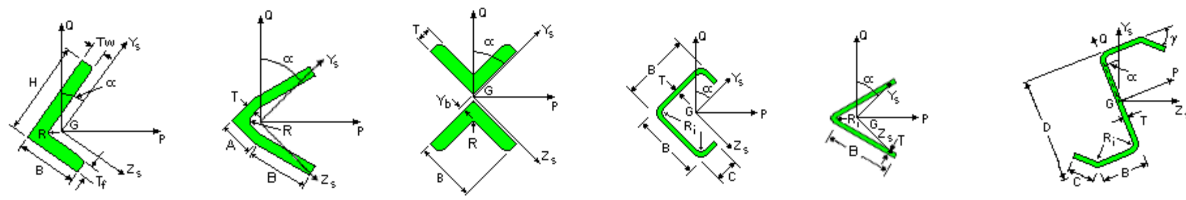
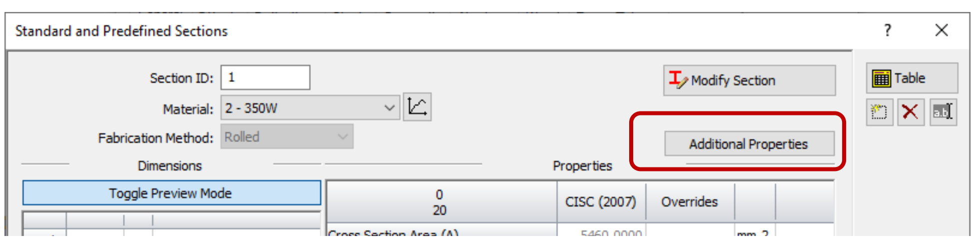
1.1. Section properties according to the straight axes

1.1.1. Additional section properties available

When the alpha (α) angle for a section is different than zero, it means that the principal axes does not correspond to the straight axes. The images below show some of these sections:



To get the exact analysis results, the sections must be analyzed on their principal axes. The bending resistance must also be computed on the principal axes of the section. Until now, the software was only displaying the properties on the principal axes for these sections. It is now possible to see the section properties on the straight axes by clicking on the **Additional Properties** button. The properties on the straight axes are provided for information only since they are not directly used by the software.



The coordinates attached to the sections are the following:

Z_s Y_s: Reference section coordinates system. This system is aligned with the straight faces of the section. It is used only to measure the α angle

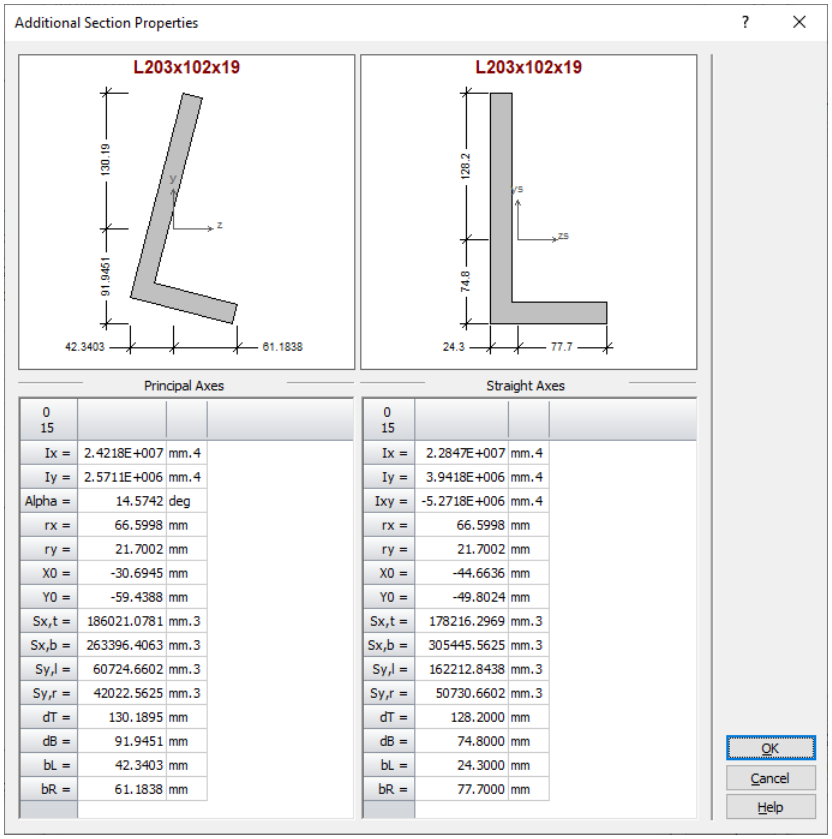
P Q: Coordinate system of the section corresponding to the principal axes. For Alpha equals zero, this system is parallel to the reference coordinates.

Section Properties (for principal axes P and Q)

I_x	Moment of inertia around the P axis
I_y	Moment of inertia around the Q axis
α	Represents the angle between the principal axes and the reference axes ($-45° < \alpha < 45°$).
r_x	Radius of gyration of the section around the P axis.
r_y	Radius of gyration of the section around the Q axis.
X_o, Y_o	Coordinates of the shear center with respect to the center of gravity according to the P, Q axes.
$S_{x,t}$	Elastic section modulus in bending around P axis at the top chord.
$S_{x,b}$	Elastic section modulus in bending around P axis at the bottom chord.
$S_{y,l}$	Elastic section modulus in bending around Q axis at the left chord.
$S_{y,r}$	Elastic section modulus in bending around Q axis at the right chord.
dT	Distance between the neutral axis and the top chord.
dB	Distance between the neutral axis and bottom chord.
bL	Distance between the neutral axis and left chord.
bR	Distance between the neutral axis and right chord.

Section Properties (for straight axes Y_s and Z_s)

I_x	Moment of inertia around the Z_s axis
I_y	Moment of inertia around the Y_s axis
I_{xy}	Moment of inertia about rotated axes
r_x	Radius of gyration of the section around the Z_s axis.
r_y	Radius of gyration of the section around the Y_s axis.
X_o, Y_o	Coordinates of the shear center with respect to the center of gravity according to the Z_s, Y_s axes.
$S_{x,t}$	Elastic section modulus in bending around Z_s axis at the top chord.
$S_{x,b}$	Elastic section modulus in bending around Z_s axis at the bottom chord.
$S_{y,l}$	Elastic section modulus in bending around Y_s axis at the left chord.
$S_{y,r}$	Elastic section modulus in bending around Y_s axis at the right chord.
dT	Distance between the neutral axis and the top chord.
dB	Distance between the neutral axis and bottom chord.
bL	Distance between the neutral axis and left chord.
bR	Distance between the neutral axis and right chord.



Principal Axes

Ix =	2.4218E+007	mm.4
Iy =	2.5711E+006	mm.4
Alpha =	14.5742	deg
rx =	66.5998	mm
ry =	21.7002	mm
X0 =	-30.6945	mm
Y0 =	-59.4388	mm
Sx,t =	186021.0781	mm.3
Sx,b =	263396.4063	mm.3
Sy,l =	60724.6602	mm.3
Sy,r =	42022.5625	mm.3
dT =	130.1895	mm
dB =	91.9451	mm
bL =	42.3403	mm
bR =	61.1838	mm

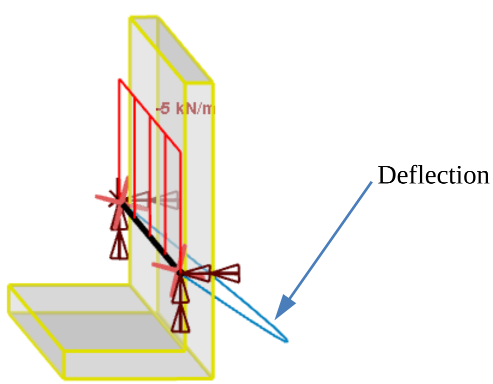
Straight Axes

Ix =	2.2847E+007	mm.4
Iy =	3.9418E+006	mm.4
Ixy =	-5.2718E+006	mm.4
rx =	66.5998	mm
ry =	21.7002	mm
X0 =	-44.6636	mm
Y0 =	-49.8024	mm
Sx,t =	178216.2969	mm.3
Sx,b =	305445.5625	mm.3
Sy,l =	162212.8438	mm.3
Sy,r =	50730.6602	mm.3
dT =	128.2000	mm
dB =	74.8000	mm
bL =	24.3000	mm
bR =	77.7000	mm

1.1.2. Deflections available on straight axes

In the previous version of the software, the internal displacements of the member were always displayed according to the principal axes of the section. In addition, it is now possible to display the deflections on the straight axes.

For example, for a simply supported single angle with vertical loads the displacement is not only vertical. A horizontal component to the deflection is also computed, as displayed below.



Also, the deflection criteria and the limit states calculation for the deflections with an alpha (α) angle different than zero are now done on the straight axes.

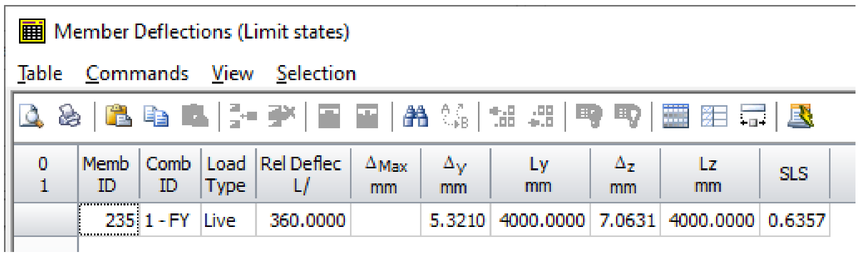

Member Deflections (Limit states)

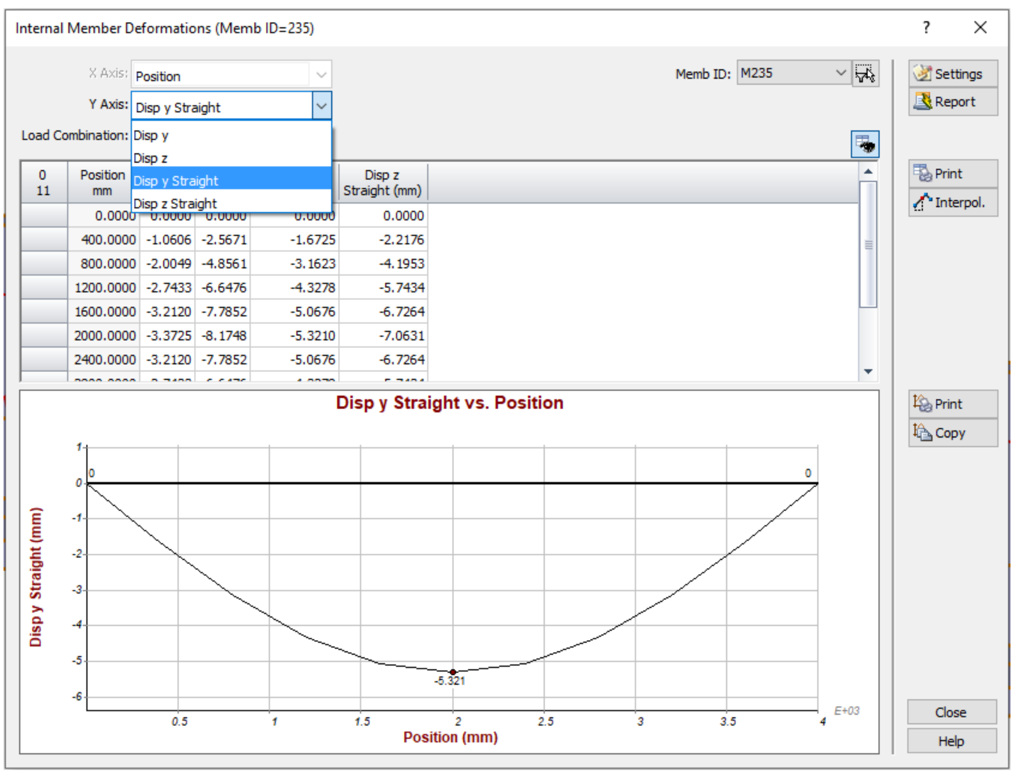
Table Commands View Selection

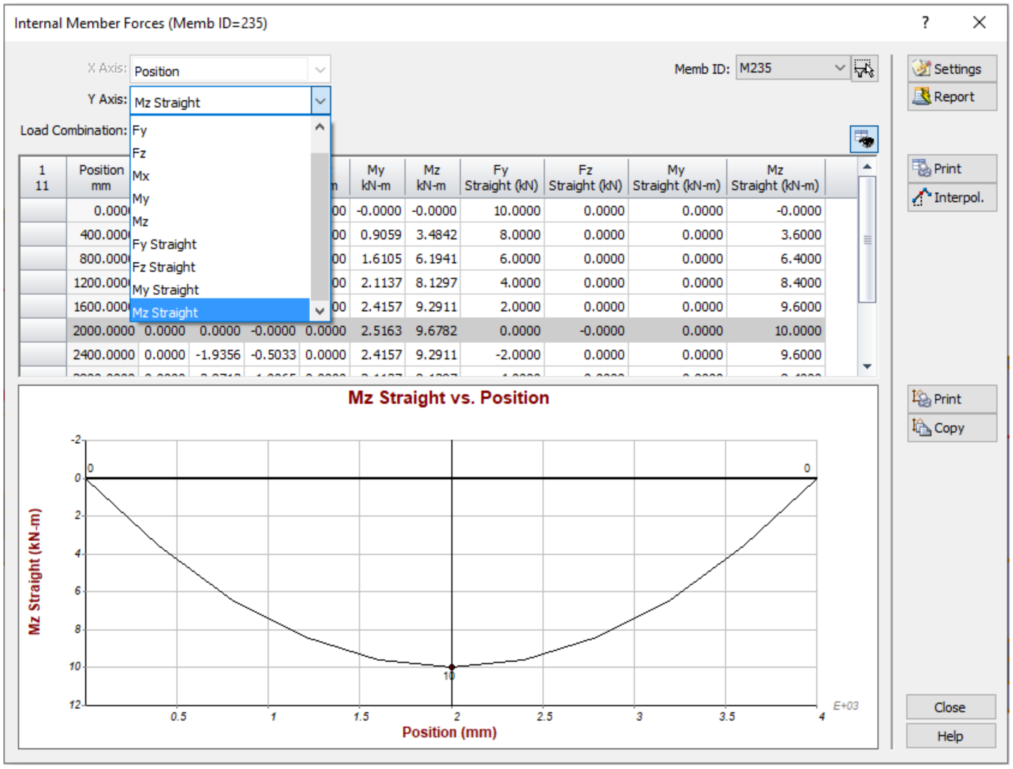
0 1	Memb ID	Comb ID	Load Type	Rel Deflec L/	ΔMax mm	Δy mm	Ly mm	Δz mm	Lz mm	SLS
	235	1 - FY	Live	360.0000		5.3210	4000.0000	7.0631	4000.0000	0.6357

1.1.3. Shear forces and bending moments available on straight axes

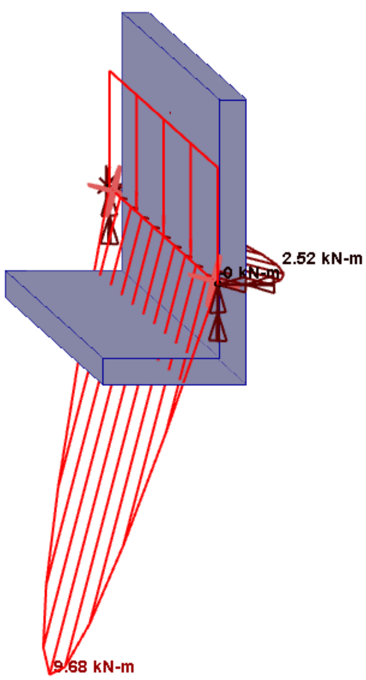
In the previous version of the software, the internal forces for the members were always displayed according to the principal axes of the section.

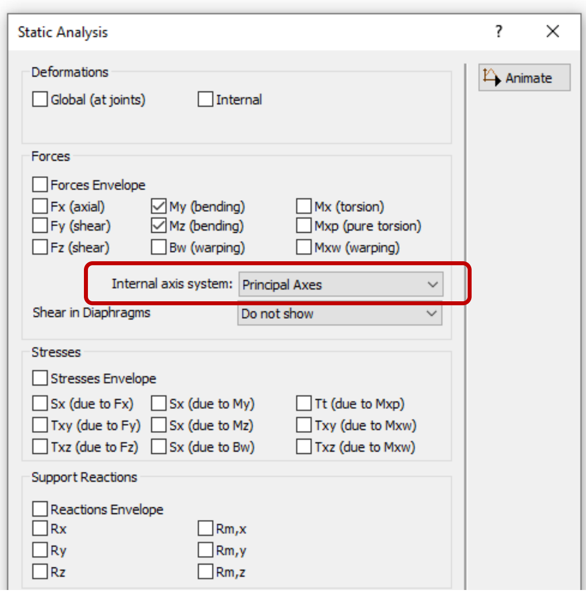
It is now possible to display shear forces and bending moments on the straight axes. This can be done using the graphic visualization command of the **Internal Member Forces**.



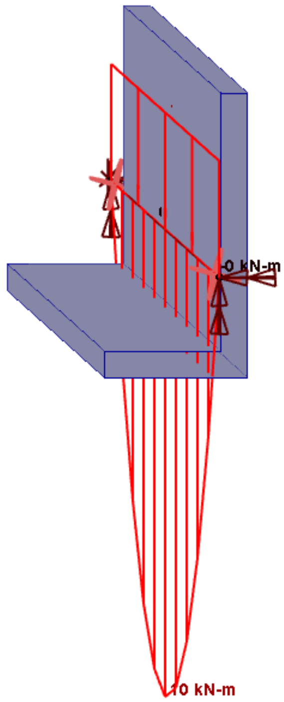


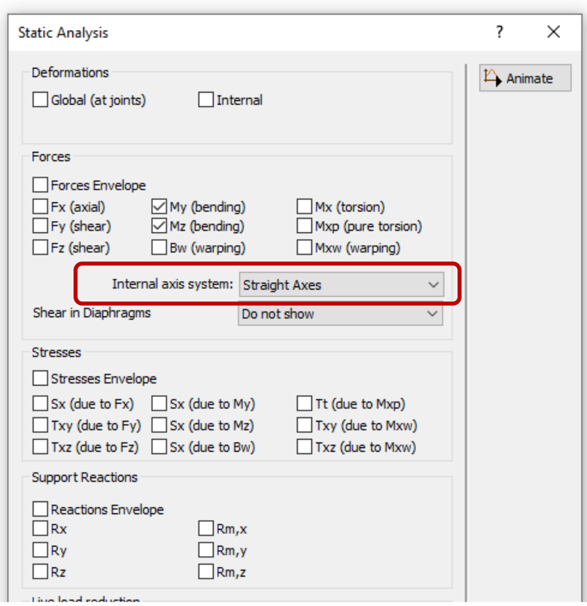
The forces and moments on the straight axes can also be visualized on the structure in the main window. For example, for a simply supported single angle with vertical loads, the moments on the strong and weak axes are both different than zero, as displayed below. Note that the steel design for bending moments are always done according to the principal axes.





For the same example, the bending moments according to the straight axes is only around the Mz axis and the My value is zero, as displayed below.





Note that the design for the shear limit states for steel is always done according to the straight axes. So, the associated forces are Fy and Fz on the straight axes.

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