 3.1)
Structure Made From Steel Conforming To		

Constant

Constant	Value
Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel

# Define Thickness Of Countersinking

1

Press  in Thickness Of Countersinking

2

Selection Value: 0

3

Press OK

Thickness of countersinking - predefine countersinking value.

**Add Element Characteristic**

ID: 11 Title: Thickness of countersinking

Alias: tc

Description: In model units

Elemental Selections

Selection	Value
Full Model	0

2

3

OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Defined	Option	Value
Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load	
Bolt Threat Pitch	Defined	Bolt Class	
Shear Plane Position	Defined	Hole Diameter	
Countersunk Bolt	Defined	Hole Type	
Class Of Friction Surfaces	Defined	Thickness Of The Connected Plates	
Thickness Of Countersinking		Friction Planes	
Connection In Tension		Net Area	
End Distance (Figure 3.1)		Spacing P1 (Figure 3.1)	
Edge Distance (Figure 3.1)		Spacing P2 (Figure 3.1)	
Structure Made From Steel Conforming To			

1

Constant

Constant	Value
Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

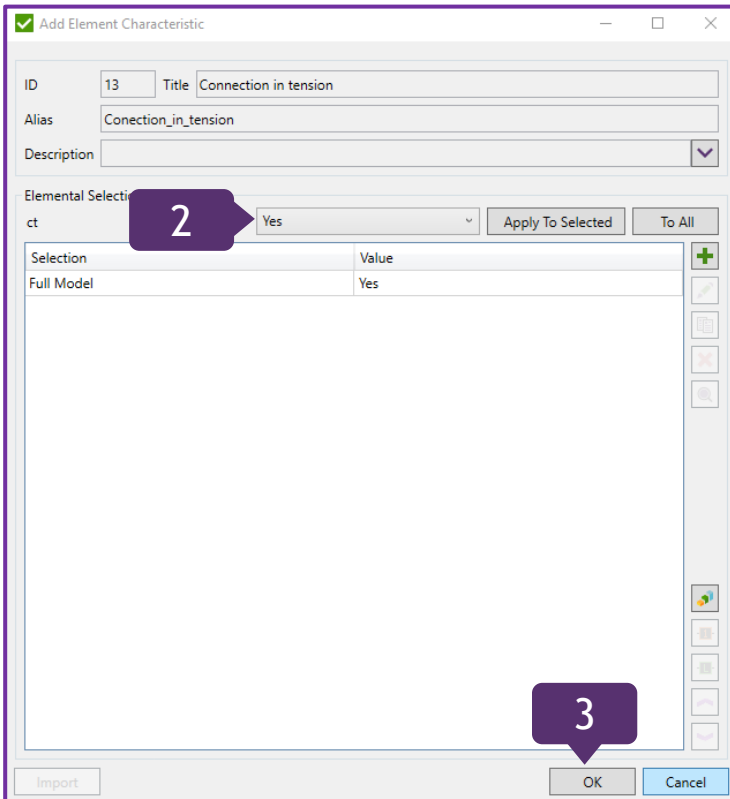
OK Cancel

# Define Connection In Tension

1 Press  in Connection In Tension

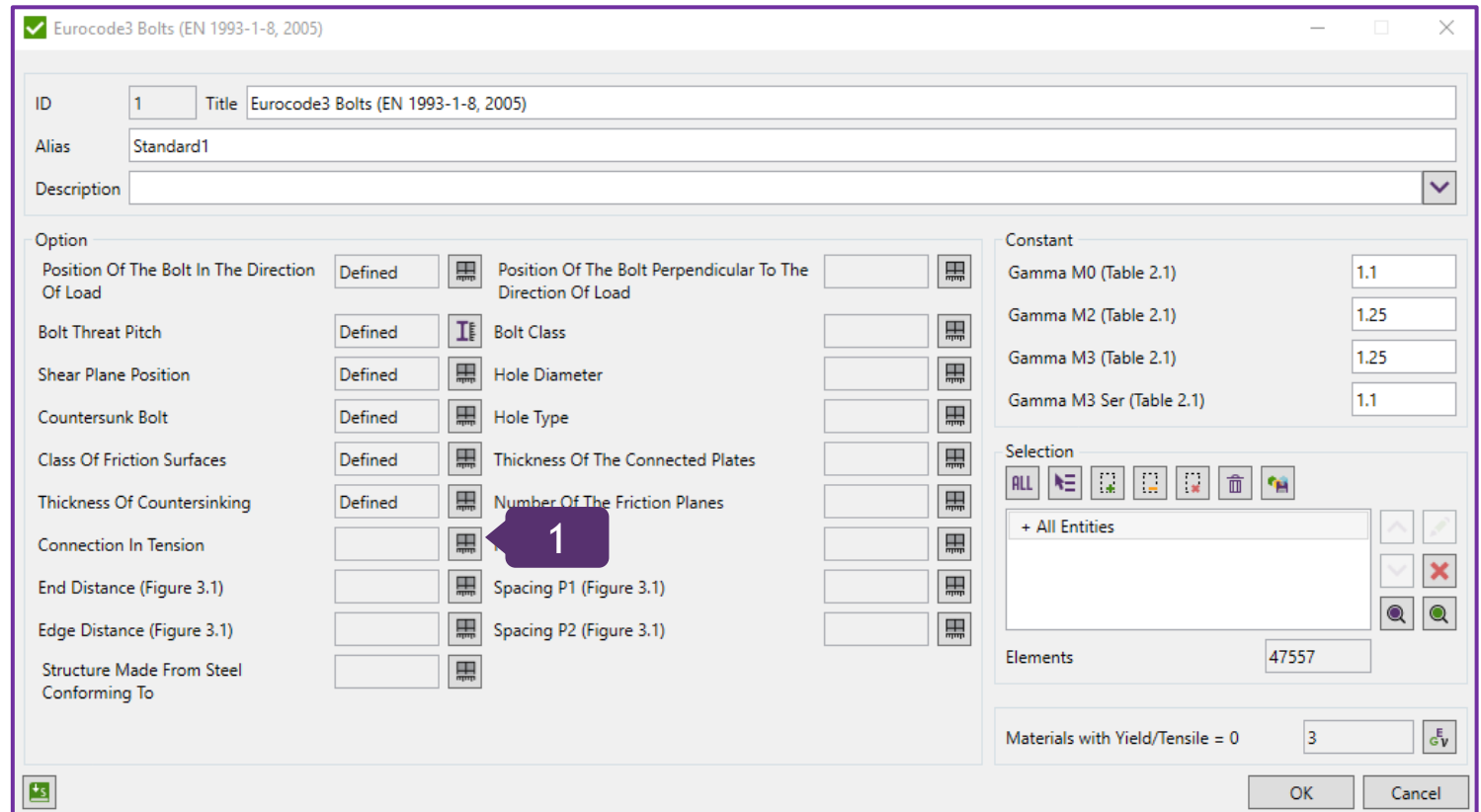
2 Elemental Selections ct: Yes

3 Press OK



13

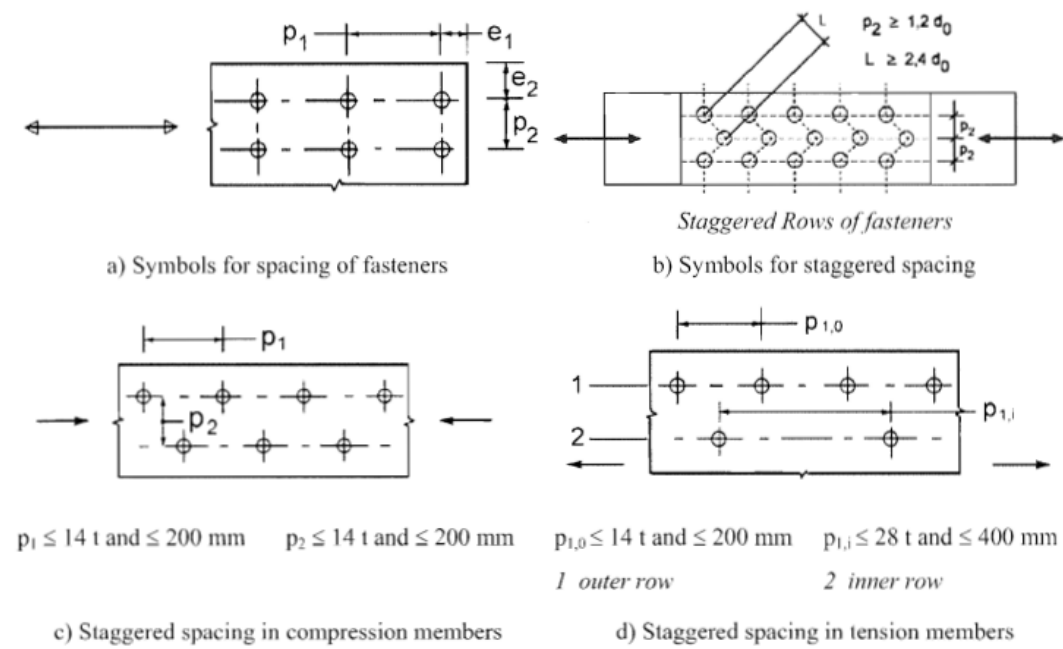
Connection in tension - select whether the connection is under tension



Distances between bolts (End Distance E1, Edge Distance E2, Spacing P1 and Spacing P2) have to be defined for each bolt connection with different plates (Figure 3.1);

Structure made from steel conforming to - select limits for maximum and minimum spacing, end and edge distances according to EN 10025 or EN10025-5 (Table 3.3).

To start calculation according to standard, all parameters need to be defined



✓ Eurocode3 Bolts (EN 1993-1-8, 2005)

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option	Defined	Constant
Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load
Bolt Threat Pitch	Defined	Bolt Class
Shear Plane Position	Defined	Hole Diameter
Countersunk Bolt	Defined	Hole Type
Class Of Friction Surfaces	Defined	Thickness Of The Connected Plates
Thickness Of Countersinking	Defined	Number Of The Friction Planes
Connection In Tension	Defined	Net Area
End Distance (Figure 3.1)		Spacing P1 (Figure 3.1)
Edge Distance (Figure 3.1)		Spacing P2 (Figure 3.1)
Structure Made From Steel Conforming To		

Constant

Gamma M0 (Table 2.1): 1.1

Gamma M2 (Table 2.1): 1.25

Gamma M3 (Table 2.1): 1.25

Gamma M3 Ser (Table 2.1): 1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel

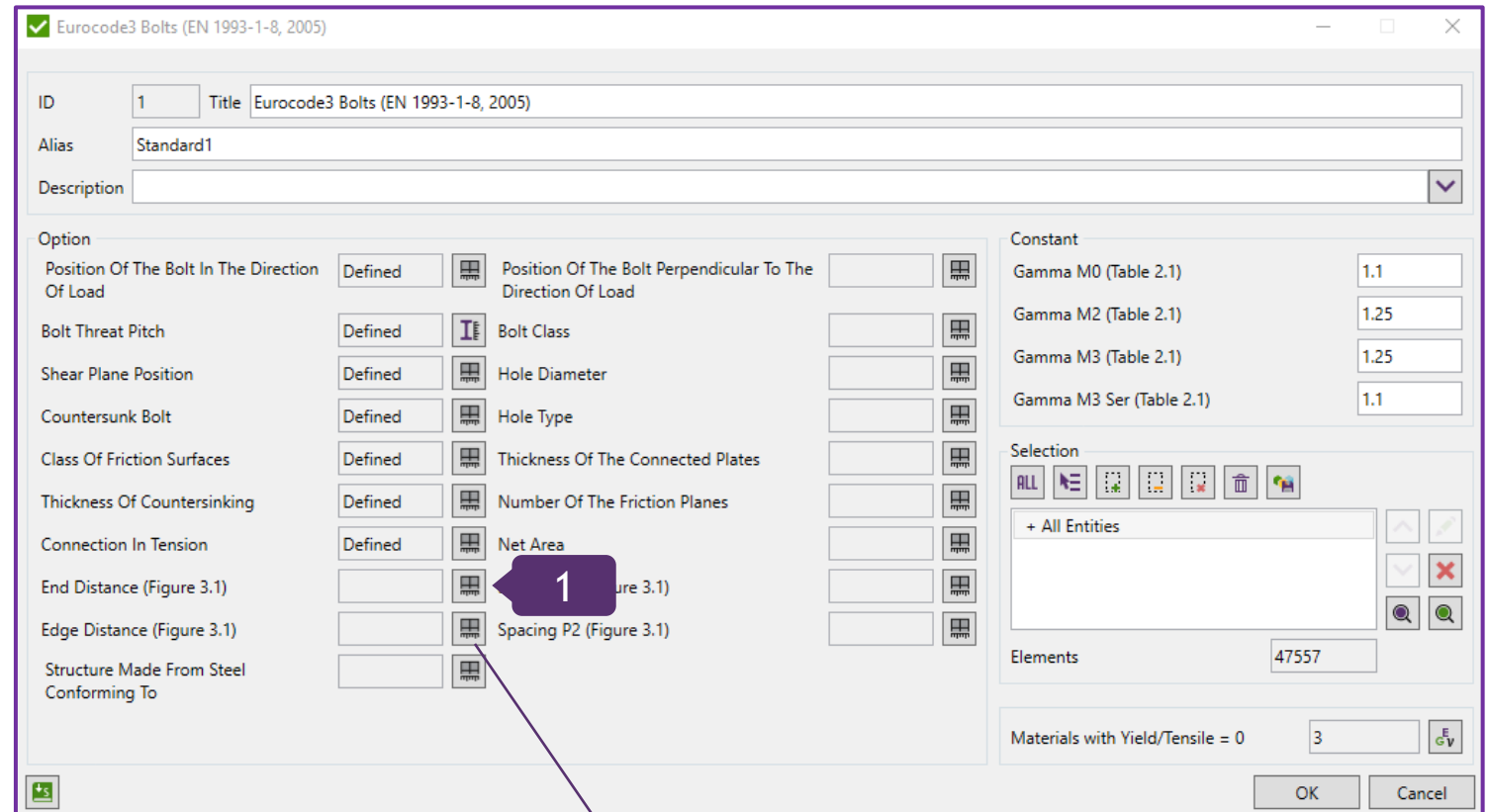
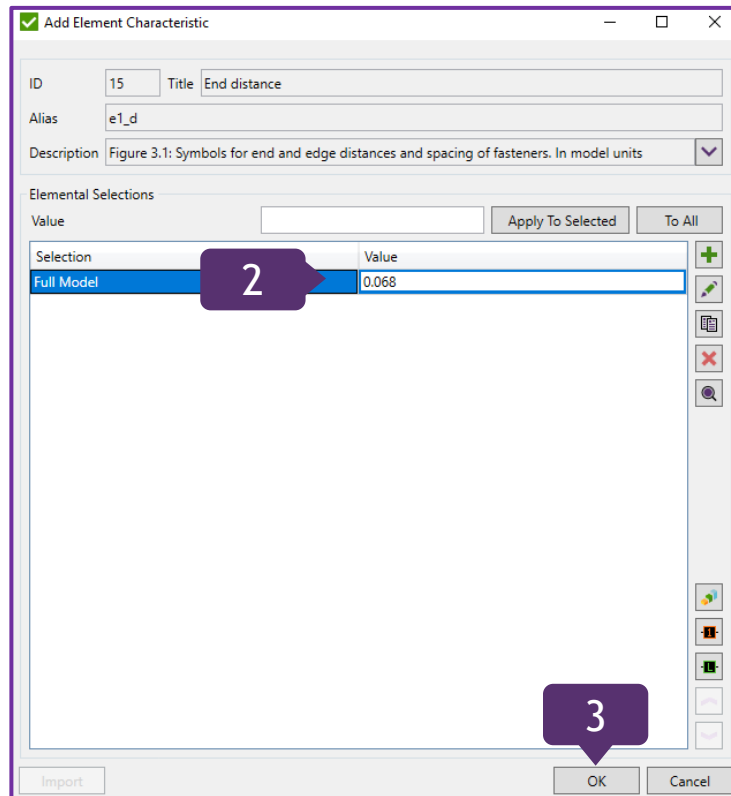
Figure 3.1: Symbols for end and edge distances and spacing of fasteners

# Define End Distance (Figure 3.1)

1 Press  in End Distance (Figure 3.1)

2 Selection Value: 0.068 and press *To All*

3 Press *OK*



The identical step with the same Value may be carried out for Edge Distance (Figure 3.1) Option to define it.

# Define Structure Made From Steel Conforming To

1

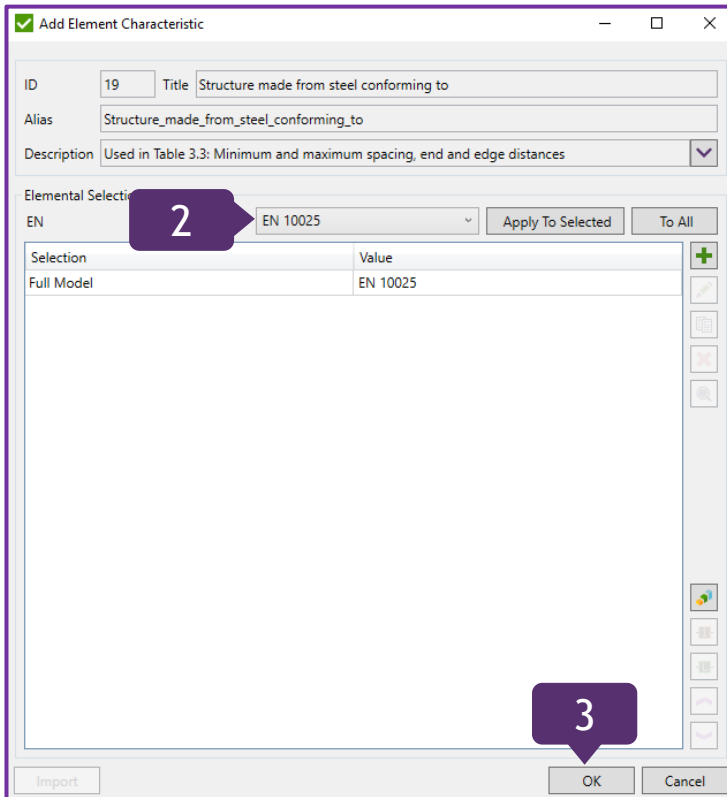
Press  in Structure Made From Steel Conforming To

2

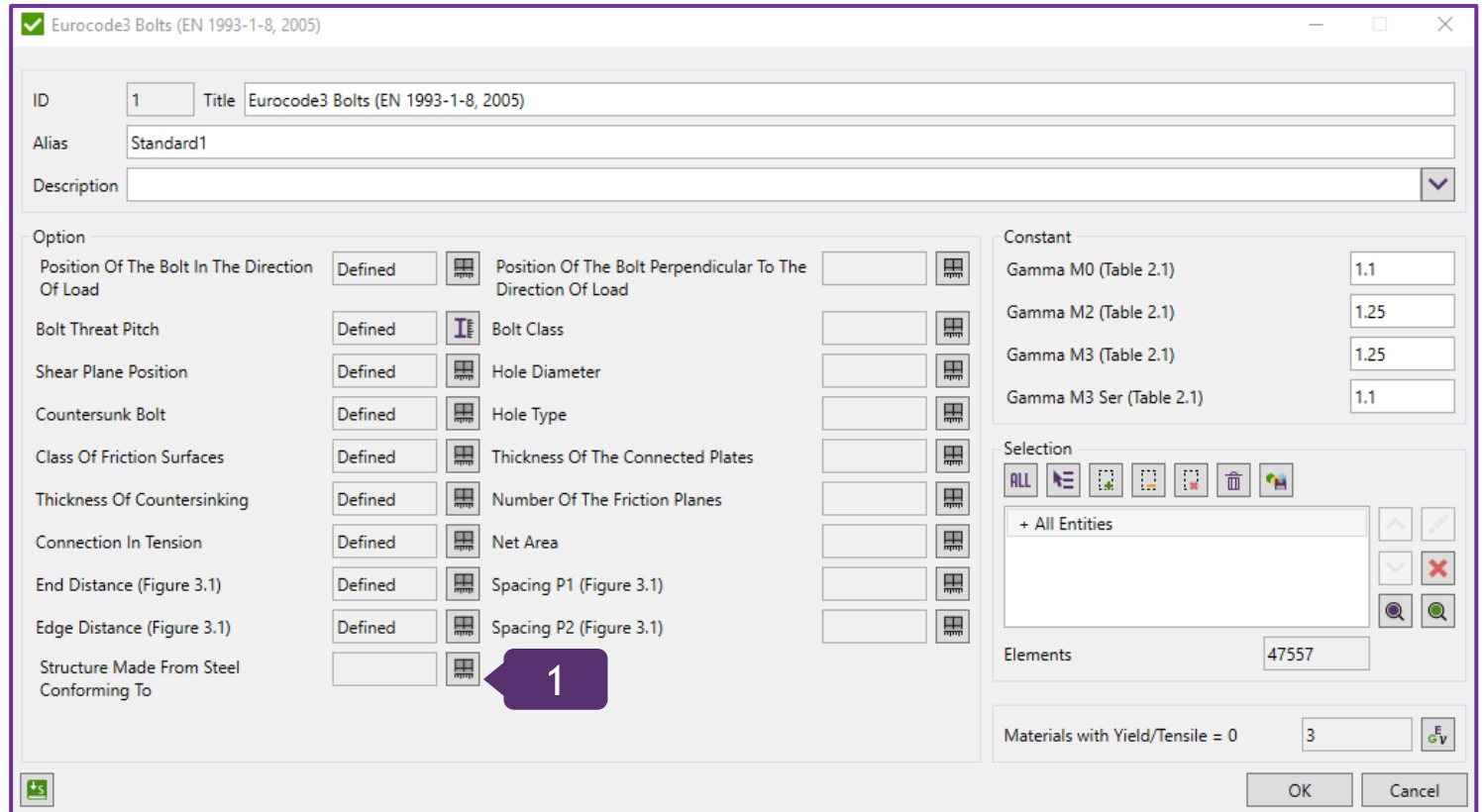
Elemental Selections EN: *EN 10025*

3

Press *OK*



Selection	Value
Full Model	EN 10025



Option	Defined	Icon	Value
Position Of The Bolt In The Direction Of Load	Defined		
Bolt Threat Pitch	Defined		
Shear Plane Position	Defined		
Countersunk Bolt	Defined		
Class Of Friction Surfaces	Defined		
Thickness Of Countersinking	Defined		
Connection In Tension	Defined		
End Distance (Figure 3.1)	Defined		
Edge Distance (Figure 3.1)	Defined		
Structure Made From Steel Conforming To			

Constant	Value
Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection
+ All Entities

Elements
47557

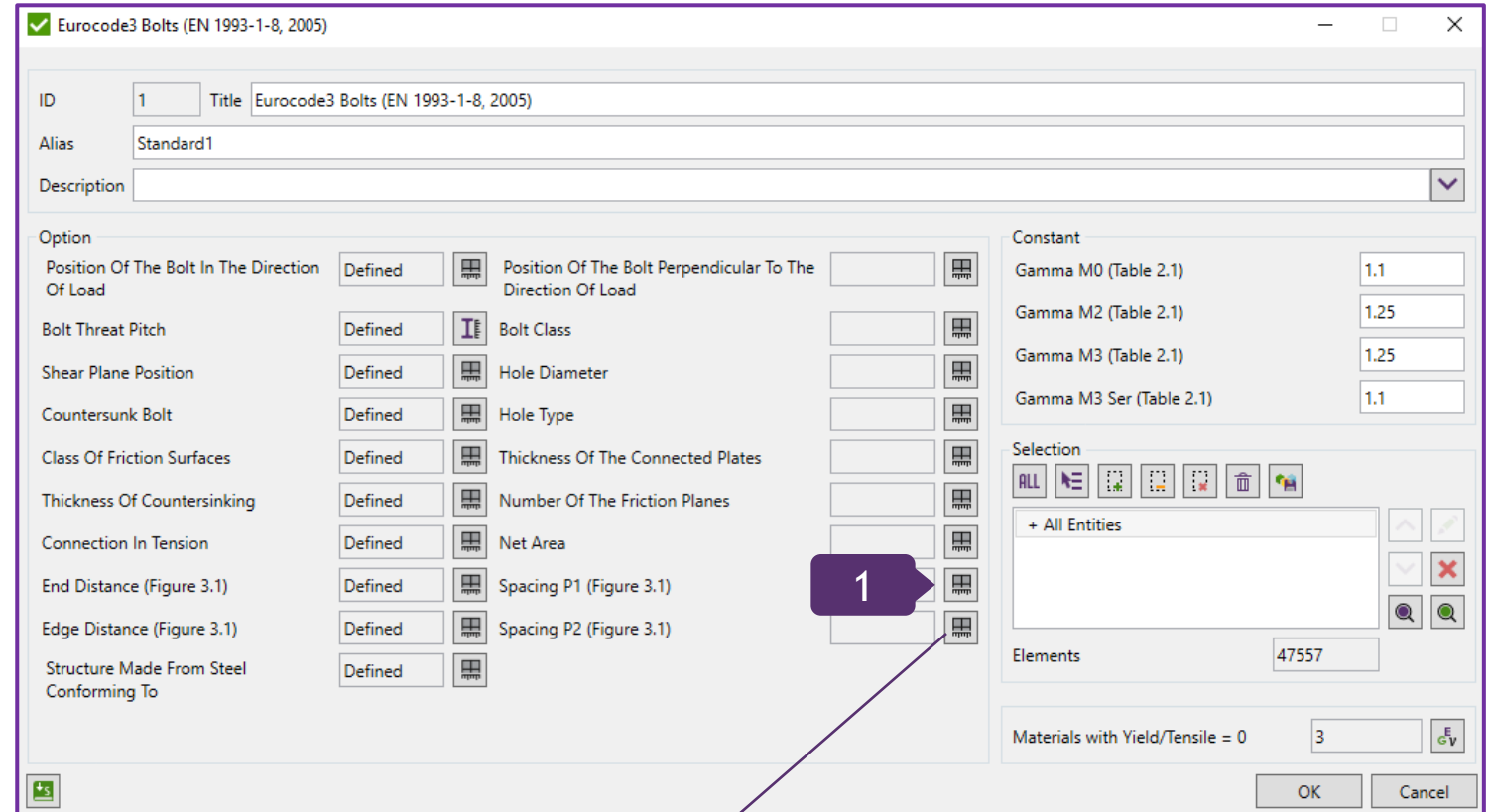
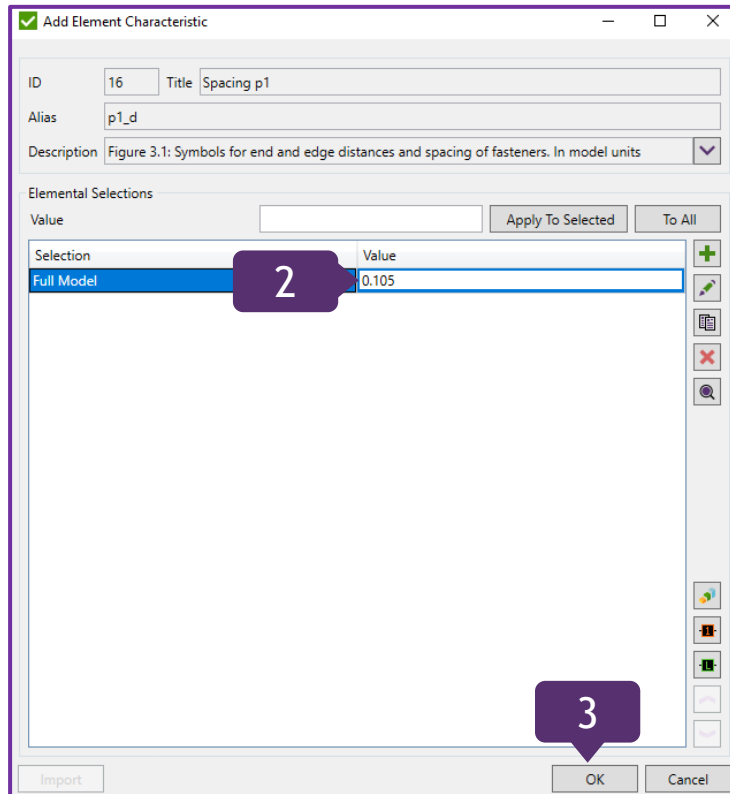


# Define Spacing P1 (Figure 3.1)

1 Press  in Spacing P1 (Figure 3.1)

2 Selection Value: 0.105

3 Press OK



The identical step with the same Value may be carried out for Spacing P2 (Figure 3.1) Option to define it.

# Define Position Of The Bolt Perpendicular To The Direction Of Load

1

Press  in Position Of The Bolt Perpendicular To The Direction Of Load

2

Elemental Selections pd: *Edge bolts*

3

Press **OK**

Position of the bolt perpendicular to the direction of load - bolts need to be defined as edge bolts or inner bolts in connection.

**Add Element Characteristic**

ID: 6 Title: Position of the bolt perpendicular to the direction of load

Alias: Position\_perpendicular\_to\_the\_direction\_of\_load

Description:

Elemental Selections pd: **2** Edge bolts

Selection	Value
Full Model	Edge bolts

**3** OK Cancel











**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Defined	Icon	Value
Position Of The Bolt In The Direction Of Load	Defined		<b>1</b> Position Of The Bolt Perpendicular To The Direction Of Load
Bolt Threat Pitch	Defined		Bolt Class
Shear Plane Position	Defined		Hole Diameter
Countersunk Bolt	Defined		Hole Type
Class Of Friction Surfaces	Defined		Thickness Of The Connected Plates
Thickness Of Countersinking	Defined		Number Of The Friction Planes
Connection In Tension	Defined		Net Area
End Distance (Figure 3.1)	Defined		Spacing P1 (Figure 3.1)
Edge Distance (Figure 3.1)	Defined		Spacing P2 (Figure 3.1)
Structure Made From Steel Conforming To	Defined		

Constant

Constant	Value
Gamma M2 (Table 2.1)	1.1
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel

# Define Bolt Class

1 Press  in Bolt Class

2 Elemental Selections bc: *Class 10\_9*

3 Press *OK*

**Table 3.1: Nominal values of the yield strength  $f_{yb}$  and the ultimate tensile strength  $f_{ub}$  for bolts**

Bolt class	4.6	4.8	5.6	5.8	6.8	8.8	10.9
$f_{yb}$ (N/mm <sup>2</sup> )	240	320	300	400	480	640	900
$f_{ub}$ (N/mm <sup>2</sup> )	400	400	500	500	600	800	1000

**Add Element Characteristic**

ID: 2 Title: Bolt class

Alias: bolt\_class

Description: Table 3.1

Elemental Selections

bc: Class 10\_9

Selection Value

Full Model Class 10\_9

OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Position Of The Bolt In The Direction Of Load: Defined

Bolt Threat Pitch: Defined

Shear Plane Position: Defined

Countersunk Bolt: Defined

Class Of Friction Surfaces: Defined

Thickness Of Countersinking: Defined

Connection In Tension: Defined

End Distance (Figure 3.1): Defined

Edge Distance (Figure 3.1): Defined

Structure Made From Steel Conforming To: Defined

Position Of The Bolt Perpendicular To The Direction Of Load: Defined

Bolt Class: 1

Hole Diameter: 1.25

Hole Type: 1.25

Thickness Of The Connected Plates: 1.1

Number Of The Friction Planes: 1.1

Net Area: 1.1

Spacing P1 (Figure 3.1): 1.1

Spacing P2 (Figure 3.1): 1.1

Constant

Gamma M0 (Table 2.1): 1.1

Gamma M2 (Table 2.1): 1.25

Gamma M3 Ser (Table 2.1): 1.25

Gamma M3 Ser (Table 2.1): 1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

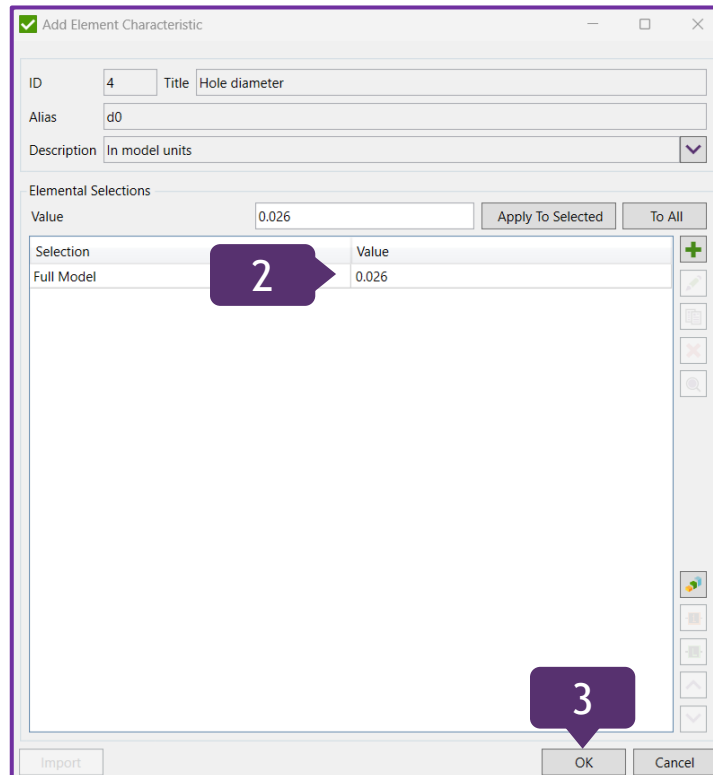
OK Cancel

# Define Hole Diameter

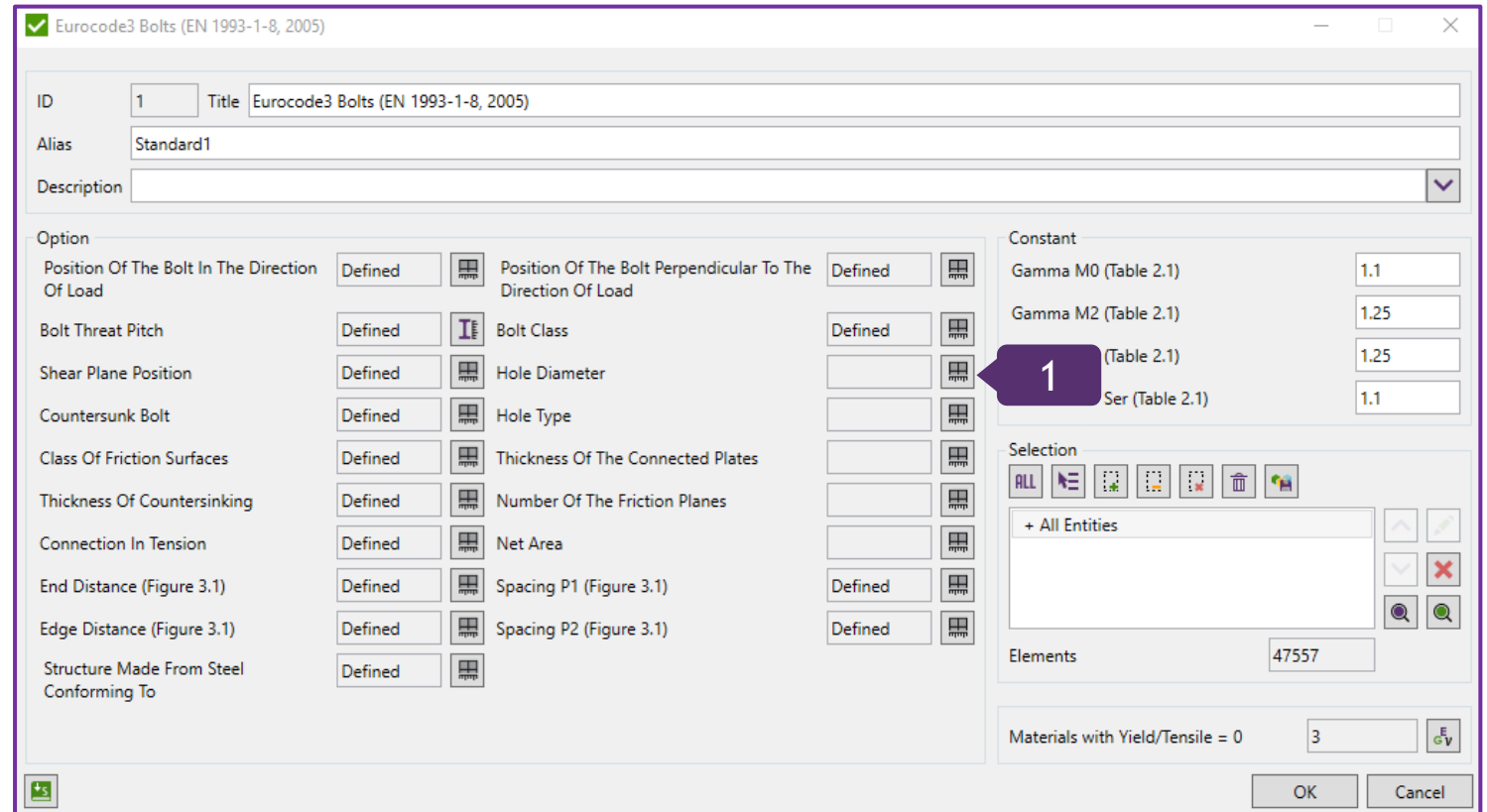
1 Press  in Hole Diameter

2 Selection Value: 0.026

3 Press OK



Hole diameter - to apply diameter of holes for each bolt type.



# Define Hole Type

1

Press  in Hole Type

2

Elemental Selections ht: Normal holes

3

Press OK

Hole type -  $k_s$  factor depends on hole type (Table 3.6).

Table 3.6: Values of  $k_s$

Description	$k_s$
Bolts in normal holes.	1,0
Bolts in either oversized holes or short slotted holes with the axis of the slot perpendicular to the direction of load transfer.	0,85
Bolts in long slotted holes with the axis of the slot perpendicular to the direction of load transfer.	0,7
Bolts in short slotted holes with the axis of the slot parallel to the direction of load transfer.	0,76
Bolts in long slotted holes with the axis of the slot parallel to the direction of load transfer.	0,63

**Add Element Characteristic**

ID: 8 Title: Hole type

Alias: Hole\_type

Description:

Elemental Selections

ht: Normal holes

Selection Value

Full Model Normal holes

Import OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Position Of The Bolt In The Direction Of Load: Defined

Bolt Threat Pitch: Defined

Shear Plane Position: Defined

Countersunk Bolt: Defined

Class Of Friction Surfaces: Defined

Thickness Of Countersinking: Defined

Connection In Tension: Defined

End Distance (Figure 3.1): Defined


Edge Distance (Figure 3.1): Defined

Structure Made From Steel Conforming To: Defined

Position Of The Bolt Perpendicular To The Direction Of Load: Defined

Bolt Class: Defined

Hole Diameter: Defined

Hole Type: 

Thickness Of The Connected Plates: Defined

Number Of The Friction Planes: Defined

Net Area: Defined

Spacing P1 (Figure 3.1): Defined

Spacing P2 (Figure 3.1): Defined

Constant

Gamma M0 (Table 2.1): 1.1

Gamma M2 (Table 2.1): 1.25

Gamma M3 (Table 2.1): 1.25

Gamma M3 Ser (Table 2.1): 1.1

Selection

ALL

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

OK Cancel

# Define Thickness Of The Connected Plates

1

Press  in Thickness Of The Connected Plates

2

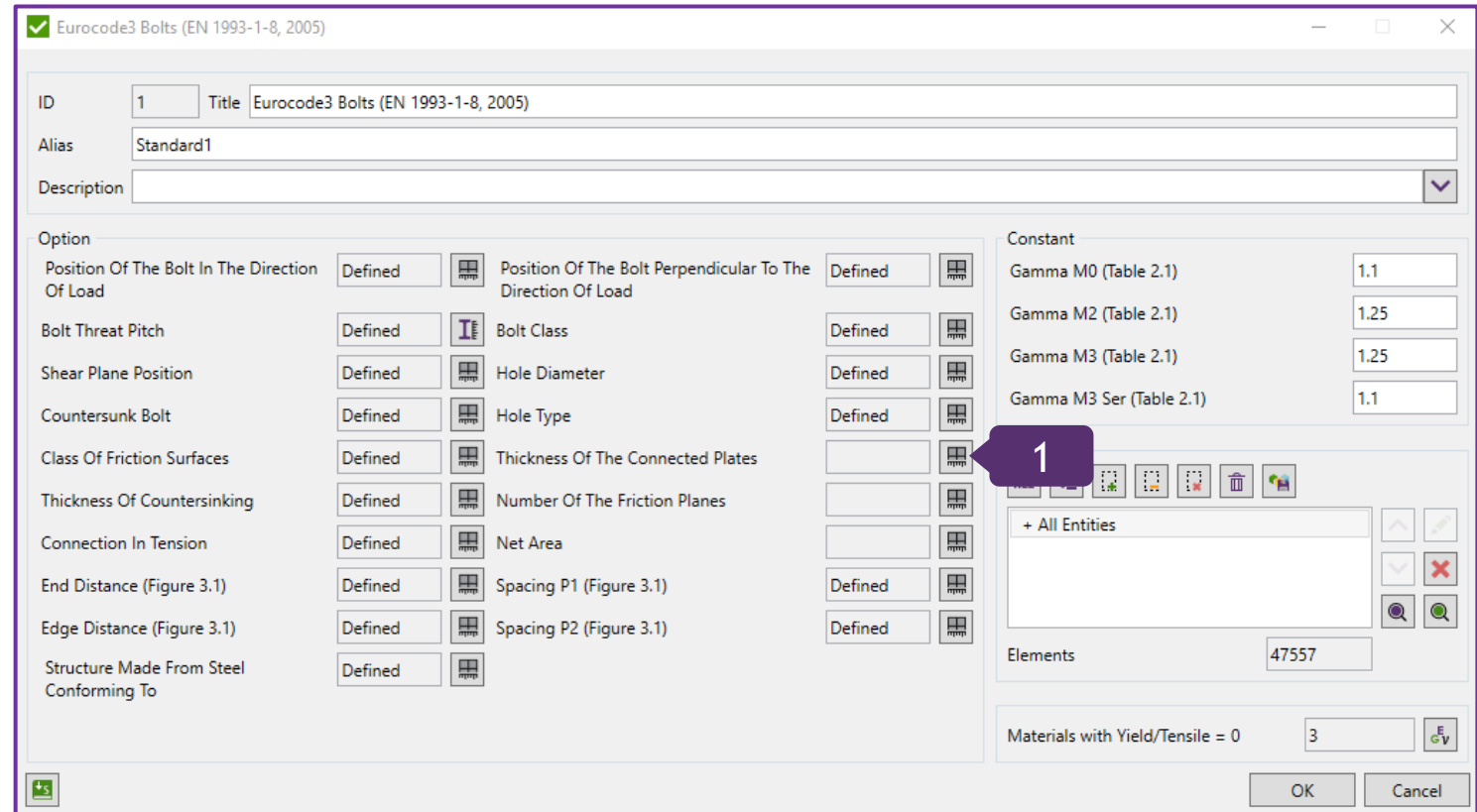
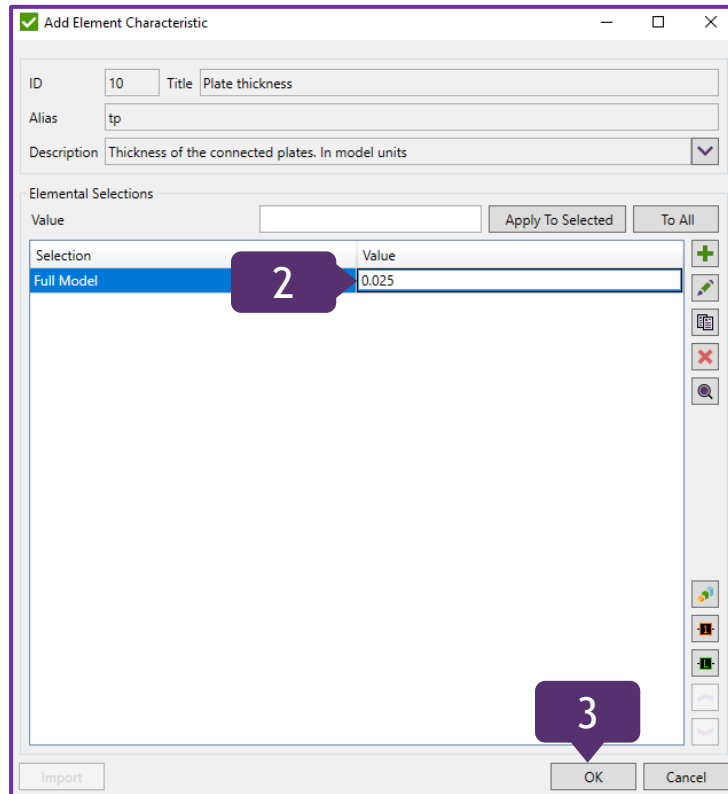
Selection Value: 0.025 (mm)

3

Press OK

All bolted plates in the connection have thickness of 25 mm, so this parameter can be applied to full model.

To run calculation correctly, this parameter needs to be applied as 25 mm (not 0 mm).



# Define Number Of The Friction Planes

1

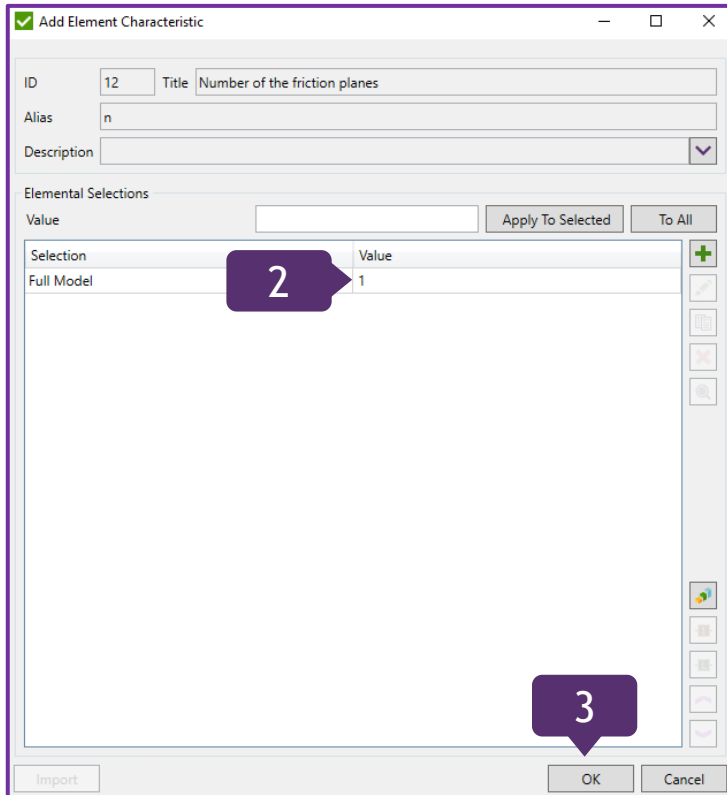
Press  in Number Of The Friction Planes

2

Selection Value: 1

3

Press OK



**Add Element Characteristic**

ID: 12 Title: Number of the friction planes

Alias: n

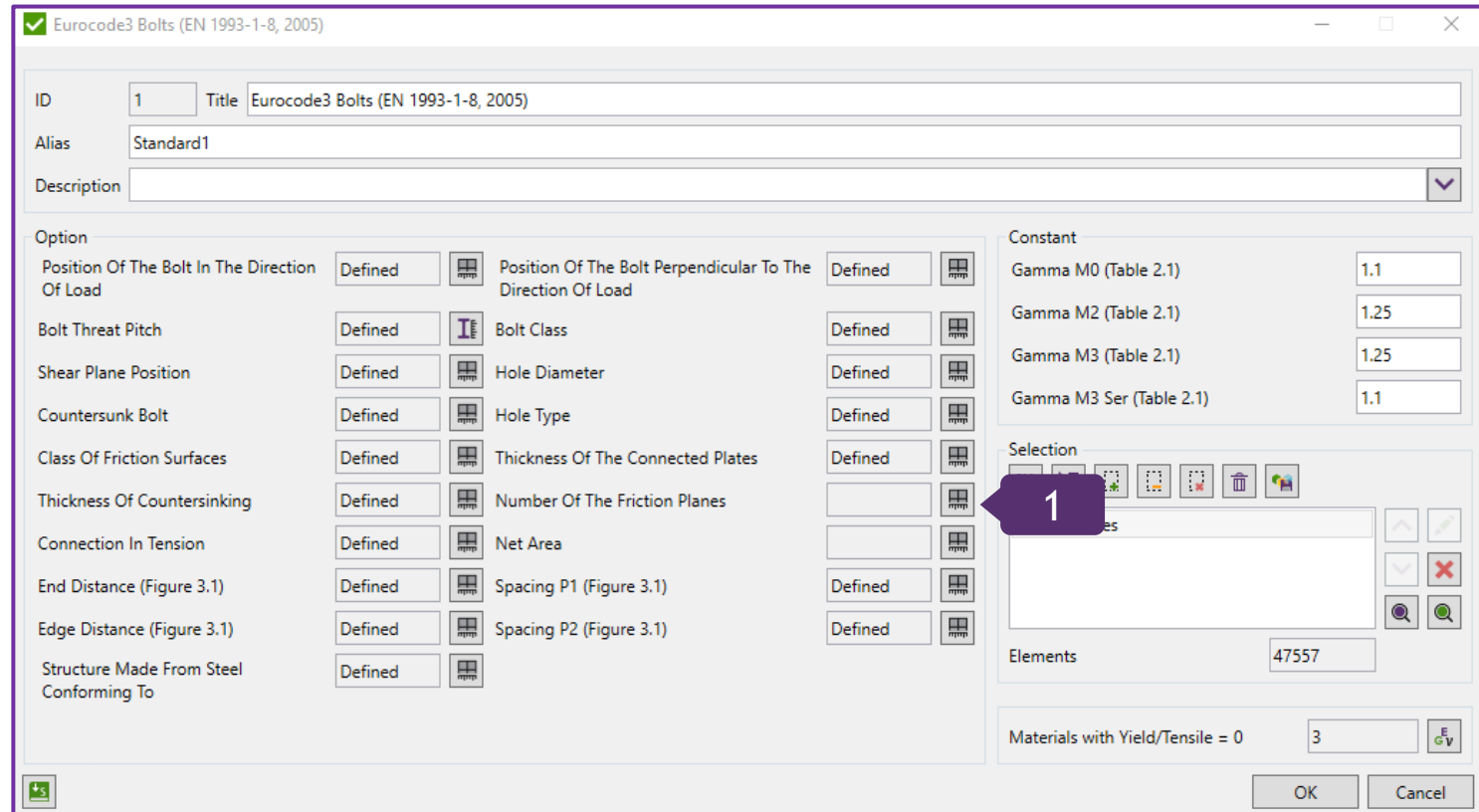
Description:

Elemental Selections

Selection	Value
Full Model	1

Buttons: Apply To Selected, To All, OK, Cancel

Number of the friction planes - each bolted connection in the model contains 2 plates, resulting in one plane of friction.



**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Value
Position Of The Bolt In The Direction Of Load	Defined
Bolt Threat Pitch	Defined
Shear Plane Position	Defined
Countersunk Bolt	Defined
Class Of Friction Surfaces	Defined
Thickness Of Countersinking	Defined
Connection In Tension	Defined
End Distance (Figure 3.1)	Defined
Edge Distance (Figure 3.1)	Defined
Structure Made From Steel Conforming To	Defined
Position Of The Bolt Perpendicular To The Direction Of Load	Defined
Bolt Class	Defined
Hole Diameter	Defined
Hole Type	Defined
Thickness Of The Connected Plates	Defined
Number Of The Friction Planes	Defined
Net Area	Defined
Spacing P1 (Figure 3.1)	Defined
Spacing P2 (Figure 3.1)	Defined

Constant

Constant	Value
Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

Elements: 47557

Materials with Yield/Tensile = 0: 3

Buttons: OK, Cancel

# Define Net Area

1 Press  in Net Area

2 Selection Value: 0

3 Press OK

Net area - plate cross section area used for tension verification.

**Add Element Characteristic**

ID: 14 Title: Net area

Alias: Anet

Description:

Elemental Selections

Selection	Value
Full Model	0

Apply To Selected To All

OK Cancel

**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Option	Defined	Option	Defined
Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load	Defined
Bolt Threat Pitch	Defined	Bolt Class	Defined
Shear Plane Position	Defined	Hole Diameter	Defined
Countersunk Bolt	Defined	Hole Type	Defined
Class Of Friction Surfaces	Defined	Thickness Of The Connected Plates	Defined
Thickness Of Countersinking	Defined	Number Of The Friction Planes	Defined
Connection In Tension	Defined	Net Area	Defined
End Distance (Figure 3.1)	Defined	Spacing P1 (Figure 3.1)	Defined
Edge Distance (Figure 3.1)	Defined	Spacing P2 (Figure 3.1)	Defined
Structure Made From Steel Conforming To	Defined		

Constant

Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

ALL

Elements: 47557

Materials with Yield/Tensile = 0 3

OK Cancel



GmM0 and - Resistance of members and cross-sections;  
GmM2 - Resistance of bolts, rivets, pins, weld and plates in bearing;  
GmM3 - Slip resistance at ultimate limit state (Category C);  
GmM3 Ser - Slip resistance at serviceability limit state (Category B);

**Table 2.1: Partial safety factors for joints**

Resistance of members and cross-sections	$\gamma_{M0}$ , $\gamma_{M1}$ and $\gamma_{M2}$ see EN 1993-1-1
Resistance of bolts	$\gamma_{M2}$
Resistance of rivets	
Resistance of pins	
Resistance of welds	
Resistance of plates in bearing	
Slip resistance - at ultimate limit state (Category C) - at serviceability limit state (Category B)	$\gamma_{M3}$ $\gamma_{M3,ser}$
Bearing resistance of an injection bolt	$\gamma_{M4}$
Resistance of joints in hollow section lattice girder	$\gamma_{M5}$
Resistance of pins at serviceability limit state	$\gamma_{M6,ser}$
Preload of high strength bolts	$\gamma_{M7}$
Resistance of concrete	$\gamma_c$ see EN 1992

**NOTE:** Numerical values for  $\gamma_M$  may be defined in the National Annex. Recommended values are as follows:  $\gamma_{M2} = 1,25$ ;  $\gamma_{M3} = 1,25$  and  $\gamma_{M3,ser} = 1,1$ ;  $\gamma_{M4} = 1,0$ ;  $\gamma_{M5} = 1,0$ ;  $\gamma_{M6,ser} = 1,0$ ;  $\gamma_{M7} = 1,1$ .

✓ Eurocode3 Bolts (EN 1993-1-8, 2005)

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load	Defined
Bolt Threat Pitch	Defined	Bolt Class	Defined
Shear Plane Position	Defined	Hole Diameter	Defined
Countersunk Bolt	Defined	Hole Type	Defined
Class Of Friction Surfaces	Defined	Thickness Of The Connected Plates	Defined
Thickness Of Countersinking	Defined	Number Of The Friction Planes	Defined
Connection In Tension	Defined	Net Area	Defined
End Distance (Figure 3.1)	Defined	Spacing P1 (Figure 3.1)	Defined
Edge Distance (Figure 3.1)	Defined	Spacing P2 (Figure 3.1)	Defined
Structure Made From Steel Conforming To	Defined		

Constant

Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

+ All Entities

Elements: 47557

Materials with Yield/Tensile = 0: 3

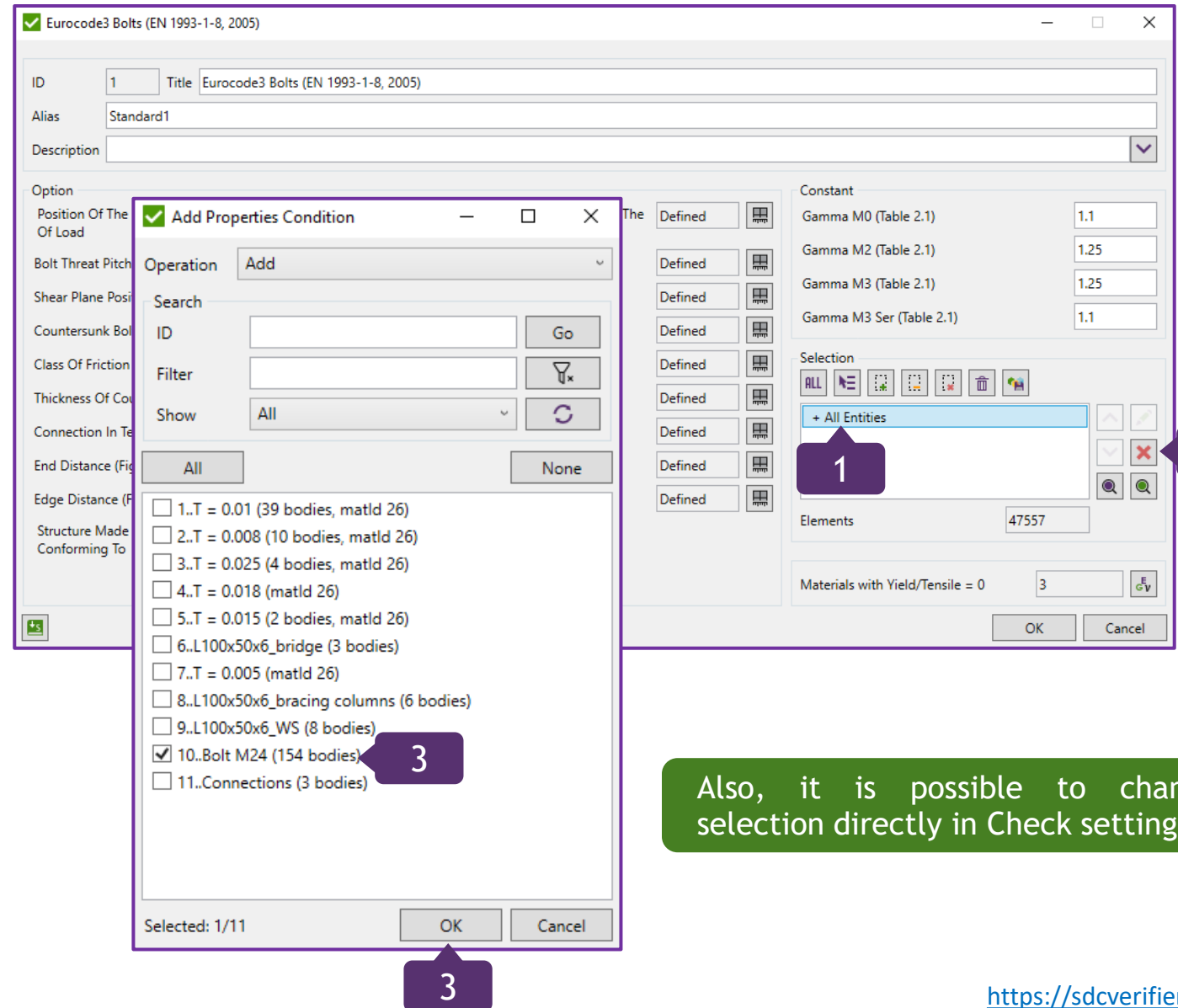
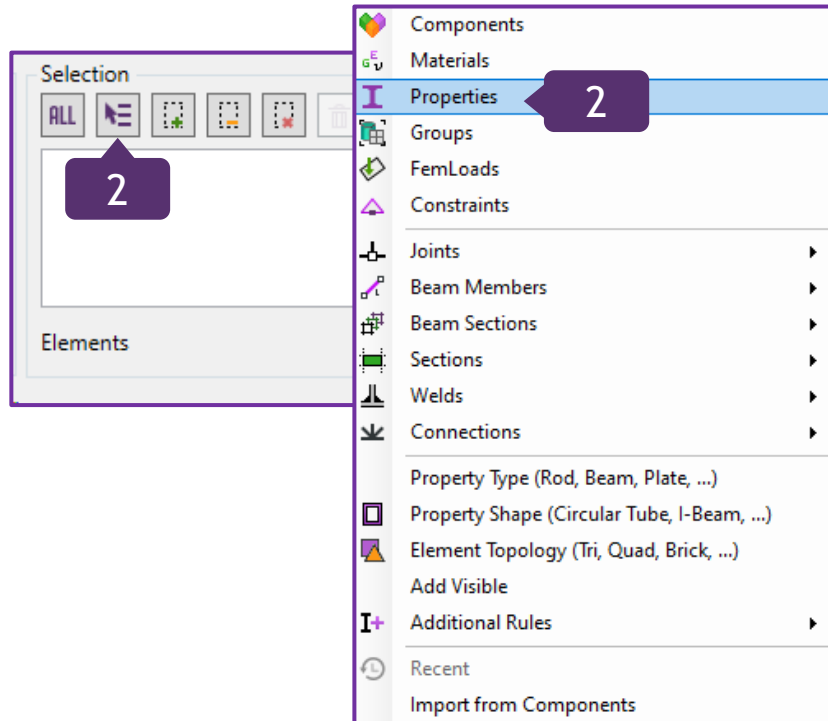
OK Cancel

# Change Selection

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

2 In Selection, press  and select **Properties**


3 Select **Property 10..Bolt M24 (154 bodies)** and press **OK**



Also, it is possible to change selection directly in Check settings.

# Define Material Characteristics

1

Press  to set the material yield stress and tensile strength

2

Select all Materials (Ctrl+A)

3

Tensile Strength:  $490e+6$

4

Yield Stress:  $355e+6$

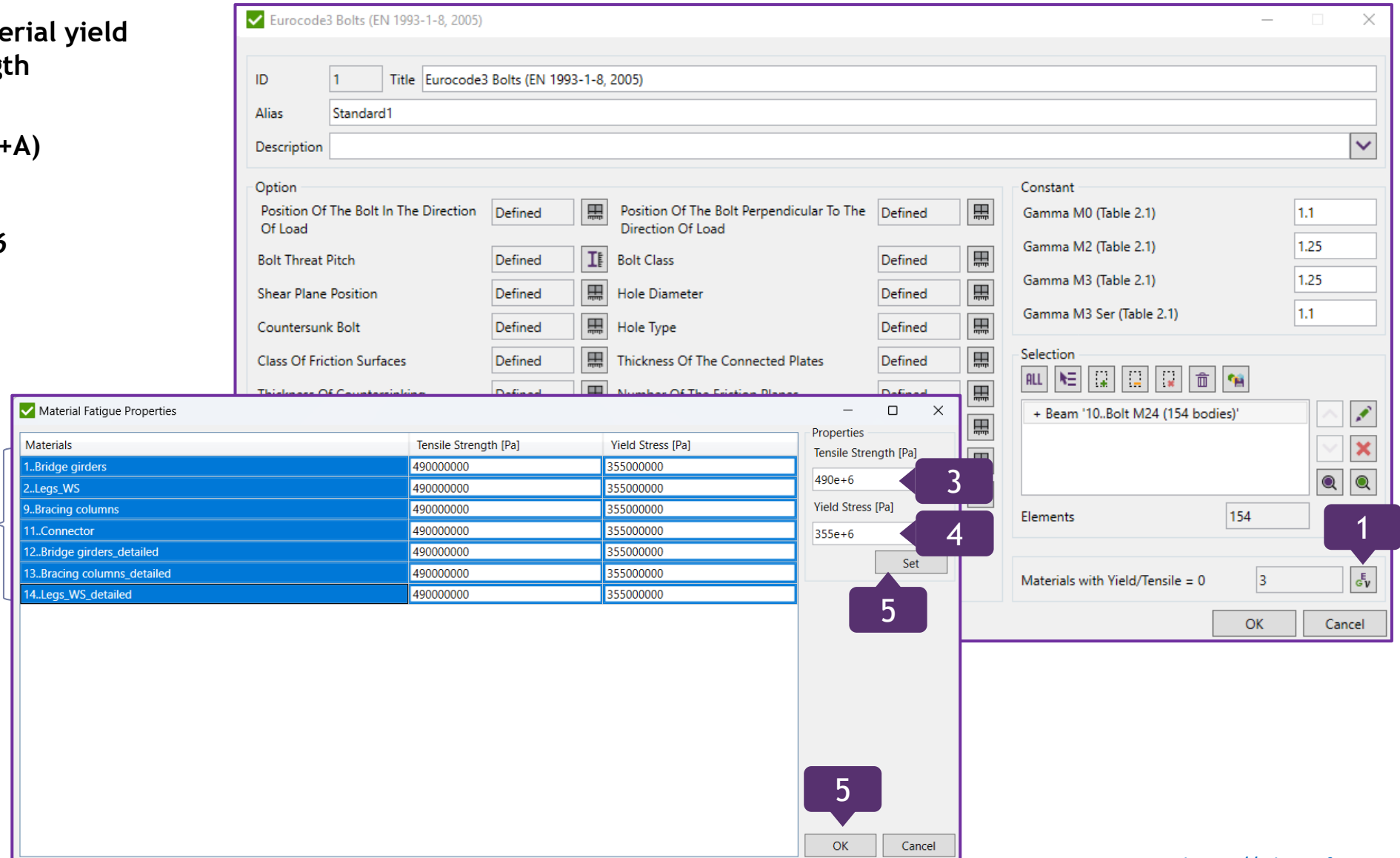
5

Press Set

6

Press OK

2



**Eurocode3 Bolts (EN 1993-1-8, 2005)**

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)  
Alias: Standard1  
Description:

Option

Position Of The Bolt In The Direction Of Load: Defined  
Position Of The Bolt Perpendicular To The Direction Of Load: Defined  
Bolt Threat Pitch: Defined  
Bolt Class: Defined  
Shear Plane Position: Defined  
Hole Diameter: Defined  
Countersunk Bolt: Defined  
Hole Type: Defined  
Class Of Friction Surfaces: Defined  
Thickness Of The Connected Plates: Defined  
Thickness Of Countersunk: Defined  
Number Of The Friction Planes: Defined

Constant

Gamma M0 (Table 2.1): 1.1  
Gamma M2 (Table 2.1): 1.25  
Gamma M3 (Table 2.1): 1.25  
Gamma M3 Ser (Table 2.1): 1.1

Selection

+ Beam '10..Bolt M24 (154 bodies)'

Elements: 154

Materials with Yield/Tensile = 0: 3

OK Cancel

**Material Fatigue Properties**

Materials	Tensile Strength [Pa]	Yield Stress [Pa]
1..Bridge girders	490000000	355000000
2..Legs_WS	490000000	355000000
9..Bracing columns	490000000	355000000
11..Connector	490000000	355000000
12..Bridge girders_detailed	490000000	355000000
13..Bracing columns_detailed	490000000	355000000
14..Legs_WS_detailed	490000000	355000000

Properties

Tensile Strength [Pa]: 490e+6  
Yield Stress [Pa]: 355e+6  
Set  
OK Cancel

# Add the Standard

1

Press OK

✓ Custom Check (built-in, not editable)

ID: 1 Title: Bolt joint parameters and coefficients

Alias: Bolts\_joint\_parameters\_coefficients

Description:

☒ Show Parameter Description

Options

☐ Calculate Results over Directions

☐ Calculate Results over Points

Load Calculation:

Selection: Beam '10..Bolt M24 (154 bodies)'

Parameters (19) / Replacements (0)

Parameter = d (Bolt diameter)  
 $R * 2$

Parameter = d1 (Bolt head or nut diameter across the point)  
 $d * 1.8$

Parameter = d2 (Bolt head or nut diameter across flats)  
 $d * 1.6$

Parameter = dm (dm)  
 $\text{MIN}(d1, d2)$

Parameter = tu (Plate thickness updated)  
Description: For countersunk bolt: - the bearing resistance  $F_{bRd}$  should be based on a thickness  $t$  equal to the thickness of the connected plate minus half the depth of the countersinking.  
 $\text{if}(tc = 0, tp, tp - tc/2)$

Parameter = fyb (Nominal yield strength of the bolt)  
Description: Table 3.1: Nominal values of the yield strength (fyb) and the ultimate tensile

Clear results OK Cancel

✓ Eurocode3 Bolts (EN 1993-1-8, 2005)

ID: 1 Title: Eurocode3 Bolts (EN 1993-1-8, 2005)

Alias: Standard1

Description:

Option

Position Of The Bolt In The Direction Of Load	Defined	Position Of The Bolt Perpendicular To The Direction Of Load	Defined
Bolt Threat Pitch	Defined	Bolt Class	Defined
Shear Plane Position	Defined	Hole Diameter	Defined
Countersunk Bolt	Defined	Hole Type	Defined
Class Of Friction Surfaces	Defined	Thickness Of The Connected Plates	Defined
Thickness Of Countersinking	Defined	Number Of The Friction Planes	Defined
Connection In Tension	Defined	Net Area	Defined
End Distance (Figure 3.1)	Defined	Spacing P1 (Figure 3.1)	Defined
Edge Distance (Figure 3.1)	Defined	Spacing P2 (Figure 3.1)	Defined
Structure Made From Steel Conforming To	Defined		

Constant

Gamma M0 (Table 2.1)	1.1
Gamma M2 (Table 2.1)	1.25
Gamma M3 (Table 2.1)	1.25
Gamma M3 Ser (Table 2.1)	1.1

Selection

ALL

+ Beam '10..Bolt M24 (154 bodies)'


Elements: 154

Materials with Yield/Tensile = 0: 3

OK Cancel

# Create Extreme Table

1

Execute  **Table (expand/extreme)** in Standards => Checks => 6..Category C and E context menu

2

In Load Group, press 

3

Select **Load Group**, 1..Overall and press **OK**

4

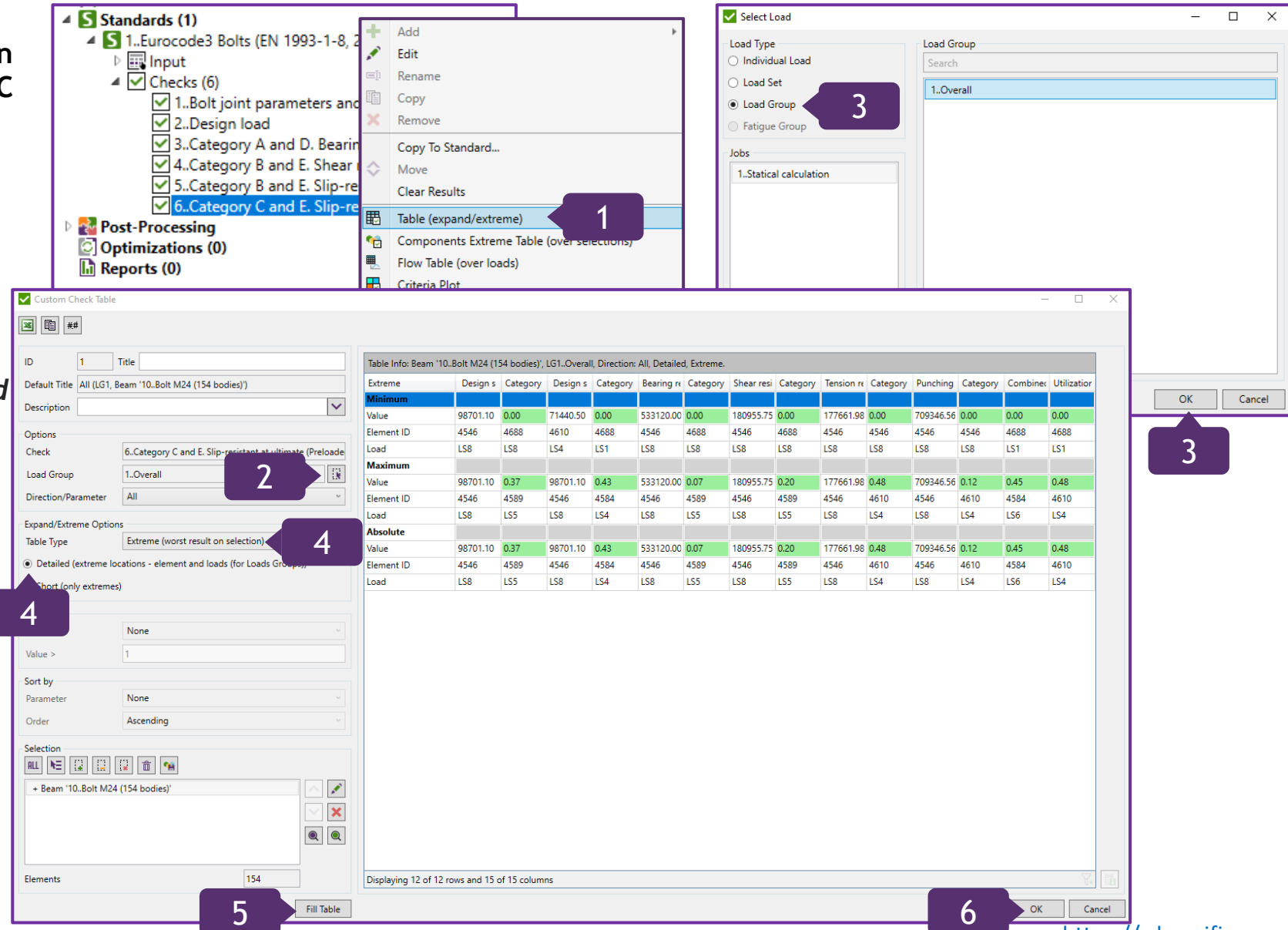
Table Type: **Extreme; Detailed (extreme locations-element and load (for Load Groups))** - ON

5

Press **Fill Table**

6

Press **OK**



**Standards (1)**

- 1..Eurocode3 Bolts (EN 1993-1-8, 2)
  - Input
    - Checks (6)
      - 1..Bolt joint parameters and
      - 2..Design load
      - 3..Category A and D. Bearing
      - 4..Category B and E. Shear
      - 5..Category B and E. Slip-re
      - 6..Category C and E. Slip-re
  - Post-Processing
  - Optimizations (0)
  - Reports (0)

**Context Menu:**

- Add
- Edit
- Rename
- Copy
- Remove
- Copy To Standard...
- Move
- Clear Results
- Table (expand/extreme)** (1)
- Components Extreme Table (over selections)
- Flow Table (over loads)
- Criteria Plot

**Select Load Dialog:**

Load Type

- ☐ Individual Load
- ☐ Load Set
- ☒ Load Group (3)
- ☐ Fatigue Group

Load Group

Search

1..Overall

Jobs

1..Static calculation

OK Cancel

**Custom Check Table Dialog:**

ID: 1 Title:

Default Title: All (LG1, Beam '10..Bolt M24 (154 bodies)')

Description:

Options

Check: 6..Category C and E. Slip-resistant at ultimate (Preload)

Load Group: 1..Overall (2)

Direction/Parameter: All

Expand/Extreme Options

Table Type: Extreme (worst result on selection) (4)

☒ Detailed (extreme locations - element and loads (for Load Groups))

☐ Short (only extremes)

Value >: 1

Sort by: Parameter

Order: Ascending

Selection

+ Beam '10..Bolt M24 (154 bodies)'

Elements: 154

Fill Table (5)

OK Cancel (6)

**Table Info:** Beam '10..Bolt M24 (154 bodies)', LG1..Overall, Direction: All, Detailed, Extreme.

Extreme	Design s	Category	Design s	Category	Bearing r	Category	Shear resi	Category	Tension r	Category	Punching	Category	Combiner	Utilization
<b>Minimum</b>														
Value	98701.10	0.00	71440.50	0.00	533120.00	0.00	180955.75	0.00	177661.98	0.00	709346.56	0.00	0.00	0.00
Element ID	4546	4688	4610	4688	4546	4688	4546	4688	4546	4546	4546	4688	4688	
Load	LS8	LS8	LS4	LS1	LS8	LS8	LS8	LS8	LS8	LS8	LS8	LS1	LS1	
<b>Maximum</b>														
Value	98701.10	0.37	98701.10	0.43	533120.00	0.07	180955.75	0.20	177661.98	0.48	709346.56	0.12	0.45	0.48
Element ID	4546	4589	4546	4584	4546	4589	4546	4589	4546	4610	4546	4610	4584	4610
Load	LS8	LS5	LS8	LS4	LS8	LS5	LS8	LS5	LS8	LS4	LS8	LS4	LS6	LS4
<b>Absolute</b>														
Value	98701.10	0.37	98701.10	0.43	533120.00	0.07	180955.75	0.20	177661.98	0.48	709346.56	0.12	0.45	0.48
Element ID	4546	4589	4546	4584	4546	4589	4546	4589	4546	4610	4546	4610	4584	4610
Load	LS8	LS5	LS8	LS4	LS8	LS5	LS8	LS5	LS8	LS4	LS8	LS4	LS6	LS4

Displaying 12 of 12 rows and 15 of 15 columns

# Utilization Factor Plot

1

In Standards, Checks => 6..Category C and E, execute *Criteria Plot*

2

In Load Group, press 

3

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

4

Parameter: *Utilization factor overall*

5

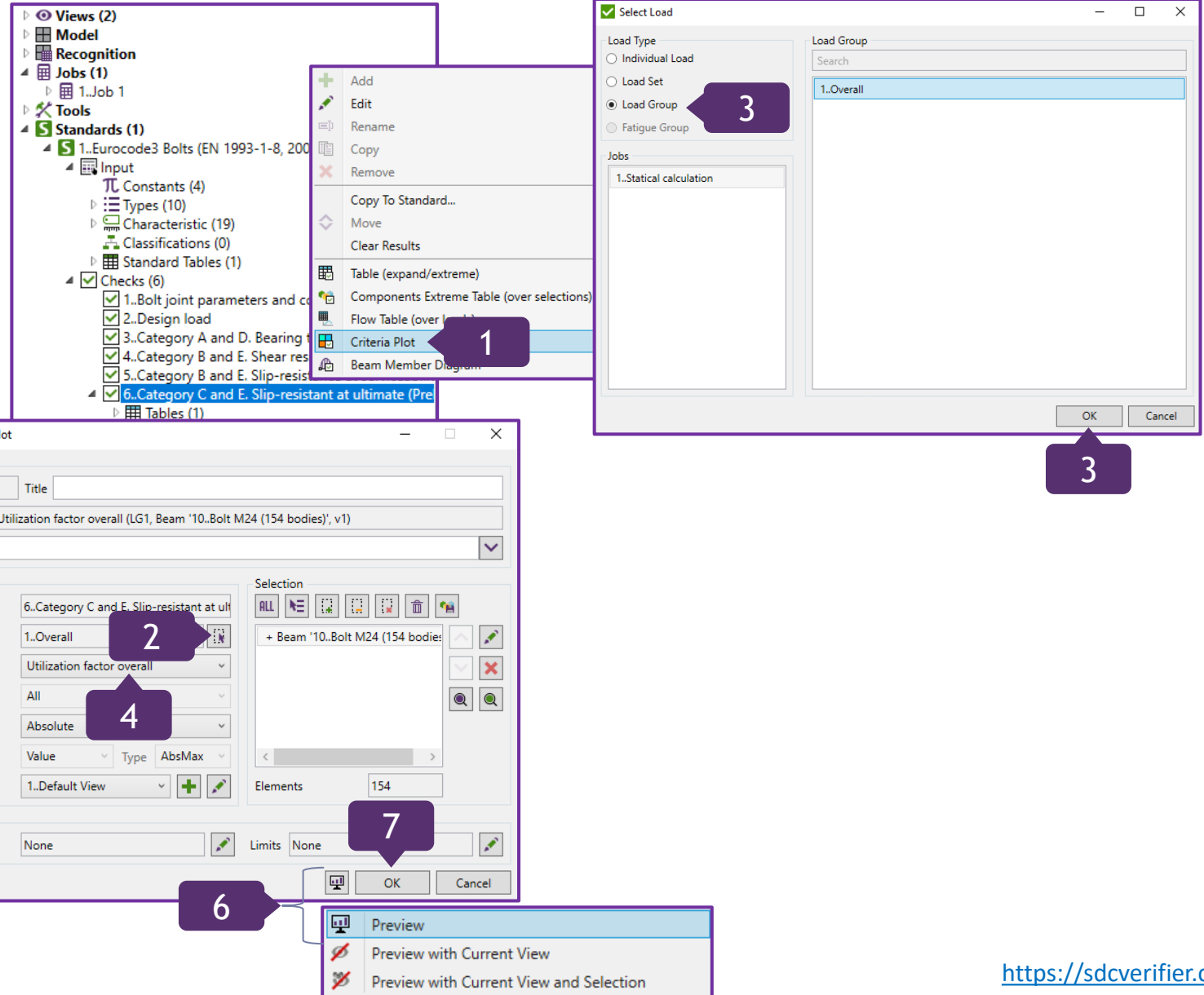
LG Parameter: Absolute

6

Press , and then *Preview*

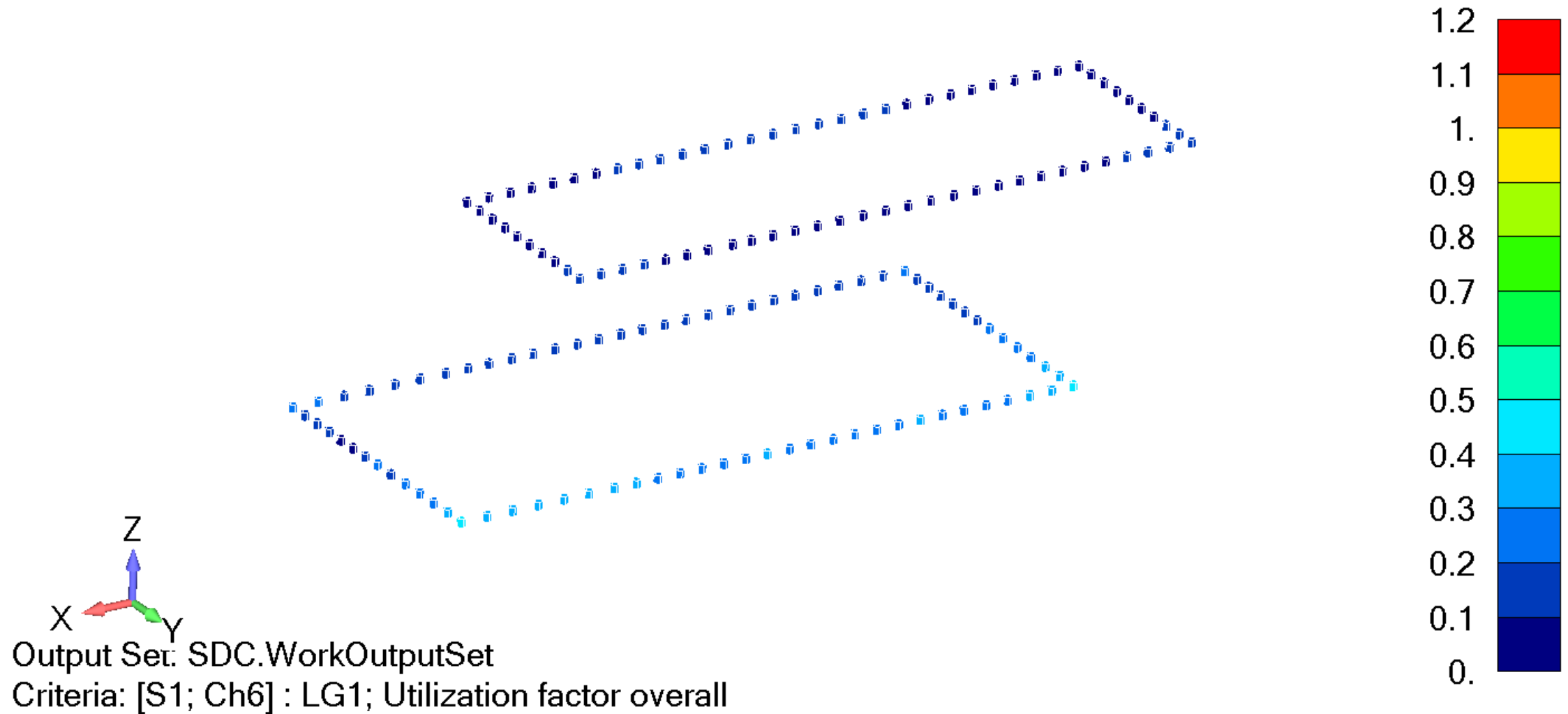
7

Press *OK*



The screenshot illustrates the steps to create a Utilization Factor Plot in SDC Verifier:

- Step 1:** In the tree view, navigate to **Standards (1)** > **1..Eurocode3 Bolts (EN 1993-1-8, 200)** > **Checks (6)** > **6..Category C and E. Slip-resistant at ultimate (Pre)**. Right-click and select **Criteria Plot**.
- Step 2:** In the **Select Load** dialog, select **Load Group** and choose **1..Overall** from the **Load Group** list. Press **OK**.
- Step 3:** In the **Check Criteria Plot** dialog, set the following options:
  - Check:** 6..Category C and E. Slip-resistant at ultimate
  - Load Group:** 1..Overall
  - Parameter:** Utilization factor overall
  - Direction:** All
  - LG Parameter:** Absolute
  - Point of Interest:** Value
  - Type:** AbsMax
  - View:** 1..Default View
  - Labels:** None
  - Limits:** None
- Step 4:** Press the **Preview** button (represented by a monitor icon).
- Step 5:** In the **Preview** menu, select **Preview**.



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/>