

# **GeniE User Manual**

## **Code checking of beams**

### **Implementation of NORSOK N-004 rev.2, 2004**

## **Table of Contents**

<b>1. IMPLEMENTATION OF NORSOK N-004.....</b>	<b>2</b>
1.1 REVISIONS SUPPORTED .....	2
1.2 MEMBER AND CONE DESIGN CHECK – NORSOK N004 .....	4
1.3 TUBULAR JOINT DESIGN CODE CHECK – NORSOK N004.....	9
1.4 CROSS SECTION PROPERTIES FOR MANUALLY UPDATED PROFILES .....	11
1.5 NOMENCLATURE – NORSOK N004 .....	12
1.5.1 <i>Member check</i> .....	12
1.5.2 <i>Cone check</i> .....	14
1.5.3 <i>Tubular joint check</i> .....	16

## 1. IMPLEMENTATION OF NORSOK N-004

The implementation of Norsok N-004 is according to:

**NORSOK STANDARD N-004, Rev. 2, October 2004, Design of steel structures**

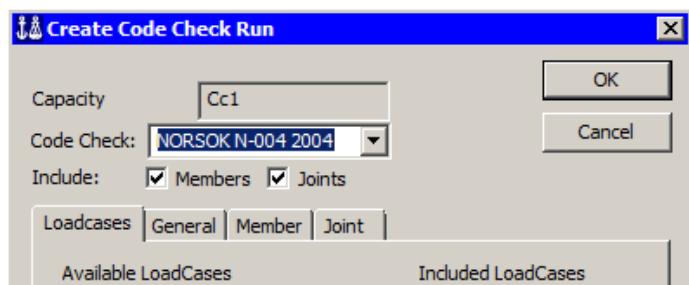
### 1.1 Revisions supported

The implementation is according to the revision 2 from October 2004

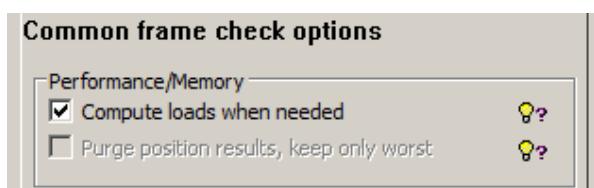
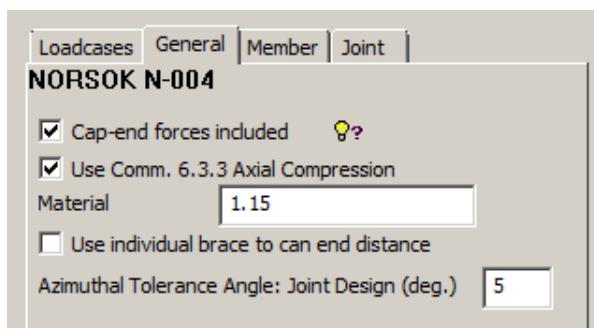
The check covers capacity check of tubular members, tubular joints and conical transitions according to chapter 6.3 “Tubular members”, chapter 6.4 “Tubular joints” and chapter 6.5 “Strength of conical transitions”.

Note that this code check includes EUROCODE 3 EN 1993-1-1 2005 for non-tubular members.

Select NORSOK from the Create Code Check Run dialog



Define the global parameters



## Options:

Cap-end forces included	Cap-end forced included corresponds to Method B, i.e. the calculated axial stress includes the effect of the hydrostatic capped-end forces. This corresponds to an analysis where Wajac has been used. (If not selected, Method A is used)
Use Comm. 6.3.3 Axial Compression	The method described in the commentary part “Comm. 6.3.3. Axial compression” is used, i.e. equations (12.1) and (12.2) are taken into account.
Material factor	When the user gives a value different from 1.15 the given value is used as-is. When 1.15 is input the material factor is calculated according to section 6.3.7 “Material factor”
Individual brace to can end distance	In previous versions only the minimum distance from brace to can end was used. GeniE’s new option allows choose between joint’s minimum or individual brace to can end distance. Ref. N-004 Figure 6-7.
Tolerance Angle	User can define azimuthal tolerance angle for joint design. Previous versions used 5 degrees as default value. This provides the possibility to define different sets of braces to be used on Joint Punch Check Analysis. The subdivision in Y-, K- and X- joint axial force patterns normally considers all members in one plane at a joint. Brace planes within ( $\pm\alpha^\circ$ ) of each other may be considered as being in the same plane.
Compute loads when needed	<ul style="list-style-type: none"> <li>• To reduce use of database memory, you can compute temporary loads (during code check execution). These loads will be deleted immediately when no longer needed.</li> <li>• This option can affect performance on redesign, as loads must be recalculated locally every time you change member/joint settings.</li> <li>• With this option checked, you will always use the latest FEM loads. When unchecked, you will use the FEM loads retrieved the last time you used “Generate Code Check Loads”.</li> <li>• Note that with option checked member loads will not be available in the report nor in object properties.</li> </ul>
Purge position results, keep only worst	<i>No longer supported</i>

## 1.2 Member and cone design check – NORSO<sub>K</sub> N004

The member and cone design code check is performed according to the chapters and sections referred to in the table below:

	Design consideration	Sections covered
6.3	Tubular members	<p><b>6.3.1</b> General</p> <p><b>6.3.2</b> Axial tension</p> <p><b>6.3.3</b> Axial compression</p> <p><b>6.3.4</b> Bending</p> <p><b>6.3.5</b> Shear</p> <p><b>6.3.6</b> Hydrostatic pressure</p> <p>6.3.6.1 Hoop buckling</p> <p><b>6.3.7</b> Material factor</p> <p><b>6.3.8</b> Tubular members subjected to combined loads without hydrostatic pressure</p> <p>6.3.8.1 Axial tension and bending</p> <p>6.3.8.2 Axial compression and bending <sup>1)</sup></p> <p>6.3.8.3 Interaction shear and bending moment</p> <p>6.3.8.4 Interaction shear, bending moment and torsional moment</p> <p><b>6.3.9</b> Tubular members subjected to combined loads with hydrostatic pressure</p> <p>6.3.9.1 Axial tension, bending, and hydrostatic pressure</p> <ul style="list-style-type: none"> <li>- Method A</li> <li>- Method B</li> </ul> <p>6.3.9.2 Axial compression, bending, and hydrostatic pressure</p> <ul style="list-style-type: none"> <li>- Method A</li> <li>- Method B</li> </ul>

6.5	Strength of conical Transitions <sup>2)</sup>	<p><b>6.5.1 General</b></p> <p><b>6.5.2 Design stresses</b></p> <ul style="list-style-type: none"> <li>6.5.2.1 Equivalent design axial stress in the cone section</li> <li>6.5.2.2 Local bending stress at unstiffened junctions</li> <li>6.5.2.3 Hoop stress at unstiffened junctions</li> </ul> <p><b>6.5.3 Strength requirements without external hydrostatic pressure</b></p> <ul style="list-style-type: none"> <li>6.5.3.1 Local buckling under axial compression</li> <li>6.5.3.2 Junction yielding</li> <li>6.5.3.3 Junction buckling</li> </ul> <p><b>6.5.4 Strength requirements with external hydrostatic pressure</b></p> <ul style="list-style-type: none"> <li>6.5.4.1 Hoop buckling</li> <li>6.5.4.2 Junction yielding and buckling</li> </ul>

Note 1) to 6.3.8.2:

Reference is made to Table 6-2 with respect to selecting the moment reduction factor Cm. When selecting moment reduction factor option “Norsok B or C” the following criteria is used to determine if the beam is exposed to transverse loading or not:

1. Calculate bending moment at midspan (point closest to midspan from check positions investigated) based on moment at start and end of beam, i.e. a linear distribution “Mlin”
2. Calculate difference “Δmom” between acting moment and “Mlin”
3. If “Δmom” is less than 1% of acting moment at the investigated point a linear distribution is assumed, i.e. no transverse loading

Note 2) to 6.5:

Note that the formulas given for conical transitions in axial compression and bending are also used for axial tension and that the checks are always performed both for positive and negative resulting bending stress.

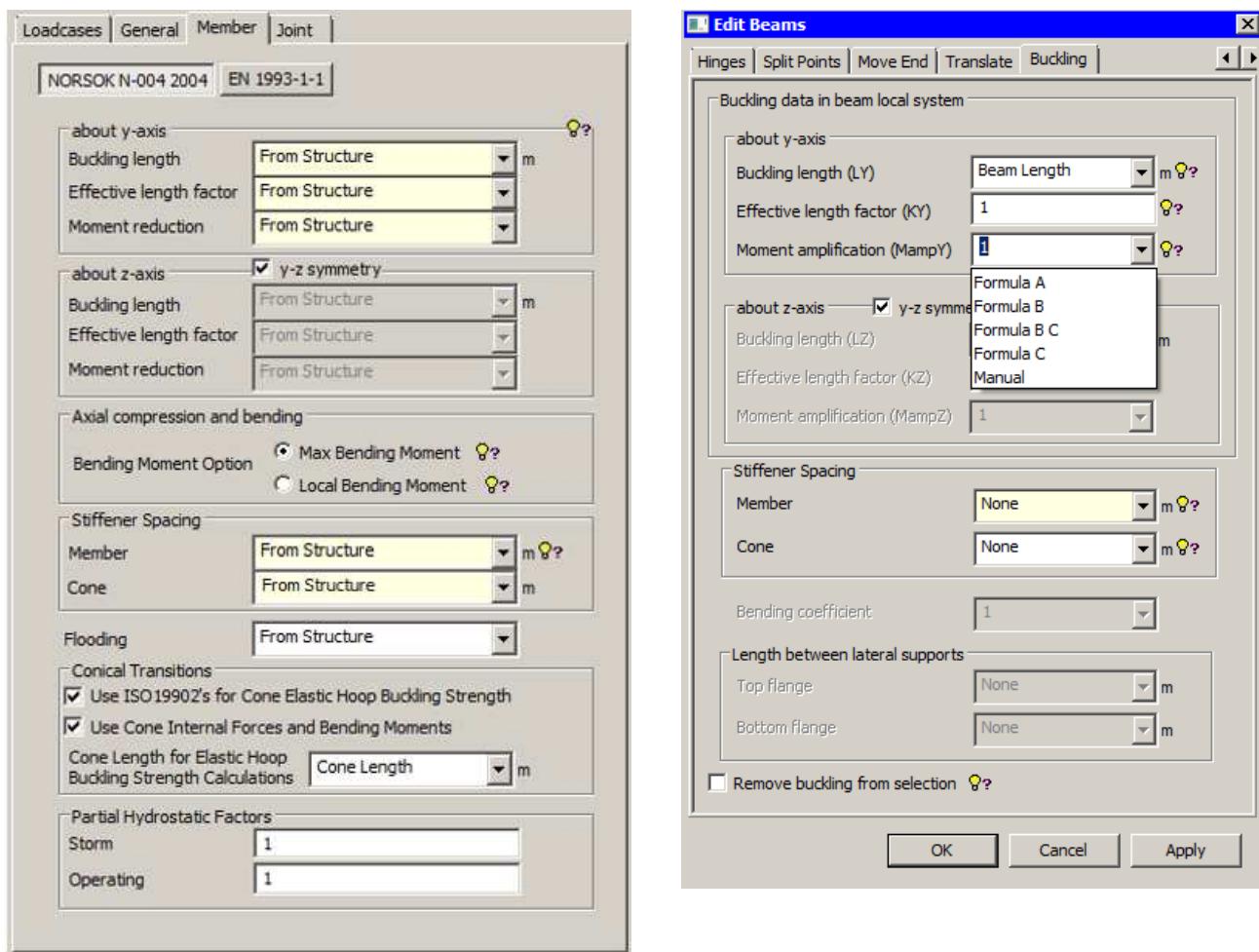
Note that for segmented beams with tubular cross sections of different sizes, the Euler buckling strength for the member is based on the cross section with the smallest radius of gyration. However, from V7.9 the “Energy method” is used, see User Documentation section 2.1.4.8 Compatibility Options: “**Energy method for column buckling of segmented members**”.

### Definition of member specific parameters:

For the Member specific parameters shown below (to the left) set to From Structure the values will be inherited from the assignments done to the Beam concept (dialog to the right).

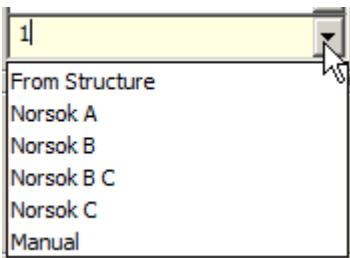
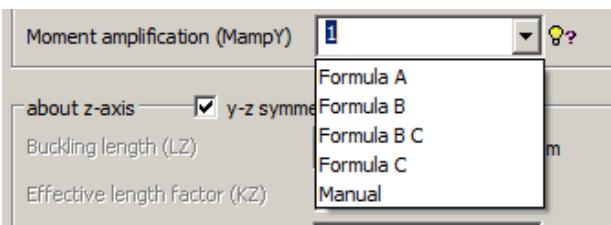
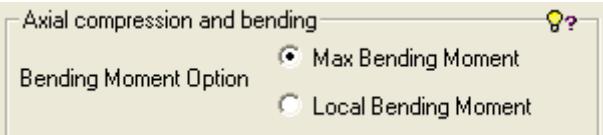
The default member data for tubular members are shown. Notice that there are different properties for tubular members and non-tubular members (using EN 1993-1-1). GeniE will automatically detect which profiles are present in the capacity model.

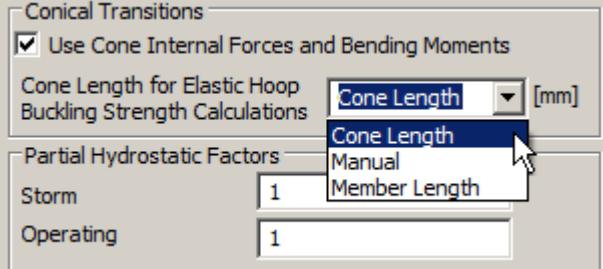
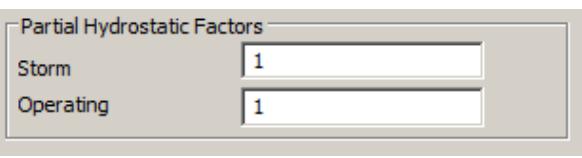
The From Structure alternative is only accepted in cases with one-to-one mapping between modelled beam and member, else the default value/option will be used.



### Options:

Buckling length	<b>From Structure</b> = use value/option assigned to the beam concept, ref. Edit Beam dialog  <b>Member Length</b> = use the geometric length of the member (capacity model)  <b>Manual</b> = specify the length to be used
Effective length factor	<b>From Structure</b> = use value/option assigned to the beam concept, ref. Edit Beam dialog  <b>Manual</b> = specify the factor to be used

Moment amplification	<p>Specify rule according to the standard, ref. Table 6-2, i.e. alternatives (a), (b), (b) or (c), (c)</p>  <p>or select:</p> <p><b>From Structure</b> = use value/option assigned to the beam concept, ref. Edit Beam dialog</p>  <p>The moment amplification definitions are mapped as follows:</p> <p>Formula A → Norsok A , Formula B → Norsok B, Formula B C → Norsok B or C, Formula C → Norsok C</p> <p><b>Manual</b> = specify the factor to be used</p>
Axial compression and bending.	 <p><b>Max Bending Moment</b> This option selects the maximum bending moments along a capacity member derived by the effect of moment gradient, Cm. This method is considered to be best practise.</p> <p><b>Local Bending Moment</b> This option uses the local bending moments at every code check positions. Use of local bending moment could be non-conservative.</p>
Stiffener spacing, Member and Cone	<p><b>None</b> = no ring stiffeners given (For member: stiffener spacing = member length, for cone: stiffener spacing = cone length)</p> <p><b>From Structure</b> = option will use the assignment given to the Beam concept, ref. Edit Beam dialog</p> <p><b>Manual</b> = specify the length between stiffeners.</p>
Flooding	<p><b>From Structure</b> = use the properties assigned to the beam concepts using the properties defined from the “Create/Edit Hydro Property” dialog</p> <p><b>Flooded</b> = Manually set to flooded</p> <p><b>Not Flooded</b> = Manually set to not flooded</p>

<p><b>Conical Transitions</b></p>	<p>Switch for cone hoop buckling strength: possible to use ISO 19902:2007 or NORSOOK N-004 2004 formula. Users can use Hoop Buckling Strength for Cones defined in NORSOOK N-004 2004 or ISO19902:2007. (It is not clear why ISO19902:2007 and NORSOOK N-004 2004 present different formulas. NORSOOK N-004 2004 gives conservative results when compared against ISO 19902:2007)</p> <p><input checked="" type="checkbox"/> Use ISO19902's for Cone Elastic Hoop Buckling Strength</p> <p>GeniE allows users to choose between internal forces on cone structures or adjacent forces on tubulars close to transitions points for Cone Code Check Analysis. Analysis, where the cap end forces are computed, present internal axial force values bounded by the axial forces at the transitions.</p> <p>Use of internal forces is coherent and recommended but the use of external forces provides conservative results.</p> <p><input checked="" type="checkbox"/> Use Cone Internal Forces and Bending Moments</p> <p>Select option for the Cone Length for Elastic Hoop Buckling Strength Calculations (for calculating <math>\mu \rightarrow Ch \rightarrow fhe</math>):</p> <ul style="list-style-type: none"> <li>- When set to Cone Length (default) the minimum length of actual cone length and any given cone stiffener spacing is used</li> <li>- When set to Member Length the total concept/member length is used. (Stiffener spacing for member is not considered.)</li> <li>- Alternatively, give the length to be used manually</li> </ul> 
<p><b>Partial Hydrostatic Factors</b></p>	<p>These partial hydrostatic factors can be defined on the member code check tab. The design conditions "Operating" and "Storm" may be used to represent action combinations "ULS a" and "ULS b" respectively to give the partial action factors to be used when calculating the design external hydrostatic pressure. The action factor is selected based on the design condition assigned to the load combination.</p> 

### 1.3 Tubular joint design code check – NORSOX N004

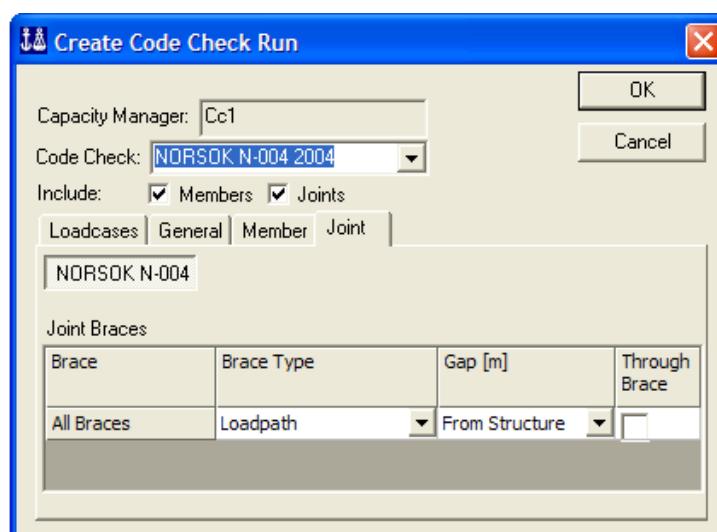
The tubular joint design code check is performed according to the chapter and sections referred to in the table below:

	Design consideration	Sections covered
6.4	Tubular joints	<p><b>6.4.1 General</b></p> <p><b>6.4.2 Joint classification</b></p> <p><b>6.4.3 Strength of simple joints</b></p> <p>6.4.3.1 General</p> <p>6.4.3.2 Basic resistance</p> <p>6.4.3.3 Strength factor <math>Q_u</math></p> <p>6.4.3.4 Chord action factor <math>Q_f</math></p> <p>6.4.3.5 Design axial resistance for X and Y joints with joint cans <sup>1)</sup></p> <p>6.4.3.6 Strength check</p> <p><b>6.4.4 Overlap joints</b></p>

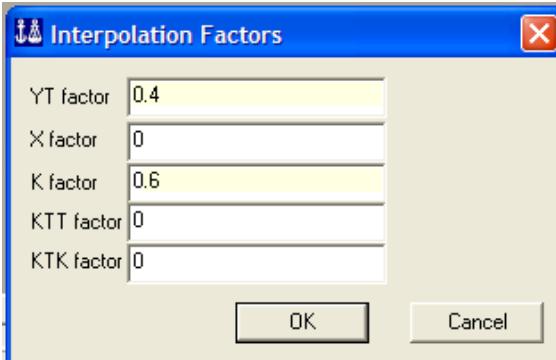
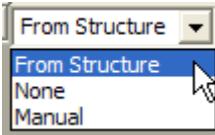
Note 1) to 6.4.3.5:

The reduction factor  $\{r+(1-r)(Tn/Tc)^2\}$  is modified to also adjust for different yield strength in can section and nominal member, i.e. the implementation uses  $\{r + (1-r)(Tn/Tc)^2(fyn/fyc)\}$ .

#### Joint specific parameters:

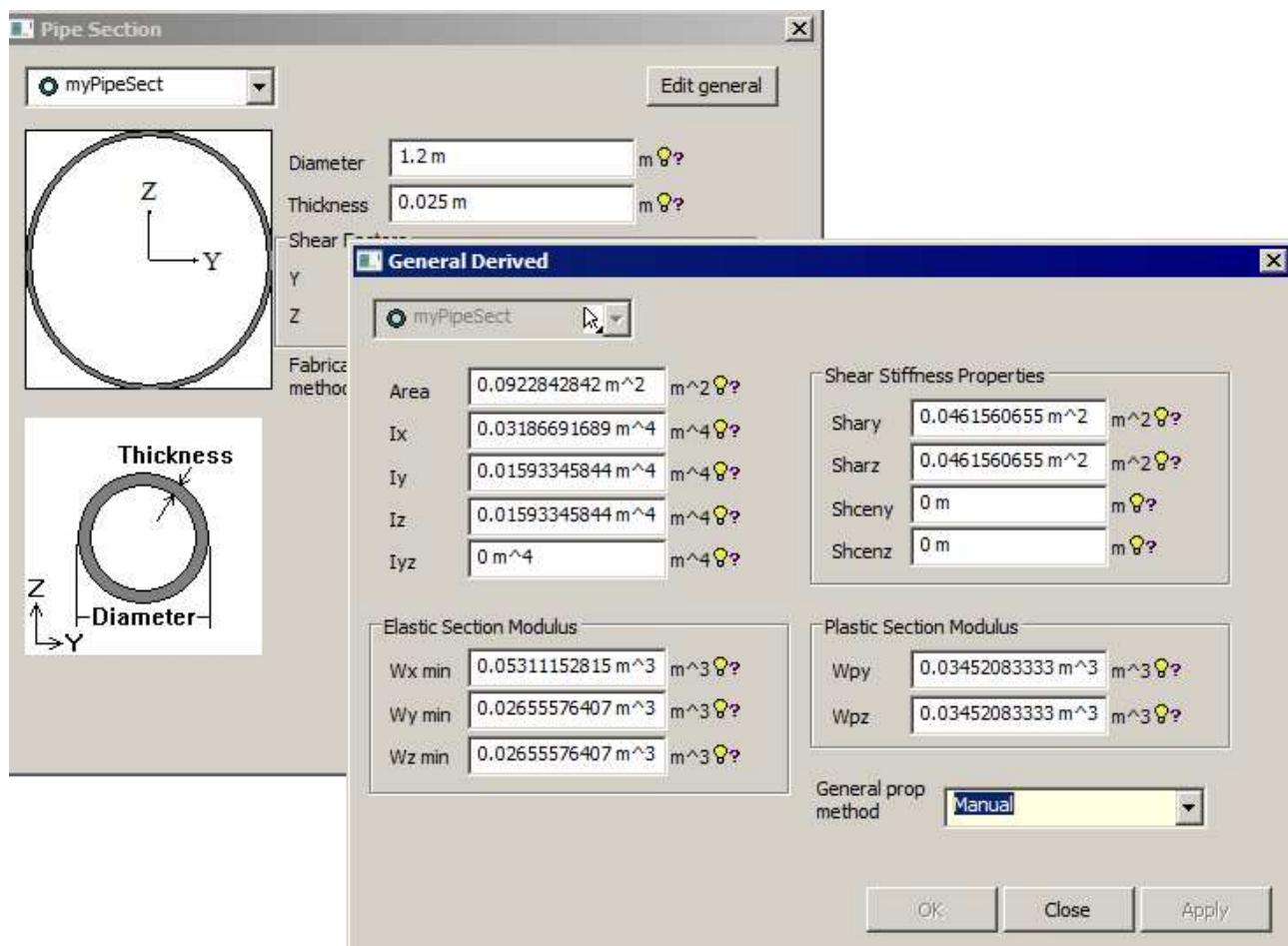


## Options:

Brace Type	Select how to classify the brace type regarding geometry. Alternatives are: <ul style="list-style-type: none"> <li>- manually set to YT, X, K, KTT, KTK</li> <li>- classify according to geometry</li> <li>- classify according to loadpath (and geometry)</li> <li>- interpolate using manual input</li> </ul> 
Gap	<b>From Structure</b> = use the geometry as defined in the model and calculate gap values.  <b>None</b> = do not include gap => set gap to zero <b>Manual</b> = specify the gap value to be used towards neighbour braces
Through Brace	The program will propose the through brace in an overlapping joint based on: <ol style="list-style-type: none"> <li>1. Max. thickness is through-brace</li> <li>2. Max. diameter is through, when 1. equal</li> <li>3. Minimum angle with chord is through brace</li> </ol> The user may change this if the situation is different from the proposal.

## 1.4 Cross section properties for manually updated profiles

From GeniE v7.5 it is possible to manually modify/update the computed cross section properties.



Member code checks will utilize updated/modified:

- Area
- Moment of inertia,  $I_x$ ,  $I_y$  and  $I_z$
- Elastic section modulus,  $W_y$  and  $W_z$
- Plastic section modulus,  $W_{py}$  and  $W_{pz}$

No attempt to calculate any equivalent diameter or wall thickness. It is strongly recommended to always update related values, e.g. if modifying  $I_y$  also update  $W_{ymin}$  and  $W_{py}$  accordingly.

No specific update for cone or joint code check has been made to utilize modified values. However, modified area and elastic section modulus will be used when calculating stress in chord member. (Stress in chord for calculation of parameter A used in chord load factor Qf.)

## 1.5 Nomenclature – NORSOK N004

### 1.5.1 Member check

The print of all available results inclusive intermediate data from the member check will report the following data.

<b>Member</b>	Capacity model name (name of Beam(s) or part of beam representing the member)
<b>Loadcase</b>	Name of load case/combination under consideration
<b>Position</b>	Relative position along member longitudinal axis (start = 0, end = 1)
<b>Status</b>	Status regarding outcome of code check (OK or Failed)
<b>UfTot</b>	Value of governing usage factor
<b>Formula</b>	Reference to formula/check type causing the governing usage factor
<b>SubCheck</b>	Which check causes this result, here NORSOK N-004 member check
<b>GeomCheck</b>	Status regarding any violation of geometric limitations
<b>uf6_1</b>	Usage factor according to (6.1)
<b>uf6_13</b>	Usage factor according to (6.13)
<b>uf6_14</b>	Usage factor according to (6.14)
<b>uf6_15</b>	Usage factor according to (6.15)
<b>uf6_41</b>	Usage factor according to (6.41)
<b>uf6_26</b>	Usage factor according to (6.26)
<b>uf6_26ax</b>	Axial contribution to usage factor according to (6.26)
<b>uf6_26mo</b>	Moment contribution to usage factor according to (6.26)
<b>uf6_27</b>	Usage factor according to (6.27)
<b>uf6_27ax</b>	Axial contribution to usage factor according to (6.27)
<b>uf6_27mo</b>	Moment contribution to usage factor according to (6.27)
<b>uf6_28</b>	Usage factor according to (6.28)
<b>uf6_28ax</b>	Axial contribution to usage factor according to (6.28)
<b>uf6_28mo</b>	Moment contribution to usage factor according to (6.28)
<b>uf6_31</b>	Usage factor according to (6.31)
<b>uf6_33</b>	Usage factor according to (6.33)
<b>uf6_34</b>	Usage factor according to (6.34)
<b>uf6_34ax</b>	Axial contribution to usage factor according to (6.34)
<b>uf6_34mo</b>	Moment contribution to usage factor according to (6.34)
<b>uf6_39</b>	Usage factor according to (6.39)
<b>uf6_39ax</b>	Axial contribution to usage factor according to (6.39)
<b>uf6_39mo</b>	Moment contribution to usage factor according to (6.39)
<b>uf6_42</b>	Usage factor according to (6.42)
<b>uf6_42ax</b>	Axial contribution to usage factor according to (6.42)
<b>uf6_42mo</b>	Moment contribution to usage factor according to (6.42)
<b>uf6_43</b>	Usage factor according to (6.43)

<b>uf6_43ax</b>	Axial contribution to usage factor according to (6.43)
<b>uf6_43mo</b>	Moment contribution to usage factor according to (6.43)
<b>uf6_44</b>	Usage factor according to (6.44)
<b>uf6_44ax</b>	Axial contribution to usage factor according to (6.44)
<b>uf6_44mo</b>	Moment contribution to usage factor according to (6.44)
<b>uf6_50</b>	Usage factor according to (6.50)
<b>uf6_50ax</b>	Axial contribution to usage factor according to (6.50)
<b>uf6_50mo</b>	Moment contribution to usage factor according to (6.50)
<b>uf6_51</b>	Usage factor according to (6.51)
<b>uf6_51ax</b>	Axial contribution to usage factor according to (6.51)
<b>uf6_51mo</b>	Moment contribution to usage factor according to (6.51)
<b>D/t</b>	The D/t ratio (outer diameter / wall thickness)
<b>thk(m)</b>	Tubular wall thickness in meter
<b>relpos</b>	Relative position along member longitudinal axis (start = 0, end = 1)
<b>D</b>	Tubular outside diameter
<b>thk</b>	Tubular wall thickness
<b>fy</b>	Yield strength
<b>E</b>	Young's modulus of elasticity
<b>NSd</b>	Design axial force
<b>NtRd</b>	Design axial tensile resistance
<b>NEy</b>	Euler buckling strength about y-axis
<b>NEz</b>	Euler buckling strength about z-axis
<b>NcRd</b>	Design axial compressive resistance
<b>NclRd</b>	Design axial local buckling resistance
<b>MySd</b>	Design bending moment about member y-axis
<b>MzSd</b>	Design bending moment about member z-axis
<b>MySdMax</b>	Design bending moment about member y-axis, for use in (6.27)
<b>MzSdMax</b>	Design bending moment about member z-axis, for use in (6.27)
<b>Mrd</b>	Design bending moment resistance
<b>oaSd</b>	Design axial stress
<b>oacSd</b>	Design axial stress that includes the effect of capped-end axial compression
<b>fthRd</b>	Design bending resistance in the presence of external hydrostatic pressure
<b>fEy</b>	Euler buckling stress about y-axis
<b>fEZ</b>	Euler buckling stress about z-axis
<b>fclRd</b>	Design axial local buckling strength
<b>fchRd</b>	Design axial compression strength in the presence of external hydrostatic pressure
<b>omySd</b>	Design bending stress about member y-axis
<b>omzSd</b>	Design bending stress about member z-axis
<b>omySdMax</b>	Design bending stress about member y-axis, for use in (6.43)

<b>omzSdMax</b>	Design bending stress about member z-axis, for use in (6.43)
<b>fmhRd</b>	Design bending resistance in the presence of external hydrostatic pressure
<b>yM</b>	The material factor
<b>kly</b>	effective length factor times unbraced length for buckling about member y-axis
<b>klz</b>	effective length factor times unbraced length for buckling about member z-axis
<b>Cmy</b>	Reduction factor corresponding to member y-axis
<b>Cmz</b>	Reduction factor corresponding to member z-axis
<b>stfspace</b>	Length between ring stiffeners
<b>slendery</b>	Member slenderness about y-axis
<b>slenderz</b>	Member slenderness about z-axis
<b>fcle</b>	Characteristic elastic local buckling strength
<b>fcl</b>	Characteristic local buckling strength
<b>fc</b>	Characteristic axial compressive strength
<b>fm</b>	Characteristic bending strength
<b>fhe</b>	Elastic hoop buckling strength
<b>fh</b>	Characteristic hoop buckling strength
<b>pSd</b>	Design hydrostatic pressure
<b>opSd</b>	Design hoop stress due to hydrostatic pressure
<b>oqSd</b>	Capped-end design axial compression stress due to external hydrostatic pressure
<b>VSd</b>	Design shear force
<b>VRd</b>	Design shear resistance
<b>MTSd</b>	Design torsional moment
<b>MTRd</b>	Design torsional moment resistance

### 1.5.2 Cone check

The print of all available results inclusive intermediate data from the cone check will report the following data.

<b>Member</b>	Capacity model name (name of Beam(s) or part of beam representing the member)
<b>Loadcase</b>	Name of load case/combination under consideration
<b>Position</b>	Relative position along member longitudinal axis (start = 0, end = 1)
<b>Status</b>	Status regarding outcome of code check (OK or Failed)
<b>UfTot</b>	Value of governing usage factor
<b>Formula</b>	Reference to formula/check type causing the governing usage factor
<b>SubCheck</b>	Which check causes this result, here NORSO N-004 cone check
<b>GeomCheck</b>	Status regarding any violation of geometric limitations
<b>uf6_64</b>	Usage factor according to (6.64)
<b>uf6_66</b>	Usage factor according to (6.66)

<b>uf6_67</b>	Usage factor according to (6.67)
<b>uf6_68</b>	Usage factor according to (6.68)
<b>uf6_71</b>	Usage factor according to (6.71)
<b>uf6_72</b>	Usage factor according to (6.72)
<b>uf6_44</b>	Usage factor according to (6.44)
<b>uf6_44ax</b>	Axial contribution to usage factor according to (6.44)
<b>uf6_44mo</b>	Moment contribution to usage factor according to (6.44)
<b>uf6_51</b>	Usage factor according to (6.51)
<b>uf6_51ax</b>	Axial contribution to usage factor according to (6.51)
<b>uf6_51mo</b>	Moment contribution to usage factor according to (6.51)
<b>Alpha</b>	The slope angle of the cone
<b>relpos</b>	Relative position along member longitudinal axis (start = 0, end = 1)
<b>Ds</b>	Outer cone diameter at the section under consideration
<b>tc</b>	Cone thickness
<b>fyc</b>	Yield strength of cone
<b>Dj</b>	Cylinder diameter at junction
<b>t</b>	Tubular member wall thickness
<b>fy</b>	Yield strength of tubular
<b>yM</b>	Material factor
<b>NSd</b>	Design axial force
<b>MSd</b>	Design axial tensile resistance
<b>oacSd</b>	Design axial stress at the section within the cone due to global actions
<b>omcSd</b>	Design bending stress at the section within the cone due to global actions
<b>oequSd</b>	Equivalent design axial stress within the conical transition
<b>oatSd</b>	Design axial stress in tubular section at junction due to global actions
<b>omtSd</b>	Design bending stress in tubular section at junction due to global actions
<b>omltSd</b>	Local design bending stress at the tubular side of unstiffened tubular-cone junction
<b>omlcSd</b>	Local design bending stress at the cone side of unstiffened tubular-cone junction
<b>ohcSd</b>	The design hoop stress at unstiffened tubular-cone junctions due to unbalanced radial line forces
<b>fclc</b>	Local buckling strength of conical transition
<b>ototSdT</b>	Total stress for checking stresses on the tubular side of the junction
<b>ototSdC</b>	Total stress for checking stresses on the cone side of the junction
<b>fhe</b>	Elastic hoop buckling strength
<b>fhT</b>	Characteristic hoop buckling strength, tubular side
<b>fcljT</b>	Characteristic axial local compressive strength, tubular side
<b>fhC</b>	Characteristic hoop buckling strength, cone side
<b>fcljC</b>	Characteristic axial local compressive strength, cone side
<b>opSd</b>	Design hoop stress due to hydrostatic pressure

<b>oqSd</b>	Capped-end design axial compression stress due to external hydrostatic pressure
<b>fhe6541</b>	Elastic hoop buckling strength for use in 6.5.4.1
<b>fh6541</b>	Characteristic hoop buckling strength for use in 6.5.4.1
<b>fm</b>	Characteristic bending strength
<b>fmhRd</b>	Design bending resistance in the presence of external hydrostatic pressure
<b>fcIRd</b>	Design axial local buckling strength
<b>ohjSd</b>	The net design hoop stress at a tubular-cone junction

### 1.5.3 Tubular joint check

The print of all available results inclusive intermediate data from the tubular joint check will report the following data.

<b>Member</b>	Capacity model name (brace name)
<b>Loadcase</b>	Name of load case/combination under consideration
<b>Position</b>	Governing brace causing highest utilisation
<b>Status</b>	Status regarding outcome of code check (OK or Failed)
<b>UfTot</b>	Value of governing usage factor
<b>Formula</b>	Reference to formula/check type causing the governing usage factor
<b>SubCheck</b>	Which check causes this result, here NORSOEK N-004 joint capacity check
<b>GeomCheck</b>	Status regarding any violation of geometric limitations
<b>uf6_57</b>	Usage factor according to equation (6.57)
<b>uf6_57ax</b>	Axial contribution to usage factor according to equation (6.57)
<b>uf6_57mo</b>	Moment contribution to usage factor according to equation (6.57)
<b>uf6_57mod</b>	Usage factor from through brace in overlapping joint, modified loads
<b>uf6_57axmod</b>	Axial contribution in uf6_57mod
<b>uf6_57momod</b>	Moment contribution in uf6_57mod
<b>uf6_57ove</b>	Usage factor from overlap brace in overlapping joint, through brace as chord
<b>uf6_57axove</b>	Axial contribution in uf6_57ove
<b>uf6_57moove</b>	Moment contribution in uf6_57ove
<b>beta</b>	Value of $\beta$ ( $= d/D$ ), geometric limitation; $0.2 < \beta < 1$ .
<b>gamma</b>	Value of $\gamma$ ( $= D/2T$ )
<b>theta</b>	Angle between brace and chord
<b>gap_D</b>	The gap/D ratio
<b>ufIPB</b>	usage factor, contribution from in-plane bending
<b>ufOPB</b>	usage factor, contribution from out-of-plane bending
<b>NSd</b>	Design axial force in the brace member
<b>NRd</b>	The joint design axial resistance
<b>MySd</b>	Design in-plane bending moment in the brace member

<b>MyRd</b>	Design in-plane bending resistance
<b>MzSd</b>	Design out-of-plane bending moment in the brace member
<b>MzRd</b>	Design out-of-plane bending resistance
<b>Quaxial</b>	Ultimate strength factor dependant of joint and load type, axial
<b>QuiPB</b>	Ultimate strength factor dependant of joint and load type, in-plane bending
<b>QuOPB</b>	Ultimate strength factor dependant of joint and load type, out-of-plane bending
<b>Qfaxial</b>	Factor to account for nominal longitudinal stress in chord, axial
<b>QfIPB</b>	Factor to account for nominal longitudinal stress in chord, in-plane bending
<b>QfOPB</b>	Factor to account for nominal longitudinal stress in chord, out-of-plane bending
<b>Ytfact</b>	Brace classification, fraction as type YT behaviour
<b>Xfact</b>	Brace classification, fraction as type X behaviour
<b>Kfact</b>	Brace classification, fraction as type K behaviour
<b>KTTfact</b>	Brace classification, fraction as type KTT behaviour
<b>KTKfact</b>	Brace classification, fraction as type KTK behaviour
<b>CanFact</b>	reduction factor r in section 6.4.3.5
<b>fy</b>	Yield strength of chord
<b>gammaM</b>	Material factor
<b>D</b>	Outer diameter of chord
<b>T</b>	Wall thickness of chord
<b>d</b>	Outer diameter of brace
<b>t</b>	Wall thickness of brace
<b>g</b>	Gap value used in calculations